Product Recoverability and Vapor Extraction/Air Sparging Pilot Test Report

for the Nestle USA Former Carnation Dairy Facility 1310 14th Street Oakland, California

Prepared for

Nestle USA, Inc.

Prepared by

EA Engineering, Science, and Technology

July 1996

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July 31, 1996

Ms. Jennifer Eberle
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Dear Ms. Eberle:

We enclose for your review the "Product Recoverability and Vapor Extraction/Air Sparging Pilot Test Report for the Nestle USA Former Carnation Dairy Facility".

Sincerely yours,

George Read

George Read, Editor
for Doug Oram, Project Manager

Enclosure
cc. Binayak Acharaya, Nestle USA

60966.01.0008

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July 1996

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1. INTRODUCTION

Nestle USA has carried out three remediation actions at the site of the former Carnation Dairy facility, located at 1310 14th Street, Oakland, California:

- soil excavation, treatment, and replacement
- groundwater pumping and treatment
- soil vapor extraction.

The most recent remedial action was vapor extraction, which was operated for approximately two years. Vapor extraction was discontinued, because the concentration of volatile hydrocarbons in the extracted vapors decreased below 1 ppmv but appreciable thicknesses of non-aqueous phase liquid (NAPL) continued to be measured in about 17 wells within the remediation area.

EA (EA Engineering, Science, and Technology) has been retained as a consultant to Nestle to help the company evaluate alternative technologies for the remediation of the site. Technologies and processes that are being considered are the following:

- Vapor extraction enhanced by air sparging
- NAPL recovery using conventional skimmers
- NAPL recovery using vacuum-enhanced skimming
- NAPL recovery using dual-fluid pumping
- NAPL recovery using multi-faceted extraction (referred to in U. S. Air Force reports as bioslurping).

This report documents a pilot test of vapor extraction coupled with air sparging and the results of NAPL recoverability testing using conventional skimming. An Interim Product Recoverability Report was submitted in May 1996 which reported on the testing conducted from 18 December through 16 April. This report incorporates the interim results of the study of NAPL recoverability testing and documents a study of the utility of air-sparging-enhanced vapor recovery conducted through 20 June 1996.

The applicability of the NAPL recovery methods other than by conventional skimming are currently being evaluated and are not covered in this report.

The Nestle site, located in a light-industrial zone of Oakland, with some commercial and residential properties nearby, was occupied by dairy product facilities from 1915 to the time it was closed in 1991. Petroleum hydrocarbons, in the form of a nonaqueous-phase liquid (NAPL, also commonly referred to as free product), were first discovered on the site in 1989. Although several attempts have been made at remediation of the site, no direct NAPL recovery has been conducted there. Since 18 December 1995, EA has been investigating the feasibility of recovering product at the site by periodically gauging and removing NAPL from wells. NAPL is being gauged and removed over the annual range of water level elevations normally encountered at the site. The results of eight NAPL recovery sampling sessions are covered in this report.

Another study was conducted, examining the usefulness of using soil vapor extraction, augmented with air sparging (bubbling air into the shallow aquifer to carry volatile hydrocarbons up into the vadose zone above the water table).

1.1 DESCRIPTION OF THE SITE AND PREVIOUS WORK

The Nestle site, which slopes gently to the west, is completely paved with asphalt or concrete. It abuts Cypress Street to the west, and lies between 14th Street and 16th Street south-north (Figure 1). The primary area of concern is a portion about 200 x 200 ft in the northwest corner. Along the north and west sides of this area is an L-shaped building 200 x 60 ft on the north side and 200 by 40 ft on the west. Four motor vehicle service bays under the roof of the repair garage occupied the northeast 80 x 60 ft section of the building (Figure 2).

Before 1989, delivery trucks were fueled near the service bays and were repaired and maintained inside of them. In that year Ananias Geological Engineers (AGE) removed the used-oil UST (underground storage tank) from within the service area and four USTs, two for gasoline and two for diesel fuel, from the area to the southeast of the bays, along with the fuel dispensing lines. Floating hydrocarbons were found in the excavations, which extended below the water table. AGE installed 33 4-in. monitoring wells, MW1-MW33 (MW 17-MW21 were later abandoned), and 103 2-in. PR (product recovery) wells, a groundwater extraction and treatment system, and a soil vapor extraction and treatment system. AGE stockpiled 60 cy (cubic yards) of soil from the excavations on the site. AGE extracted about 5,000 gallons of hydrocarbons in about 1.5 million gallons of water at the site.

In spring and summer 1991, Harding Lawson and Associates (HLA) drilled 20 soil borings to the estimated bottom of the hydrocarbon-impacted zone (about 20 ft below the ground surface) and sampled soil at 5 ft bgs (at the top of the impacted zone); at 10, 12.5, and 15 feet (in the middle); and at 20 ft (at the bottom). HLA also gauged NAPL and groundwater in about 40 wells monthly, sampled the stockpiled soil, re-developed two MW and two PR wells, and sampled groundwater in 20 MW wells at quarterly intervals. HLA gauged all available MW and selected PR wells. They estimated that about 23,000 cy of soil contained hydrocarbons at concentrations > 10 mg/kg, of which 13,000 cy had concentrations > 100 mg/kg.

On 9 July 1991, HLA measured 5 ft of NAPL in MW22, 1-2 ft in nine other wells, and 0-1 ft in seven wells. From these data, they estimated that there was about 25,000 gal of liquid-phase hydrocarbons in the subsurface at the site on that date.

In 1994, Park (Park Environmental) reported removal of an estimated 5,200 gallons of NAPL (equivalent) with a vapor extraction system. Park also gauged NAPL and groundwater elevations, from February 1994 to early December 1995.

The persistence of NAPL, even though it appears to be confined to a portion of the site, led Nestle USA to retain EA to examine methods of remediation. This report describes an investigation into two possible means of accomplishing that task.

1.2 THE SUBSURFACE

The soil under the 200 x 200 ft area shown in Figure 2 was described by Harding Lawson Associates (HLA 1991) as largely clayey or silty sand to a depth of about 25 feet, with some shallow silt at the top, which is deeper in the northwest direction, and relatively few and small lenses of sand, more numerous in the southeasterly direction. This was confirmed by the borings for 3 wells drilled April 1996 by EA. Most of the 200-odd wells on the site have not contained floating free product (NAPL). Those that do are largely confined to the area delineated in Figure 3.

The groundwater elevation at the site generally ranges seasonally between 4 and 7 ft above mean sea level, about 6-9 feet below ground surface. The regional and local groundwater gradient is to the northwest (Figure 2).

NAPL is found regularly near the water table in up to 20 of the many wells on the site, mainly in the area where the waste oil and fuel USTs (underground storage tanks) and fuel dispensing lines were removed in 1989.

1.3 SITE CONCEPTUAL MODEL

Based on the past reports and NAPL removal tests that started in December 1995, a conceptual model of the distribution and recoverability of free product at the site is being developed. Field efforts are ongoing in an attempt to reach conclusions about the behavior of the NAPL, with emphasis on its recoverability. The work thus far has led to the development of the conceptual model shown in Figure 4. The main points of the model are as follows:

- Results of the monitoring indicate that the product is not laterally or vertically continuous, and is not moving downgradient through the subsurface sediments. Thicknesses of NAPL have been measured in 42 wells in one or more of the previous investigations. The number of wells containing a recoverable amount of NAPL (>0.05 ft) was 15 on 20 June 1996.

- It is thought that the original release of free product (NAPL) has been smeared over the aquifer thickness between the elevation of the annual low water and the annual high water, as shown schematically in Figure 4. Free product is present as trapped tiny globular masses among the grains of the aquifer that are wetted by the continuous phase of water. This has been facilitated by the presence of natural organic matter interspersed in the sand and silt and of natural emulsifiers produced by microscopic organisms. In this separate, dispersed phase, the product likely has low mobility and is not easily recovered using conventional methods such as passive recovery, bailing, or dual-phase pumping.

- This smear zone, at the upper part of the saturated zone, is thought to contain most of the BTEX and TPH constituents. Smaller amounts of hydrocarbons are found in the vadose zone and as dissolved plumes in the saturated zone.

2. NAPL GAUGING AND REMOVAL FEASIBILITY STUDY

2.1 PRODUCT REMOVAL PROCEDURE

On eight occasions between 18 December 1995 and 20 June 1996, certain wells were gauged and bailed. Forty-two wells (all those in which appreciable thicknesses of NAPL had been measured between February 1994 and December 1995) were gauged with an oil-water interface probe, and the time was noted. If the well contained more than 0.05 feet of NAPL, the NAPL was removed with a peristaltic pump and the amount was noted. The well was re-gauged soon after, generally within five minutes. After all the wells on the site were gauged, the operator went back to the wells from which product had been removed and regauged them. If appreciable NAPL had accumulated (>0.05 ft), it was again removed. On the first three occasions (18 December 1995, 27 February 1996, and 16 April 1996), wells from which NAPL was removed were gauged again 2–10 days later. This established that further investigation was warranted, and the 16 April sampling was followed weekly on 24 and 29 April, 7 and 14 May, and, a month later, on 20 June.

The data on depth to product and to water, the calculated thickness of NAPL, the amount of NAPL bailed, and any comments about conditions in the well were transcribed from a field notebook into a spreadsheet and used to calculate and plot information about the wells. The data are transcribed in Table 1.

2.2 RESULTS OF THE INVESTIGATION

2.2.1 Location and Thickness of NAPL

Among the hundred or so wells in the area of interest, 42 wells (shown in black in Figure 3) are routinely gauged, and greater or lesser thicknesses of NAPL are generally found in 14 to 18 of them (Figures 5 and 6). The occurrence of NAPL in these wells is not consistent, as shown in these figures. The inconsistency is illustrated by Figure 7, where, for example, well PR22, which usually contains NAPL, did not in December 1994, and MW23 did not in March 1995.

It is likely that the variability over time of the NAPL thicknesses in each of the wells is influenced by a number of factors. But when a graph of the NAPL thickness in wells vs. time is overlaid on a groundwater hydrograph, it shows that there is a strong correlation between greater NAPL thickness (Figure 7) and higher water levels (Figure 8).

2.2.2 Recoverability of NAPL

The first three systematic NAPL recovery events of this series indicated that a greater volume of NAPL can be collected when the water table elevation is higher: During the two days when NAPL was removed in December, a total of 3 gallons was recovered. The water level at this time was at its annual low level (Figure 8). In each of February and April, the amount of NAPL removed increased to 16 gallons. In February the water level had increased about one foot from

that measured in December, and the water level peaked in March, shortly before the gauging and removal that was done in April.

The results for a representative well, PR21 (Figure 9), show the relationships between water level, NAPL thickness, and recoverable NAPL. The graph in the upper left shows that higher water levels correspond with greater NAPL thickness. The graph in the upper right shows that more NAPL was recovered during February and April, when the water level was higher, than was recovered in December, when the water level was low.

In the first three NAPL recovery tests, a total of 134 L (35 gallons) of NAPL was recovered from 17 wells (Table 2). Starting on 16 April 1996 and continuing through 14 May 1996, NAPL was removed from wells weekly. The volumes of NAPL recovered each week ranged from 8 to 23 liters. The individual recoveries are listed in Table 2. During the month of weekly recovery, approximately twice as much NAPL (54 L) was recovered as in the following month, during which NAPL was removed only once (29 L). The volume of NAPL that has been removed from each well is indicated and noted (in liters) in Figure 10 and listed in Table 2.

As of 20 June 1996, a total of 217 liters (57 gallons) of NAPL had been recovered from wells at the site. The initial recovery tests showed that more than half of the volume to that date had been recovered from three wells (E-0, E-5, and PR21). The results through 20 June show a more even recovery of NAPL from the wells. The total amount of NAPL recovered from a well ranged from 0.3 (PR23) to 39.5 liters (E-0), and 10 wells produced more than 10 liters each.

3. THE SOIL VAPOR EXTRACTION AND AIR SPARGING PILOT TEST

From 1 to 5 April 1996, a soil vapor extraction and an associated aquifer air sparging pilot test were conducted to determine if air sparging could be used to enhance the recovery of volatile hydrocarbons with a vapor extraction system. A vapor extraction system had been operated at the site for approximately two years, but it was discontinued because the concentration of extracted vapors decreased below 1 ppmv while appreciable thicknesses of NAPL continued to be measured in about 17 wells in the remediation area. During the earlier operation of the vapor extraction system, only a small subset of the wells available in the area containing NAPL were used. To assess the value of further vapor extraction to remediate the site and the possibility that recovery can be enhanced by air sparging, a pilot test was conducted to address the following questions:

- Are there wells in the area containing NAPL other than the ones used in the previous system that, properly screened in the vadose zone, can produce sustained concentrations of hydrocarbons?
- How does the performance of the wells that are screened to the surface differ from the wells having shorter and lower screened intervals?
- Will air sparging enhance the recovery of hydrocarbons by the vapor extraction system?
- Will the fine-grained soils at the site let the vapor extraction system recover all of the hydrocarbons that are liberated by the air sparging system?
- Do oxygen and carbon dioxide concentrations in the soil gas indicate that biodegradation of petroleum hydrocarbons is occurring?
- How are the vadose zone concentrations of oxygen and carbon dioxide affected by vapor extraction, and by air sparging?

3.1 THE SOIL VAPOR EXTRACTION TEST

3.1.1 Vapor Extraction Wells and Test Equipment

Eighteen wells screened at least partly in the vadose zone were tested individually under vapor extraction conditions. They are listed in Table 3 and shown in Figure 3. Wells that had been installed by previous contractors in the area containing NAPL were used for the vapor extraction test, except that wells whose screened intervals were entirely submerged at the time of the pilot test were not used. Some of the wells designated "MW" or "PR" had a portion of their screened intervals (generally the uppermost two feet of a 10–15 foot screen length) in the vadose zone. The wells with a "V" designation were all screened to the ground surface, and they may have had problems of "short circuiting: such wells have the potential of being directly

connected to the more permeable subgrade fill material that is typically found just below the concrete and asphalt surfaces at the site.

A blower capable of creating a 250-cfm (cubic feet per minute) flow rate at a vacuum of 10 inches of mercury (about 1/3 atmosphere, equivalent to 240 inches of water) was used to extract air from the wells. A length of PVC pipe connected the blower to the head of each extraction well. The pipe was equipped with a port for the flow meter, a vapor sampling port, and a vacuum gauge. Figure 11 shows the configuration of the pilot soil vapor extraction system

3.1.2 Vapor Extraction Methods

The vapor extraction pilot test was conducted by withdrawing soil vapor from the vadose wells with the vacuum blower. Vapor was extracted, one well at a time, from a total of 18 wells. The wells chosen for testing were located in or near the area containing NAPL. Three aspects were tested: (1) Induced pressure (vacuum) measurements were collected at a number of wells and probes at a distance from the one connected to the vacuum blower. The induced pressure measurements were used to estimate the permeability of the soil and the radius of influence of each well tested. (2) Vapor samples were collected and analyzed for hydrocarbon concentrations to determine the initial hydrocarbon mass extraction rate and how the rate would change with time. (3) The vapor flow rate from each of the extraction wells was measured with a digital flowmeter, and additional measurements were collected from extraction wells by varying the applied vacuum and measuring the flow rate at the extraction well. These flow/vacuum measurements were made to permit proper sizing of a blower if vapor extraction is implemented at the site.

Induced Vacuum Measurements

A steady vacuum was applied individually to vapor extraction wells, and the vacuum that was induced was measured at some of the other wells and probes at the site. The measurements were collected using differential-pressure gauges ranging at full scale from 0.002 to 50 inches of water. Multiple measurements were obtained from each observation point until similar consecutive measurements indicated that an equilibrium pressure was approached.

From the measurements of induced vacuum and distance between the extraction and observation wells, the radii of influence of the extraction wells were calculated. A copy of the field notes containing the vacuum readings is included in Appendix A.

Soil Gas Permeability

The vacuum and pressure measurements collected during the test provide information about the movement of soil vapor through the soil under the influence of an induced pressure gradient. In general (assuming homogeneous conditions), the permeability of the soil is an indicator of the potential effectiveness of a soil venting or air sparging system.

The intrinsic permeability (K_a) of the soil, measured in units of Darcys, is a function of the size of the pore openings, the grain size, and the type of sediment. In general, smaller grain size correlates with larger composite surface area of the soil and thus higher resistance to flow. Lower intrinsic permeability corresponds with a greater resistance to flow.

During the vapor extraction pilot test the following measurements were collected to estimate soil permeability:

- volumetric flow rate from the extraction well, measured in cubic feet per minute (cfm)
- distance between the observation and the extraction wells
- absolute pressure in the extraction and the observation wells

Intrinsic permeability values were calculated using these measurements. The equation used and the permeability calculations for each well are presented in Appendix B.

Soil Vapor Sampling and Analysis

Vapor samples were collected from each well in a Tedlar bag for baseline screening, using a wellhead fitting and diaphragm pump.

The samples were analyzed for oxygen and carbon dioxide using a Land Tech GA90 analyzer, and for total volatile hydrocarbons (TVH) using a Foxboro TVA 1000 organic vapor analyzer (OVA) equipped with a flame ionization detector (FID). Helium, used as a tracer gas during air sparging, was monitored with a Mark 9421 helium detector.

Selected samples were analyzed for total volatile hydrocarbons, for hydrocarbons more volatile than benzene, for benzene, toluene, ethyl benzene, and total xylenes, and for unidentified compounds less volatile than benzene, using a Photovac 10S50 portable gas chromatograph (GC). The vapor samples were extracted through a septum with a microliter syringe and immediately (< 1 minute) injected into the GC for analysis. The Photovac 10S50 is a portable programmable integrating gas chromatograph equipped with a photoionization detector (PID). It was calibrated using a multicomponent standard containing precise amounts of benzene, toluene, ethyl benzene, and o-, m-, and p-xylenes. A description of the vapor analysis procedure is provided in Appendix C.

Two samples were collected from the vapor sampling port using SUMMA canisters, for laboratory analysis for VOCs by EPA Method TO14.

3.1.3 Results of the Vapor Extraction Part of the Pilot Test

Data collected during the vapor extraction pilot test was used to estimate the following parameters:

- rate of soil vapor extraction
- intrinsic permeability of the soil to air
- radius of influence of the extraction wells
- concentrations of oxygen and carbon dioxide in the extracted vapor
- hydrocarbon concentration in the extracted vapors
- hydrocarbon mass removal rates

Rate of Soil Vapor Extraction

Flow rates for the "V" wells generally ranged from 20 to 30 cfm. Flow rates for the MW and PR wells, with shorter screen lengths exposed, generally ranged from 2 to 7 cfm. Higher flows could not be achieved in most of the MW and PR wells, because of the more limited amount of screen exposed in the vadose zone. If the vacuum was raised too high in these wells, there was a risk of lifting water and/or NAPL toward the surface and interfering with the vapor extraction stream.

The variability in flow rates among wells of similar construction indicates some heterogeneity with respect to vapor flow in the vadose zone. Particular wells may be installed in areas of lower or higher permeability, and preferential pathways may exist or may be created in the vadose zone. The large number of wells at the site increases the possibility that extracted air will follow preferential pathways in the vadose zone or a short circuit to the atmosphere. The highest flow rate, 77 cfm, was reached in well V94, at a vacuum of 72 inches of water. This flow rate may be falsely high because of preferential pathways. At least one short circuit to the atmosphere was observed at a cut in the concrete floor near the well: air could be heard entering the cut during extraction from V94. After the leak was sealed, high vacuums were measured at observation wells all around this well during vapor extraction.

Intrinsic Permeability of Soil to Air Flow

Permeabilities of soil to vapor flow were calculated for each well according to the equation in Appendix B. Soil permeabilities were calculated using induced vacuum measurements from more than one observation well, in order to estimate the variability of the calculated permeability for different radial directions from the extraction wells. These measurements can be used to provide a qualitative assessment of the homogeneity of the soils.

The calculation of soil permeability uses the following measurements and parameters:

- the volumetric flow rate of vapor from the extraction well
- the temperature of the extracted vapors (assumed to be 15 °C [288 °K])
- the length of the extraction well screened in the vadose zone
- the applied vacuum at the extraction well
- the induced vacuum at a remote monitoring probe or well
- the distance of the monitoring point from the extraction well
- the radius of the extraction well borehole

Appendix B contains copies of the spreadsheets used to calculate permeability. Each of the spreadsheets lists the parameters used to calculate the individual permeabilities for wells. The calculated permeabilities for the wells are shown in Table 3.

The average permeability values calculated for the extraction wells ranged from 2.0 to 32.5 Darcy, at extraction rates between 2 and 77 cfm. The permeability of 32.5 Darcy calculated for MW23 is almost twice as high as the next highest. Typical intrinsic soil permeability values are as shown below (Johnson 1990):

Soil Type	Permeability (Darcy)
Clayey Sands	<0.1
Fine Sands	0.1–1.0
Medium Sands	1–100
Coarse Sands	100–1,000

On the basis of the permeability values calculated from the pilot soil vapor extraction test, the permeability of the soils beneath the site are within the range expected for medium sands. Geologic information collected at the site indicates that the vadose zone at the site is composed more generally of silts and fine sands. The calculated permeabilities may be greater than the actual ones, because of "short-circuiting" of air or the channeling of air through macropores or disturbed areas, such as the utility trenches. The large number of wells at the site may have had an impact on permeability estimates.

Radius of Influence of the Extraction Wells

A radius of influence, $r_i(x)$, was calculated by monitoring induced vacuums at observation wells during vapor extraction. The extraction rates ranged between 2 and 77 cfm. Appendix A contains the graphs of the log of induced pressure vs. distance. Table 3 summarizes for each observation well the radius of influence corresponding to the radial distance from the extraction well within which the pressure is equal to or greater than a vacuum of 0.1 inches of water, referred to as $r_i(0.1$ in.). This has been reported as an effective radius of influence for vapor extraction (Keech 1989). The average estimated $r_i(0.1$ in.) for all of the wells taken together was 34 feet, ranging from <5 to 78 feet; that for the V wells was 43 feet, ranging from <5 to 78 feet; and that for the PR and MW wells was 28 feet, ranging from <5 to 42 feet.

Concentrations of Oxygen and Carbon Dioxide in Extracted Vapors

In general, the depleted levels of oxygen (about 10%) and elevated levels of carbon dioxide (about 5.3%) measured in the vadose zone indicate that biodegradation is occurring in the

subsurface of the site. The concentrations of oxygen and carbon dioxide in extracted vapors are summarized in Table 4.

A general trend of increased oxygen and decreased carbon dioxide was observed as vapors were extracted. This is to be expected as air is slowly introduced from the atmosphere and from areas of the site where hydrocarbon concentrations are lower .

Concentrations of Hydrocarbons in Extracted Vapors

Table 4 also summarize the concentrations of BTEX and TVH as measured by the Photovac and TVH as measured by the OVA in samples of soil vapor extracted during the pilot test. Because of interference of co-eluting hydrocarbons, concentrations of BTEX could not be accurately quantified in many of the samples collected. The following concentrations are those reported by the OVA.

TVH concentrations in vapor extracted from the V wells, screened to the surface, ranged from 10 to 480 ppmv; those in vapor extracted from the PR and MW wells, screened deeper in the vadose zone, ranged from 178 to 300,000 ppmv. At several wells, NAPL was observed in the vapor extraction piping during vapor extraction. TVH concentrations approaching percent levels may be the result of NAPL from the well collecting in the vapor extraction piping and may not be representative of the vadose zone hydrocarbon concentrations. TVH concentrations were generally higher in the wells screened deeper in the vadose zone, suggesting higher concentrations of hydrocarbons closer to the water table. The lower hydrocarbon concentrations in the wells screened to the surface may be partly due to a greater degree of short-circuiting to the atmosphere.

Wells in which TVH concentrations were relatively high (greater than 1,000 ppmv) generally showed a trend of decrease in concentration with time. The average initial hydrocarbon concentration for the 18 wells was estimated to be 3,300 ppmv. Hydrocarbon concentrations in most of the wells decreased significantly (to an estimated average of 1,900 ppmv) within the first hour of testing (see Table 3). This is to be expected, as the original equilibrium of hydrocarbons desorbed from soil into soil pore space would yield the highest concentration. The rapid decline of hydrocarbon concentrations in the extracted vapors indicates that the soils in most of the vadose zone do not contain high concentration of hydrocarbons. This is consistent with the conceptual model of the site, which has most of the remaining hydrocarbons located in the smear zone, where they are not easily removed using vapor extraction.

The decline may also be due in part to pulling more vapors from less-impacted areas farther away from the source, as is also indicated by the general trend of increasing oxygen and decreasing carbon dioxide with time. Some short-circuiting to the atmosphere may also be occurring. Short-circuiting is of particular concern at this site because of the large number of wells present: a well may serve as a partial artificial conduit to the ground surface.

Hydrocarbon Mass Removal Rates

The mass removal rate under test conditions, as calculated using the permeability equation in Appendix B (not including wells in which NAPL was suspected to have been introduced into the vapor extraction piping as discussed above), ranged from less than 1 lb/day from wells MW22, V7, V90, and V12 to 32 lb/day from well PR48. The volumetric flow rate, initial and final vapor concentrations, and calculated mass removal rates for each of the vapor extraction wells are shown in Table 3.

3.2 THE AQUIFER AIR SPARGING TEST

The main purpose of the air sparging test was to determine whether it could enhance the recovery of hydrocarbons by vapor extraction. Air sparging was done by injecting compressed air into the sparging wells, which are screened below the water, and five wells surrounding each of the two air sparging wells were manifolded together so that vapor could be extracted from all five simultaneously. The test had three objectives:

- monitor changes in the concentrations of hydrocarbon extracted by the vapor extraction equipment due to air sparging
- monitor changes in the distribution of vapor pressure in the subsurface induced by air sparging
- using helium as a tracer, determine what percenatage of the air injected during sparging can be captured by a vapor extraction system.

3.2.1 The Air Sparging Wells and Test Equipment

Three air sparging wells were installed for the pilot test in the areas containing NAPL, but difficulties encountered during installation caused one to become plugged, so only the other two, AS2 and AS3, were used. Their installation is described in Appendix D.

A Gast compressor, capable of delivering a flow of 15 cfm at 12 PSI, was used to inject air. The system, including a pressure regulator, a filter, and an inline flowmeter, was connected to the well with pressure-tight fittings. Helium was metered into the injected air with a Rotameter adjusted to produce a concentration of 5 percent by volume. Figure 12 shows the configura- tion of the pilot air sparging system. The wells nearest to air sparging well AS2 (PR61, PR68, PR58, V21, and V90) were manifolded as MAN 1 and attached to the vapor extraction blower, as were wells PR47, PR48, PR45, V5, and V77 (surrounding AS3) as MAN 2.

The pressures induced in the subsurface were measured using differential-pressure gauges connected to other wells and probes at the site. Induced pressures were monitored over time.

Because of the short duration of each sparging test (less than four hours), consecutive sets of measurements like those made during the vapor extraction test were not made for the air sparging test, so it is not known whether a pressure equilibrium was achieved. The pressure measurements can be found in the field notes in Appendix A.

During the air sparging–vapor extraction test, samples of soil vapor were collected in a Tedlar bag during vapor extraction with a diaphragm pump (Figure 12). In addition, a set of vacuum bottles were attached to the piping to collect samples for laboratory analysis for VOCs (see Appendix E).

3.2.2 Results of the Air Sparging Test

On 4 April 1996, MAN 1 was used for vapor extraction–air sparging tests in conjunction with the injection of air into AS2; on 5 April, MAN2 was used for extraction in conjunction with air injection at AS3.

Data collected during the pilot test was used to estimate the following:

- sparging air injection rate
- effect of sparging on the hydrocarbon concentrations in extracted vapors
- the recoverability of injected air by vapor extraction

Air Sparging Rates of Injection

The volumetric flow rate at which air was injected into the sparging wells was measured directly with a Rotameter. Air was injected into each well at a pressure of 10 psi. The flow rates at this pressure were 3 cfm to well AS2 and 6 cfm into well AS3

Helium Tracer Testing

Helium was added at a measured concentration of 4.3 percent to the air injected into AS2 at a rate of 3 cfm to assess how much of the injected air would be recovered by a vapor extraction system. If all helium was immediately recovered through MAN1, extracting at a rate of 14 cfm, helium would be expected to be at a concentration of 0.9 percent in the extracted vapors (Appendix F). The highest helium concentration measured in extracted vapors from MAN1 was 0.08 percent, indicating that more than 90 percent of injected air was not being immediately recovered by the wells in close proximity to AS2.

Helium was likewise added at a measured concentration of 4.5 percent to the air injected into the aquifer through AS3 at a rate of 6 cfm. If all helium was simultaneously recovered through MAN2, extracting at a rate of 41 cfm, helium would be expected to be a concentration of 0.66 percent in the extracted vapors. The highest helium concentration measured in vapor extracted from MAN2 was 0.48 percent, indicating that more than 50 percent of the injected air was being immediately recovered by the wells in close proximity to AS3. Some injected

air is traveling further away, as evidenced by helium being detected at more distant observation wells, some more than 50 feet from the AS wells.

Effect of Air Sparging on the Concentration of Hydrocarbons

Vapor was extracted from the manifold of five wells surrounding air sparging well AS2 for approximately one hour before air sparging was begun. The wells manifolded together to form MAN1 were PR61, PR68, PR58, V21, and V90. Vapor sampling continued over a 2-hour period of air sparging from MAN1. Well PR58 was disconnected from the manifold after approximately 1 hour of sparging, because NAPL became visible in the vapor extraction hose connected to it.

TVH concentrations in the vapor extracted from MAN1, as measured by the OVA, increased 100-fold in the course of sparging at Well AS2, from 180 ppmv to a maximum of 18,000 ppmv (Table 5).

Vapor was extracted from the five wells (linked as MAN 1) around air sparging well AS3 for approximately 80 minutes prior to air sparging. During this time the extracted vapor concentrations were in the 180 ppmv range, as shown in Figure 13 and listed in Table 5. Shortly after air sparging was started, the extracted vapor concentrations increased steadily over the 110-minute sparging portion of the test, and reached a maximum concentration of 18,000 ppmv. No indication of a leveling-off of hydrocarbon vapor concentration was observed in the course of this test.

Vapor was extracted from the five wells surrounding AS3, linked as MAN2, for about 50 minutes before air was injected. Concentrations in the vapor extracted from MAN2, as measured by the OVA, decreased from 1,340 to 460 ppmv during simple vapor extraction (Figure 13, Table 5), and then started increasing as soon as air was injected in AS3. After 90 minutes of sparging it had increased to 20,100 ppmv, but when air sparging was stopped and air extraction continued (this was tested only at AS3), hydrocarbon concentrations declined rapidly, from 20,000 to 12,000 ppmv in the course of 30 minutes (see Figure 13). In the same period of sparging, benzene concentrations increased six-fold, from 8 to 49 ppmv.

4. CONCLUSIONS

A pilot vapor extraction and air sparging test was conducted at the site to assess the feasibility of using soil vapor extraction to remove hydrocarbons from the vadose zone and of using aquifer air sparging to remove hydrocarbons immobilized in the smear zone and the capillary fringe. The results of the testing indicate that air sparging can increase the recovery of hydrocarbon to a vapor extraction system.

The following conclusions have been drawn regarding NAPL recovery:

- Of the hundred or so wells at the site, 15 or 20 contain measurable thicknesses of NAPL at any one time. This set of wells has remained the same for the last few years.
- There is a strong correlation between greater thickness of NAPL and higher water levels.
- NAPL has been recovered in approximately 10 wells consistently.

Results of the vapor extraction portion of the pilot test are summarized below:

- The average initial hydrocarbon concentration for the 18 wells tested under vapor extraction conditions was estimated to be 3,300 ppmv. Hydrocarbon concentrations in most of the wells decreased significantly (to an estimated average of 1,900 ppmv) within the first hour of testing. This indicates that the soils in most of the vadose zone do not contain high concentration of hydrocarbons. This is consistent with the conceptual model of the site which has the majority of the remaining hydrocarbons located in the smear zone where they are not easily removed using vapor extraction.
- The "V" wells screened to the surface had an initial average concentration that was a factor of 10 lower (see Table 2) than the "PR" or "MW" wells, which have shorter and deeper screen intervals. These V wells are not useful as vapor extraction wells and may cause short-circuiting problems for other wells. However, the increased oxygen introduced in the vadose zone by short-circuiting through these wells may enhance biodegradation.
- The permeability of the soils at the site indicate that soil vapor can be extracted and air injected at pressures attainable with readily available equipment.
- The combined radius of influence within the vadose zone of the vapor extraction wells encompasses the majority of the area identified as containing NAPL.

Results of the air sparging portion of the pilot test are summarized below:

- Aquifer air sparging increased the concentration of extracted vapors by at least one order of magnitude in the areas tested and can potentially increase the rate of

hydrocarbon mass removal from the subsurface. This is consistent with the site conceptual model. Air sparging likely promoted the migration of hydrocarbons from the smear zone to the vadose zone, where they could then be removed by the vapor extraction system.

- Caution should be used if air sparging is implemented as the results indicate that some injected air may not be recovered by simultaneous vapor extraction. Induction of a positive pressure gradient in the subsurface by air sparging may cause increased movement of hydrocarbons in both the vadose and saturated zones.

Figures

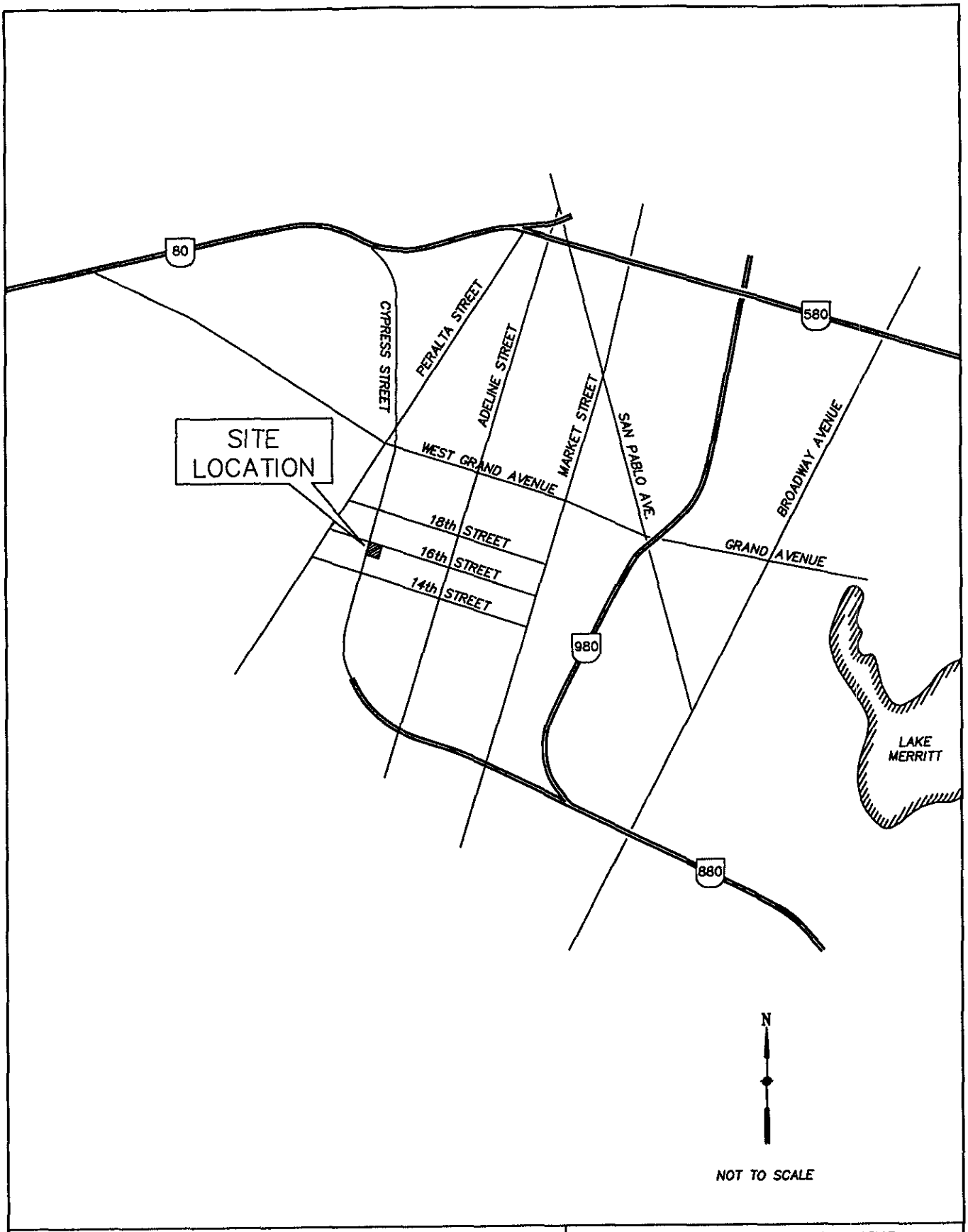

FIGURE 1.
SITE LOCATION MAP
NESTLE FACILITY, 1310 14th STREET,
OAKLAND, CALIFORNIA.

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

PROJECT NO. 60966.01.0008	DATE 2/8/96
FILE NAME LOCATION.DWG	REVIEWED BY A. MOORE

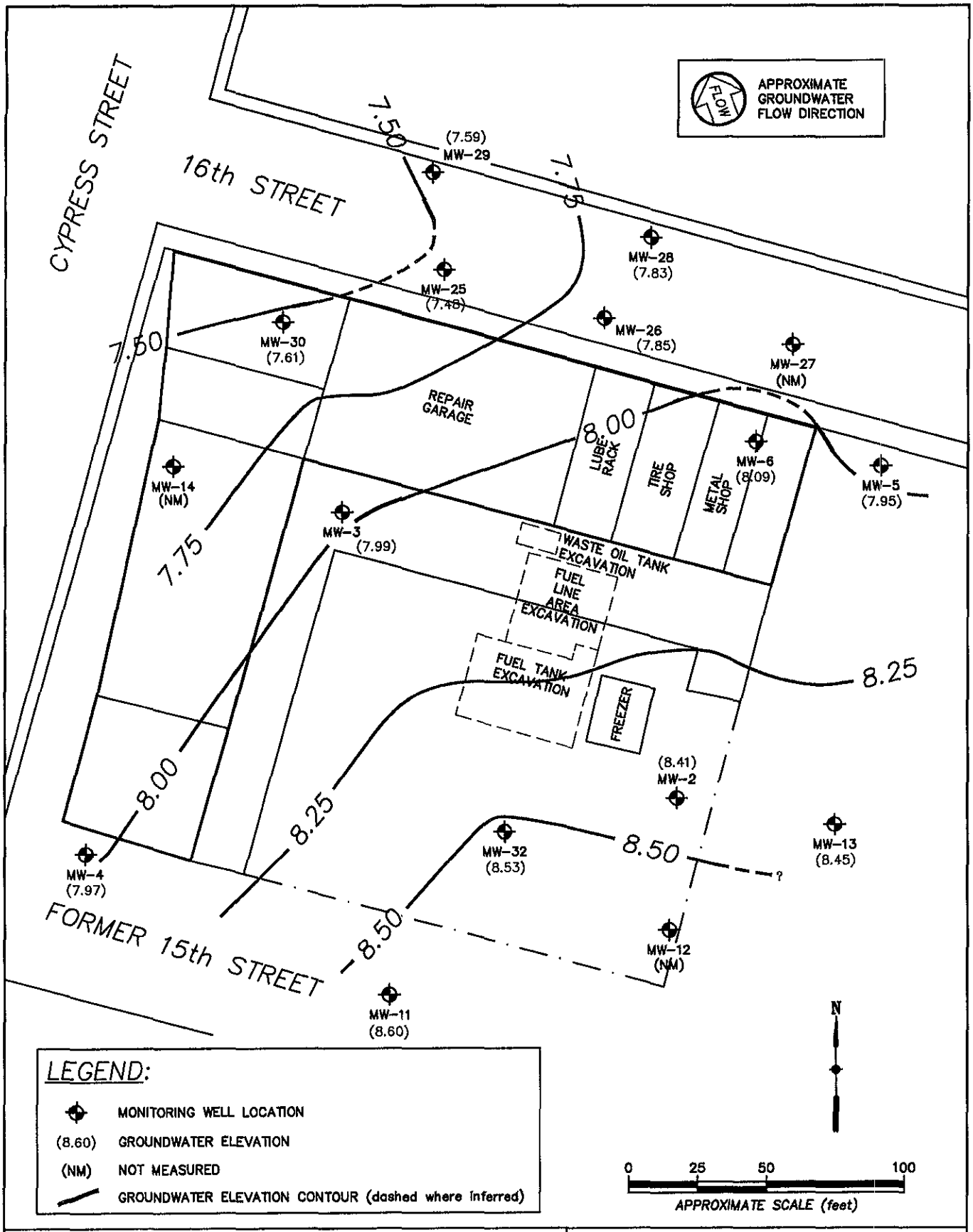

FIGURE 2.
GROUNDWATER ELEVATIONS IN SAMPLED WELLS
NESTLE FACILITY, OAKLAND, CALIFORNIA
12 MARCH 1996

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

PROJECT NO.: 60966.01.0008	DATE: 5/22/96
FILE NAME: NEST_296.DWG	REVIEWED BY: C. MARTING

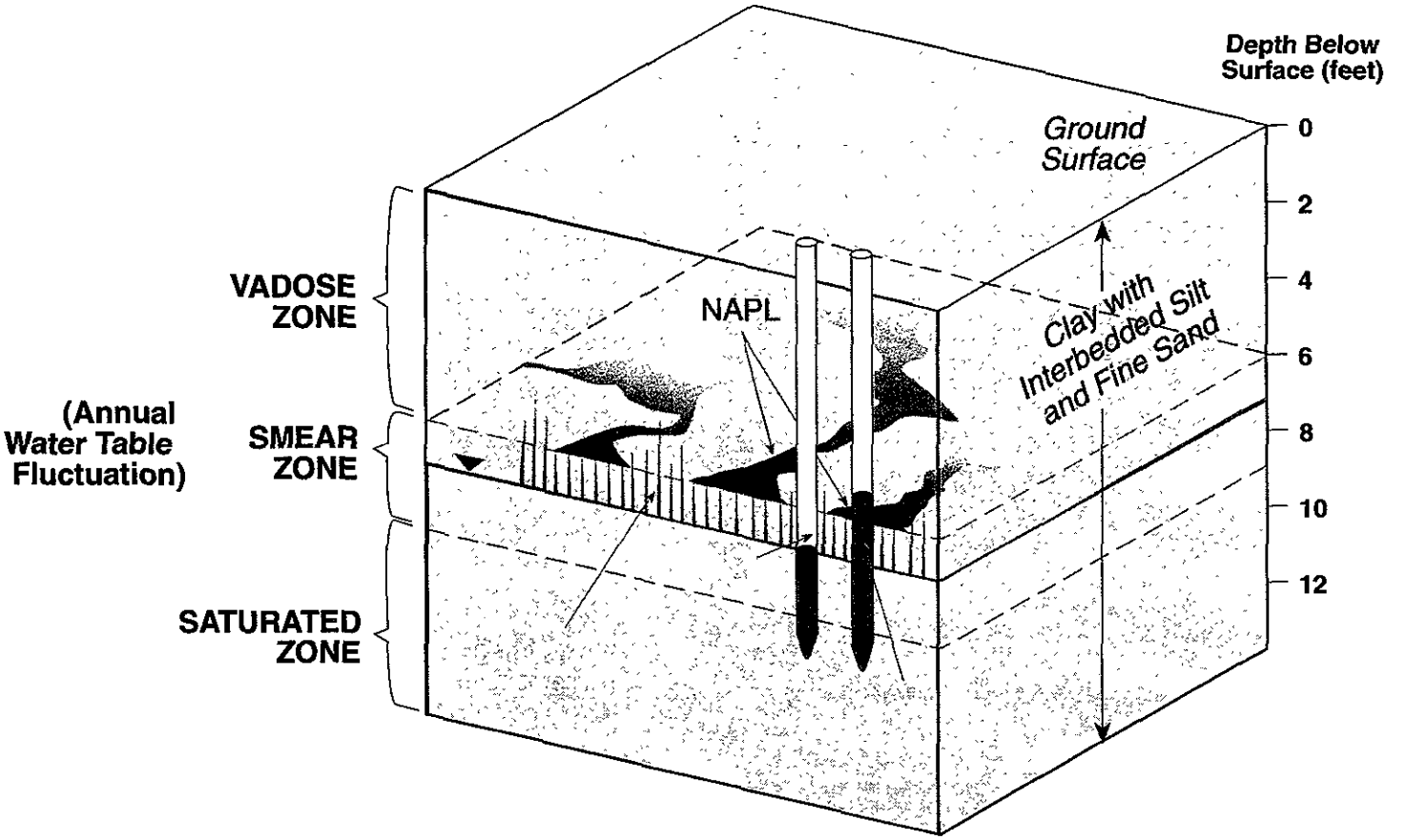

Figure 3. Conceptual model of distribution of NAPL, the Nestle site, Oakland, California.

Drawn	ELA	Date	5/3/96
Reviewed		Date	
Rev		Date	
Final		Date	

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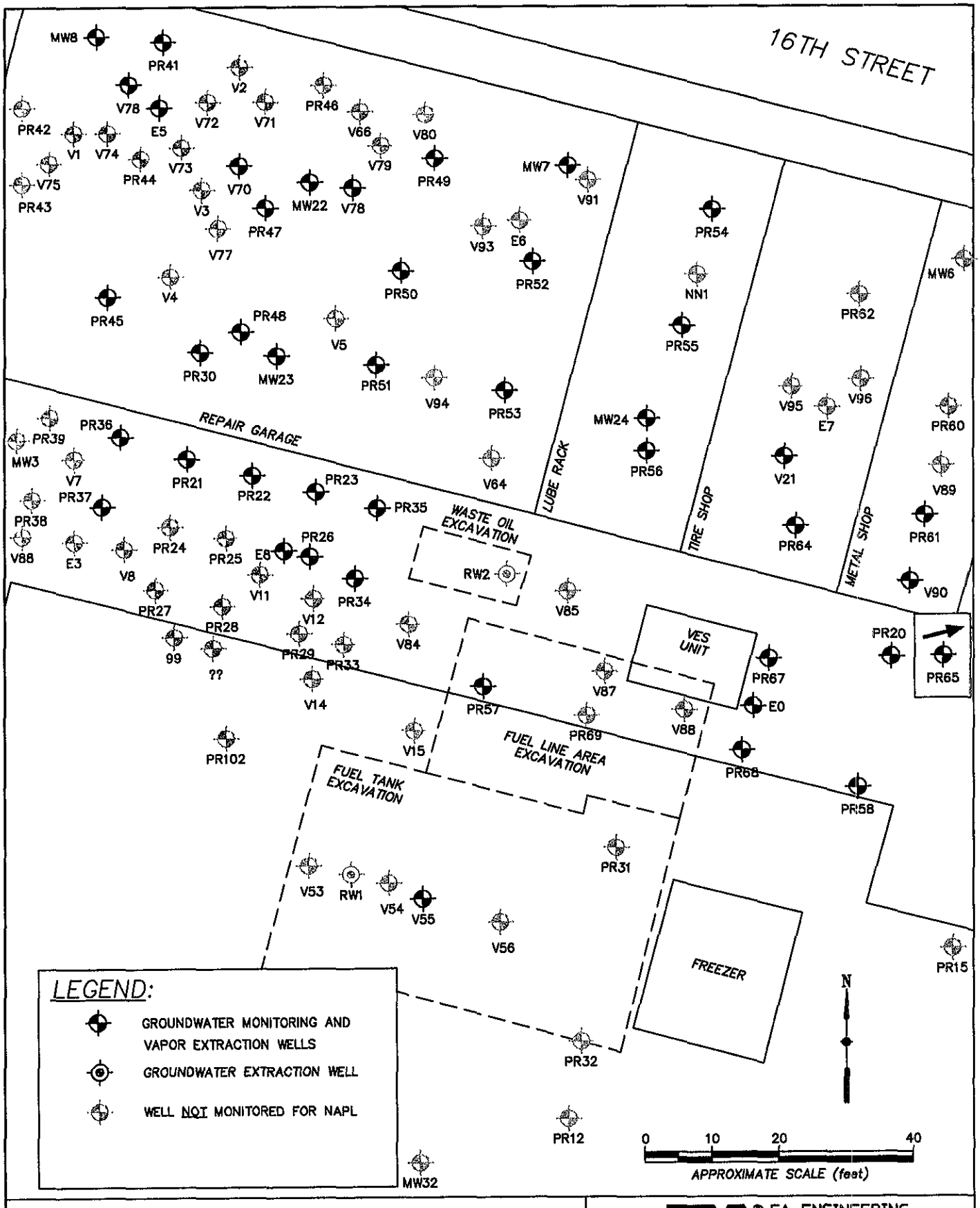

FIGURE 4.
LOCATION OF WELLS MONITORED FOR NAPL
NESTLE FACILITY,
OAKLAND, CALIFORNIA

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

PROJECT NO.: 60966.01.0008	DATE: 5/22/96
FILE NAME: NESTLE5.DWG	REVIEWED BY: C. MARTING

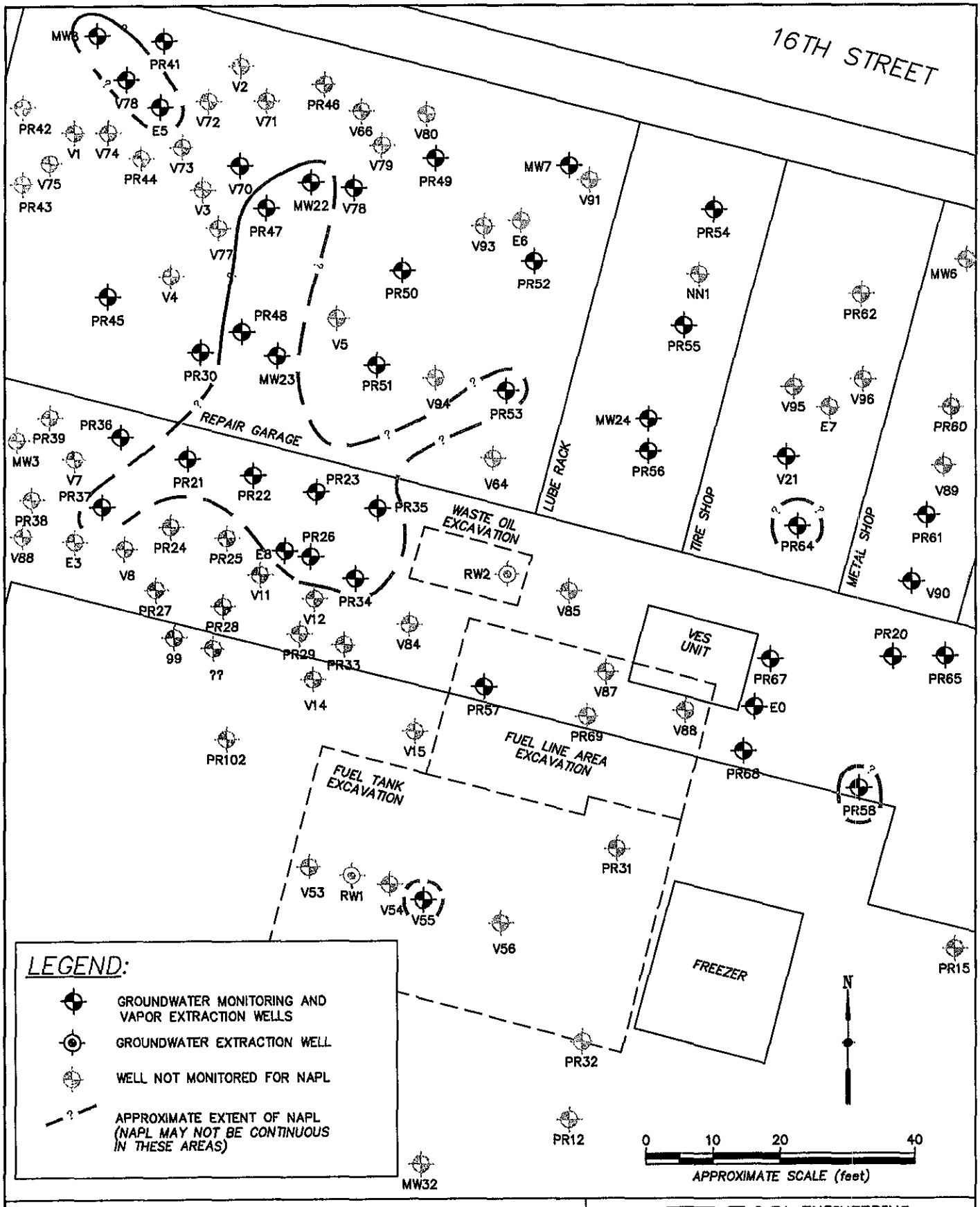

FIGURE 5.
SITE PLAN SHOWING WELL LOCATIONS CONTAINING FREE PRODUCT, 12/6/95 – 12/28/95
FORMER NESTLE FACILITY,
OAKLAND, CALIFORNIA

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

PROJECT NO.: 60966.01.0008	DATE: 5/22/96
FILE NAME: NESTLE2.DWG	REVIEWED BY: C. MARTING

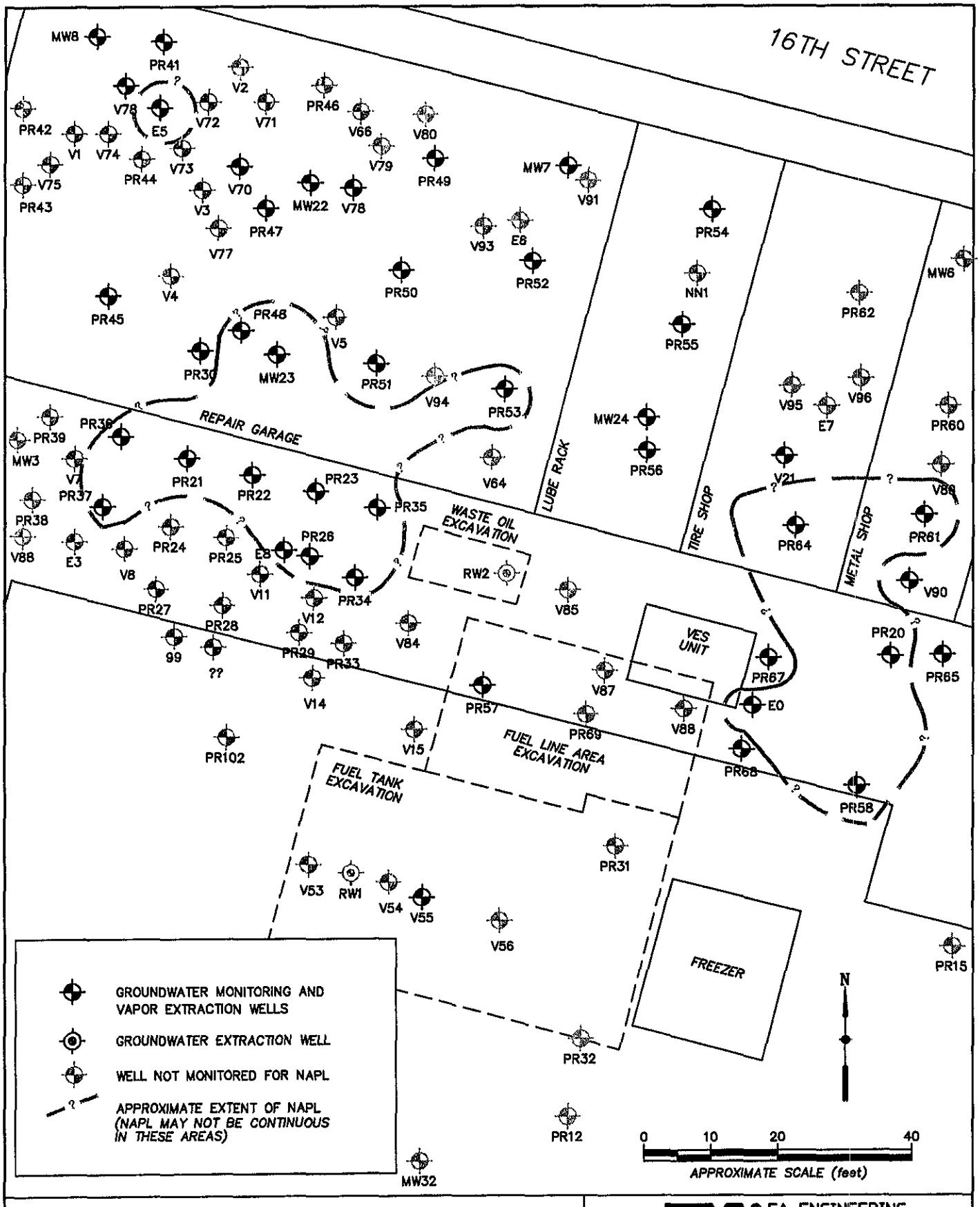

FIGURE 6.
SITE PLAN SHOWING WELL LOCATIONS CONTAINING FREE PRODUCT 27 FEBRUARY 1996
FORMER NESTLE FACILITY,
OAKLAND, CALIFORNIA

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

PROJECT NO.: 60966.01.0008	DATE: 5/22/96
FILE NAME: NESTLE6.DWG	REVIEWED BY: C. MARTING

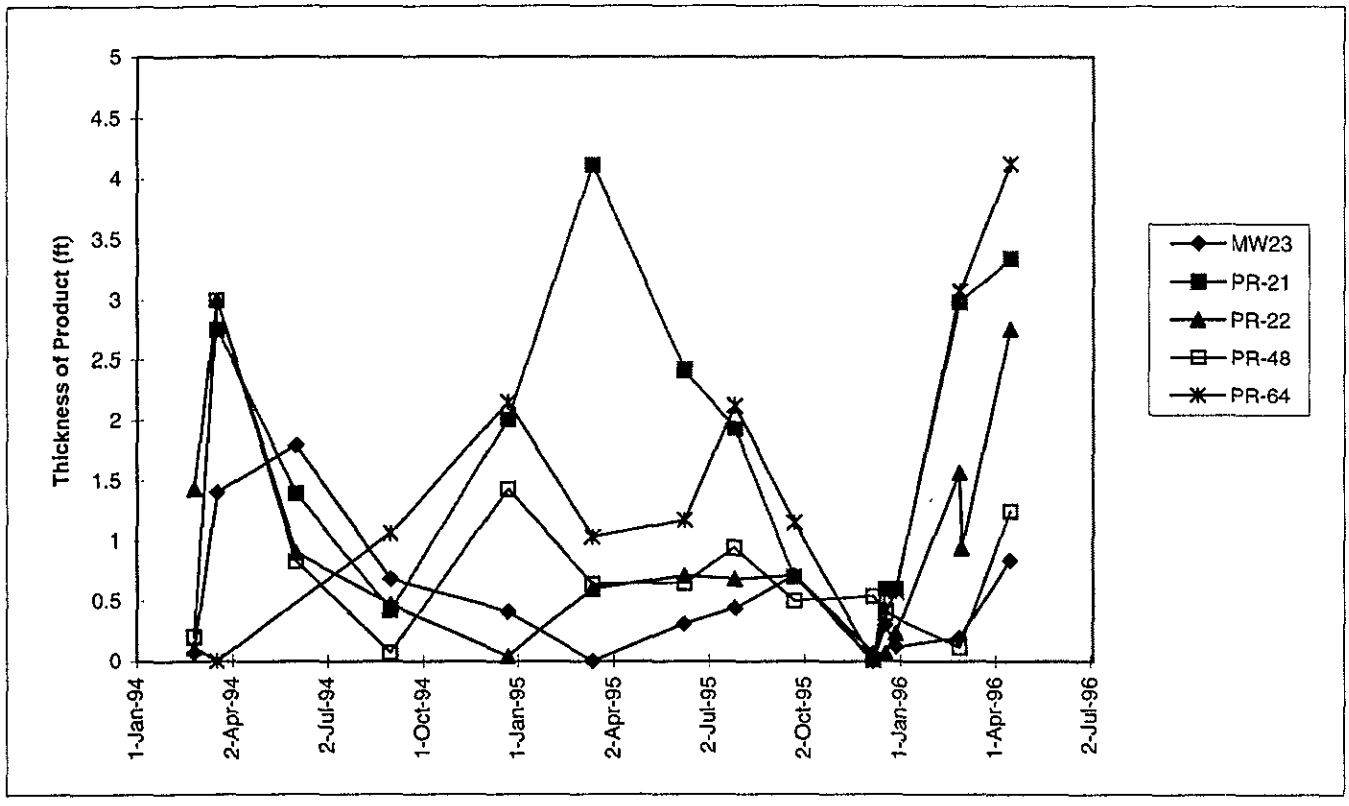

Figure 7. NAPL thickness in 5 wells, Nestle site, Oakland, California, 1 Jan 1994 - 16 Apr 1996.

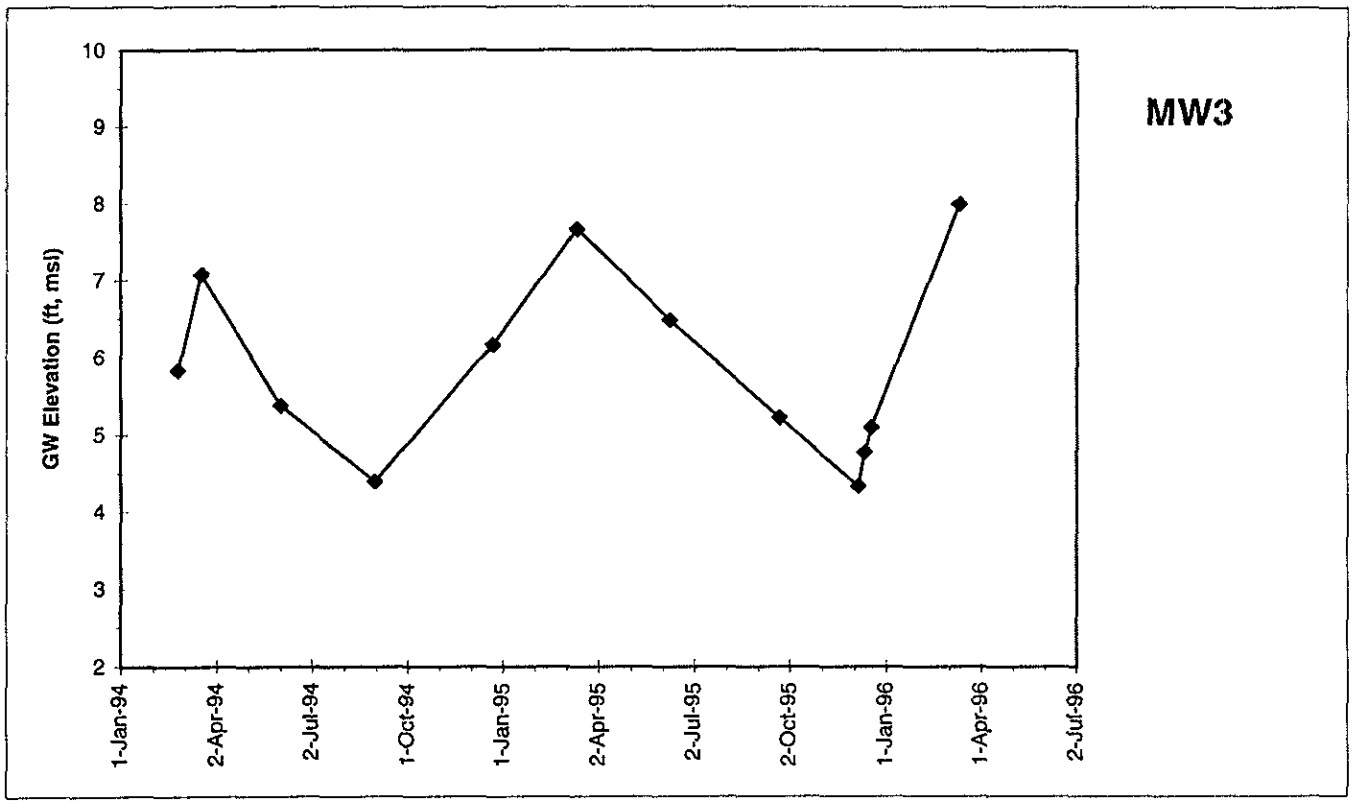

Figure 8. Hydrograph measured in well MW3, Nestle site, Oakland, California, 1 Jan 1994 - 16 Apr 1996.

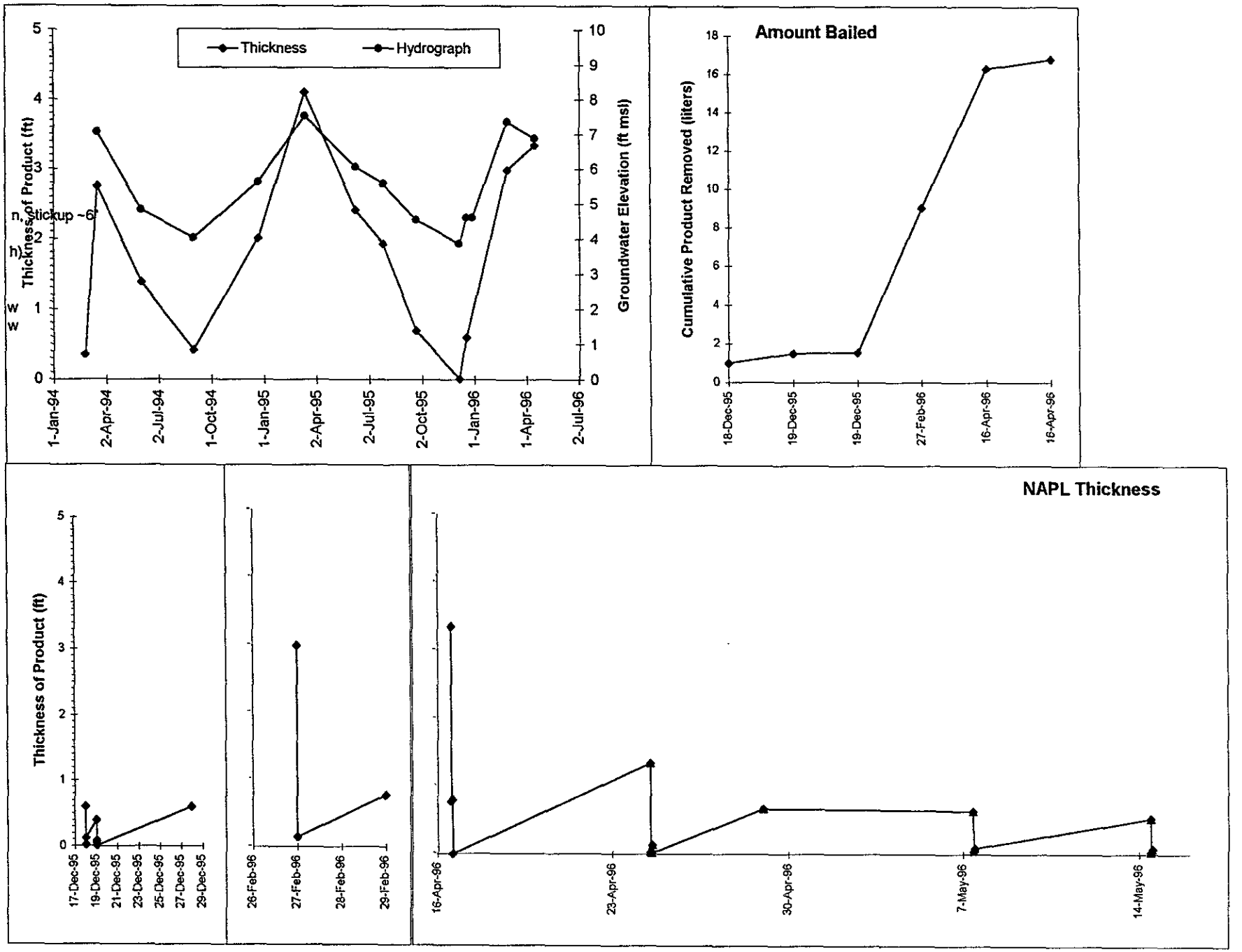

Figure 9. Measured NAPL thickness and amount of NAPL bailed in well PR21, Nestle Site, Oakland, California, 1994 - 1996.

PR21

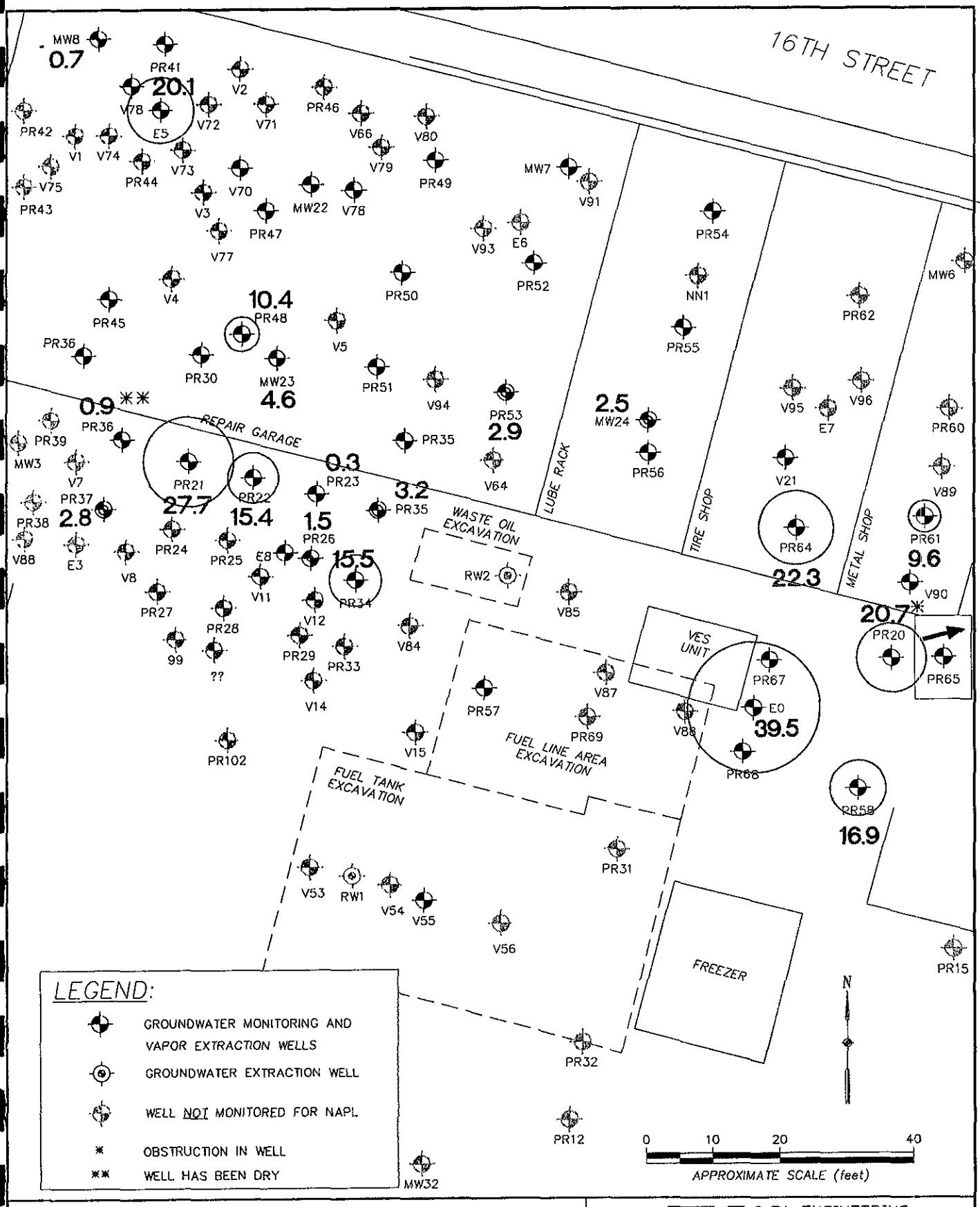

FIGURE 10.
TOTAL QUANTITY (LITERS) OF NAPL REMOVED FROM WELLS AT THE NESTLE FACILITY, OAKLAND, CA.
DECEMBER 1995 – APRIL 1996

® EA ENGINEERING, SCIENCE, AND TECHNOLOGY

PROJECT NO.	DATE
60966.01.0008	5/22/96
FILE NAME: NESTLE5.DWG	REVIEWED BY: C. MARTING

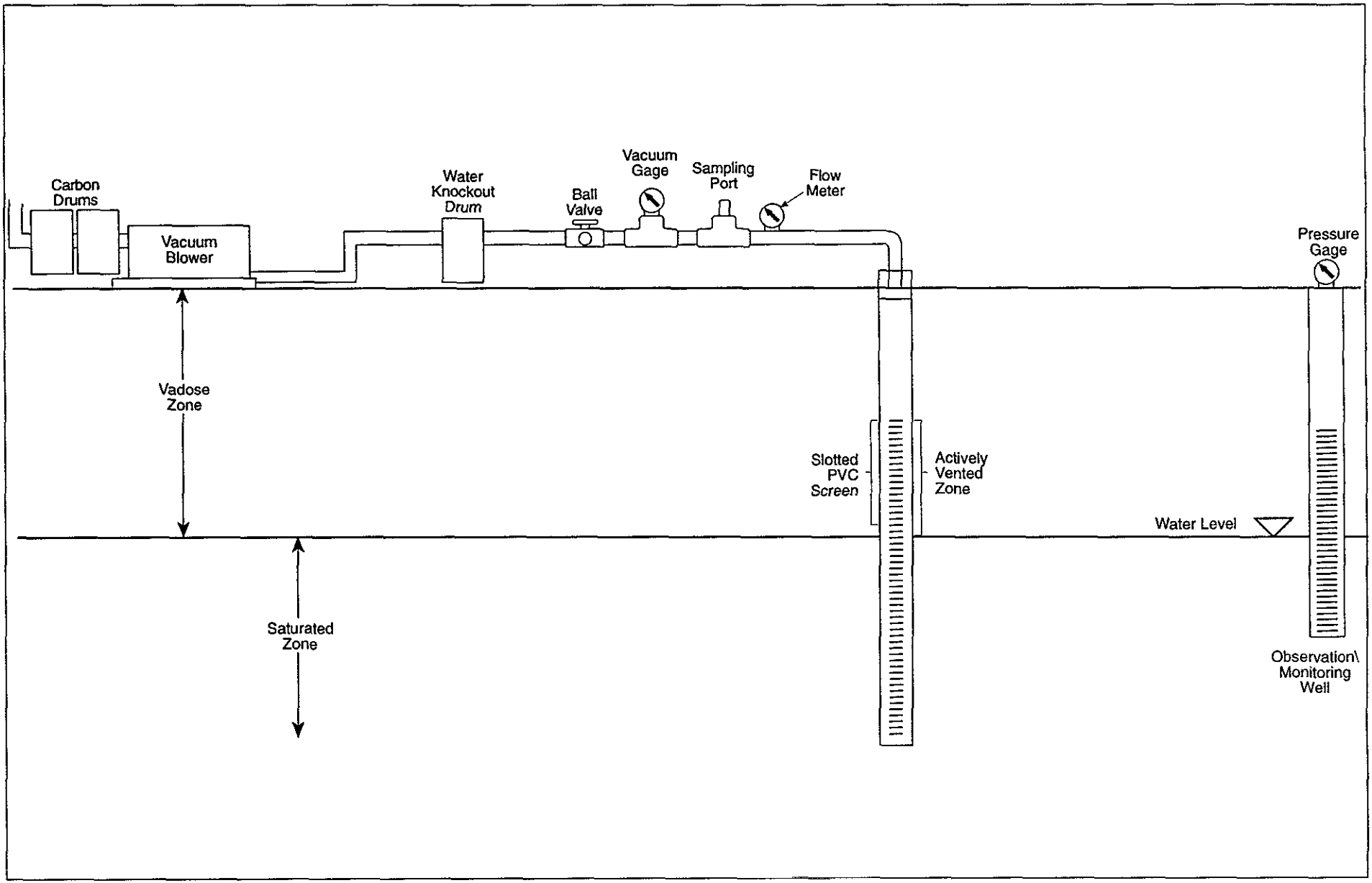

Figure 11. Pilot soil vapor extraction system configuration.

Drawn	ELA	Date	6/11/96
Reviewed		Date	
Rev		Date	
Final		Date	

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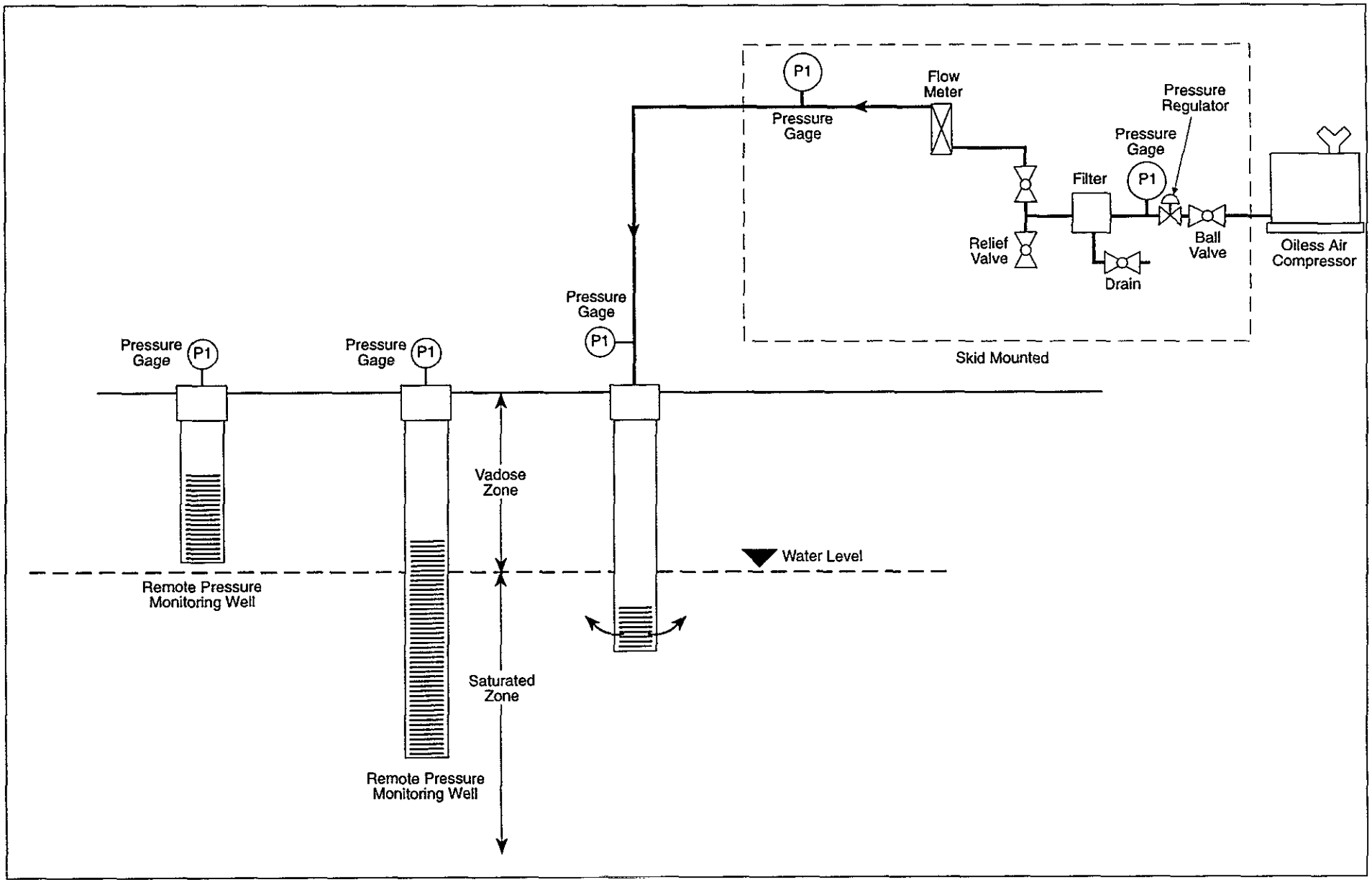

Figure 12. Pilot aquifier air sparging system configuration.

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Reviewed		Date	
Rev		Date	
Final		Date	

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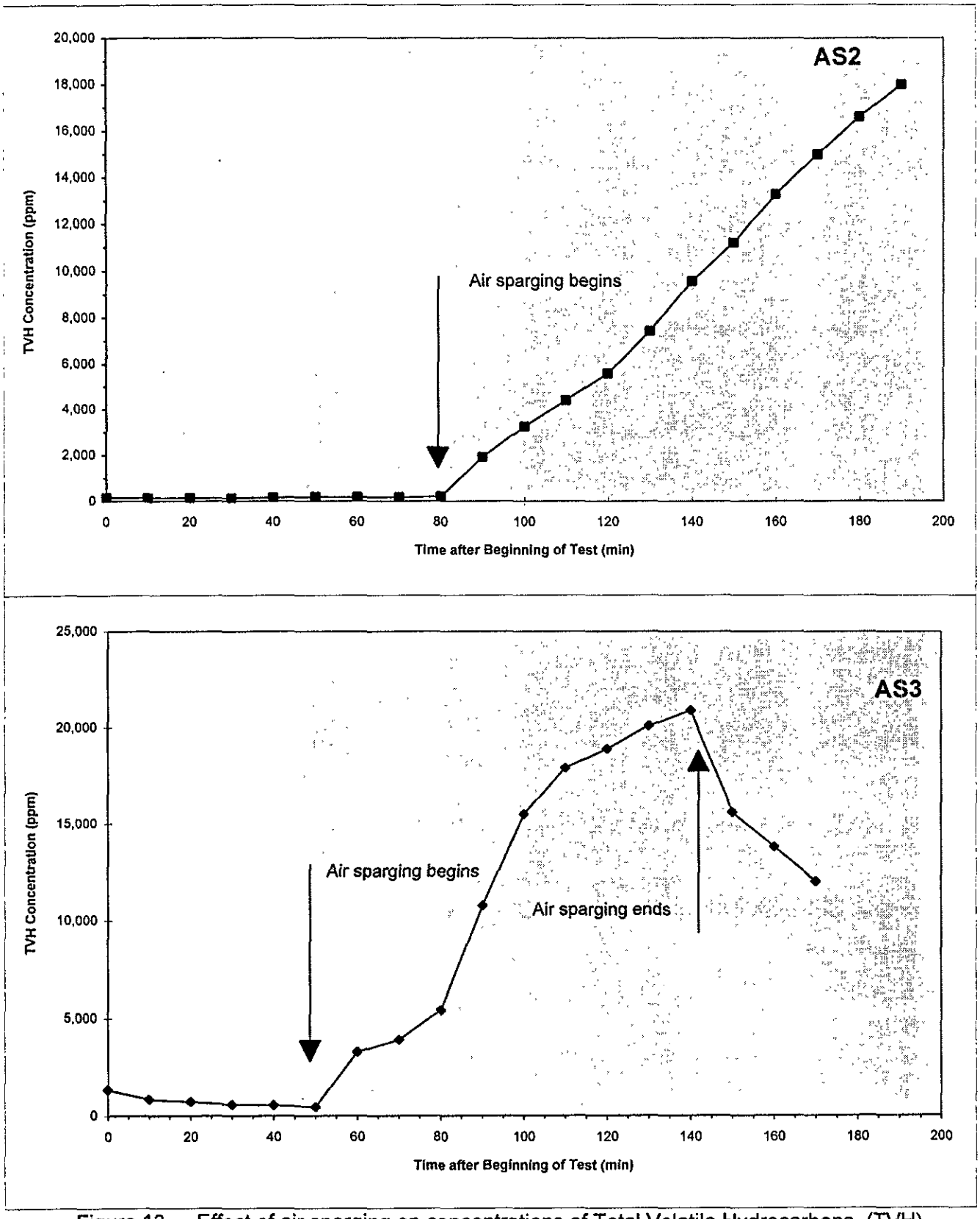


Figure 13. Effect of air sparging on concentrations of Total Volatile Hydrocarbons (TVH) in extracted soil vapor, Nestle Facility, Oakland, California.

Tables

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed	
MW-7	24-Feb-94	-	14.29	8.64	9.78	1.14	4.51			
14.29	18-Mar-94	-	14.29	6.56	9.38	2.82	4.91			
	2-Jun-94	-	14.29	9.12	9.38	0.26	4.91			
	31-Aug-94	-	14.29	9.87	9.88	0.01	4.41			
	22-Dec-94	-	14.29	8.29	8.33	0.04	5.96			
	13-Mar-95	-	14.29	-	6.72	-	7.57			
	9-Jun-95	-	14.29	-	8.79	-	5.50			
	22-Sep-95	-	14.29	9.30	9.51	0.21	4.78			
	27-Feb-96	-	14.29	-	6.60	-	7.69			
	16-Apr-96	11:41	14.29	6.92	6.93	0.01	7.36			
	24-Apr-96	11:16	14.29	-	7.25	-	7.04			
	29-Apr-96		14.29	7.33	7.34	0.01	6.95			
	7-May-96	8:49	14.29	-	7.53	-	6.76			
	14-May-96	9:57	14.29	7.56	7.57	0.01	6.72			
	20-Jun-96		14.29	7.82	7.84	0.02	6.45			
MW-8	24-Feb-94	-	14.20	8.55	8.99	0.44	5.21			
	18-Mar-94	-	14.20	7.34	7.64	0.30	6.56			
	2-Jun-94	-	14.20	8.93	9.24	0.31	4.96			
	31-Aug-94	-	14.20	9.82	10.13	0.31	4.07			
	22-Dec-94	-	14.20	8.21	8.47	0.26	5.73			
	13-Mar-95	-	14.20	6.77	6.85	0.08	7.35			
	9-Jun-95	-	14.20	8.81	8.90	0.09	5.30			
	27-Jul-95	-	14.20	8.32	8.55	0.23	5.65			
	22-Sep-95	-	14.20	9.29	9.53	0.24	4.67			
	6-Dec-95	-	14.20	9.94	10.18	0.24	4.02			
	18-Dec-95	-	14.20	9.16	9.36	0.20	4.84			
	18-Dec-95	2:20	14.20	-	9.62	-	4.58	0.50		
	18-Dec-95	2:57	14.20	-	9.25	-	4.95			
	19-Dec-95	9:00	14.20	9.21	9.30	0.09	4.90			
	19-Dec-95	11:50	14.20	9.34	9.35	0.01	4.85	0.20		0.4
	19-Dec-95	12:20	14.20	9.25	9.28	0.03	4.92			
	28-Dec-95	9:30	14.20	9.22	9.27	0.05	4.93			
	27-Feb-96	-	14.20	-	6.67		7.53			
	16-Apr-96	11:50	14.20	-	6.98	-	7.22			
	24-Apr-96	11:35	14.20	-	7.51	-	6.69			
	29-Apr-96		14.20	7.42	7.44	0.05	6.76			
	7-May-96	9:09	14.20	7.51	7.53	0.05	6.67			
	14-May-96	10:15	14.20	-	7.62	0.05	6.58			
	20-Jun-96		14.20	7.87	7.90	0.05	6.30			
MW-22	24-Feb-94	-	14.44	8.59	10.13	1.54	4.31			
	18-Mar-94	-	14.44	6.98	-	>3.0	-			
	2-Jun-94	-	14.44	9.02	10.16	1.14	4.28			
	31-Aug-94	-	14.44	9.97	10.16	0.19	4.28			
	22-Dec-94	-	14.44	8.39	8.42	0.03	6.02			
	13-Mar-95	-	14.44	-	5.92	-	8.52			
	9-Jun-95	-	14.44	-	8.60	-	5.84			
	27-Jul-95	-	14.44	-	8.49	-	5.95	0.00	sheen	
	22-Sep-95	-	14.44	9.42	9.74	0.32	4.70			
	6-Dec-95	-	14.44	10.08	10.38	0.30	4.06		2' no screen showing	
	18-Dec-95	-	14.44	-	9.35	-	5.09		bailer shows no NAPL	
	27-Feb-96	-	14.44	-	6.75	-	7.69			
	16-Apr-96	12:06	14.44	-	7.09	-				
	24-Apr-96	11:29	14.44	-	7.40	-				
	29-Apr-96		14.44	-	7.50	-	6.94			
	7-May-96	9:04	14.44	-	7.59	-	6.85			
	14-May-96	10:24	14.44	-	7.72	-	6.72			
	20-Jun-96		14.44	7.95	7.96	0.01	6.48			

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed	
MW-23	24-Feb-94	-	14.48	8.87	8.94	0.07	5.54			
	18-Mar-94	-		7.04	8.44	1.40	6.04			
	2-Jun-94	-		8.21	10.00	1.79	4.48			
	31-Aug-94	-		9.93	10.61	0.68	3.87			
	22-Dec-94	-		8.32	8.73	0.41	5.75			
	13-Mar-95	-		-	5.52	-	8.96			
	9-Jun-95	-		8.24	8.55	0.31	5.93			
	27-Jul-95	-		8.43	8.87	0.44	5.61			
	22-Sep-95	-		9.35	10.06	0.71	4.42			
	6-Dec-95	-		-	10.07	-	4.41		2', no screen showing; st	
	18-Dec-95	-		9.40	9.70	0.30	4.78	0.50		
	18-Dec-95	17:07		-	9.89	-	4.59			
	18-Dec-95	17:55		9.46	9.49	0.03	4.99			
	19-Dec-95	9:00		9.45	9.55	0.10	4.93			
	19-Dec-95	10:50		-	9.88	-	4.60	0.05		1
	19-Dec-95	12:12		9.48	9.52	0.04	4.96			
	28-Dec-95	9:30		9.40	9.52	0.12	4.96			
	27-Feb-96	9:00		6.69	6.88	0.19	7.60			
	27-Feb-96	10:00		-	7.40	-	7.08	0.25		0.5
	29-Feb-96	-		6.85	7.00	0.15	7.48			
	16-Apr-96	12:19		6.91	7.75	0.84	6.73	1.50		0.75
	16-Apr-96	12:23		7.77	7.78	0.01	6.70			
	16-Apr-96	13:51		7.02	7.43	0.41	7.05			
	24-Apr-96	11:53		7.24	7.90	0.66	6.58	0.25		0.75
	24-Apr-96	11:58		7.91	7.92	0.01	6.56			
	24-Apr-96	13:11		7.33	7.65	0.32	6.83	0.25		0.25
	24-Apr-96	13:14		7.75	7.76	0.01	6.72	1.50		0.75
	29-Apr-96	9:00		7.40	7.83	0.43	6.65	0.25		0.25
	29-Apr-96	9:10		-	7.89	-	6.59			
	29-Apr-96	10:10		7.46	7.66	0.20	6.82	0.25		0.25
	7-May-96	9:22		7.92	7.93	0.01	6.55			
	7-May-96	10:24		7.58	7.77	0.19	6.71	<0.25		0.5
	7-May-96	10:30		-	7.92	-	6.56			
	14-May-96	10:34		7.63	8.05	0.42	6.43	0.25		0.5
	14-May-96	10:38		-	8.13	-	6.35			
	14-May-96	11:45		7.70	7.88	0.18	6.60	<0.25		0.5
	14-May-96	11:49		-	8.05	-	6.43			
	20-Jun-96			7.75	8.75	1.00	5.73	0.75		0.25
	20-Jun-96			7.90	8.16	0.26	6.32			
MW-24	24-Feb-94	-	14.67	8.95	-	12.10	-			
	18-Mar-94	-	14.67	7.45	-	>3.0	-			
	2-Jun-94	-	14.67	9.11	10.08	0.97	4.59			
	31-Aug-94	-	14.67	10.19	10.58	0.39	4.09			
	22-Dec-94	-	14.67	-	8.55	-	6.12			
	13-Mar-95	-	14.67	-	6.68	-	7.99			
	9-Jun-95	-	14.67	-	9.54	-	5.13			
	22-Sep-95	-	14.67	9.35	10.76	1.41	3.91			
	6-Dec-95	-	14.67	10.39	10.39	-	4.28			
	27-Feb-96	-	14.67	-	6.70	-	7.97			
	29-Apr-96	9:00	14.67	7.41	9.20	1.79	5.47	1.50		0.5
	29-Apr-96	9:10	14.67	-	8.32	-	6.35			
	29-Apr-96	10:00	14.67	7.65	7.84	0.19	6.83	0.13		0.25
	29-Apr-96		14.67	-	8.10	-	6.57			
	20-Jun-96		14.67	7.69	10.15	2.46	4.52	1.00		2
	20-Jun-96		14.67	9.1	9.12	0.02	5.55			
	20-Jun-96		14.67	8.01	8.72	0.71	5.95			
E-0	27-Jul-95	-		7.81	10.53	2.72				
	6-Dec-95	-		-	10.75	-			6", ~1' stickup	

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed	
	27-Feb-96	9:00		5.5	9.42	3.92		30.00		1
	27-Feb-96	10:00		6.85	6.91	0.06				
	29-Feb-96	-		6.53	6.60	0.07				
	16-Apr-96	10:55		7.38	8.55	1.17		8.00		1
	16-Apr-96	13:38		7.65	7.68	0.03				
	24-Apr-96	10:59		7.98	8.03	0.05				
	29-Apr-96			7.23	7.28	0.05		0.50		0.5
	29-Apr-96			-	7.41	-				
	7-May-96	8:40		7.44	7.48	0.04				
	14-May-96	9:44		7.53	7.57	0.04				
	20-Jun-96			7.80	7.98	0.18		1.00		0.25
	20-Jun-96			7.95	7.96	0.01				
	20-Jun-96			7.80	7.84	0.04				
E-5	6-Dec-95	-		9.75	11.25	1.50			6"	
	18-Dec-95	-		9.55	11.00	1.45		1.20	1.20n (1.2' blkish produ	
	18-Dec-95	11:15		10.05	10.10	0.05		11.00	(in 10 min.)	
	18-Dec-95	11:16		9.98	10.04	0.06				
	18-Dec-95	11:20		9.72	9.80	0.08				
	18-Dec-95	11:50		9.45	9.65	0.20				
	18-Dec-95	12:18		9.45	9.64	0.19				
	18-Dec-95	12:48		9.43	9.63	0.20				
	18-Dec-95	14:21		9.43	9.63	0.20				
	18-Dec-95	14:25		9.66	9.68	0.02		1.50		
	18-Dec-95	15:00		9.45	9.47	0.02				
	19-Dec-95	9:00		9.49	9.53	0.04				
	19-Dec-95	11:30		9.63	9.65	0.02		0.50		1.5
	19-Dec-95	12:15		9.48	9.50	0.02			check w/ bailer - sheen	
	28-Dec-95	9:30		9.48	9.67	0.19				
	27-Feb-96	9:00		7.00	7.27	0.27		5.70		
	27-Feb-96	10:00		7.50	7.53	0.03				5.7
	29-Feb-96	-		7.06	7.09	0.03				
	16-Apr-96	11:53		6.18	6.18	-				
	24-Apr-96	11:40		-	8.17	-				
	29-Apr-96			8.25	8.26	0.01		0.01		
	7-May-96	9:12		-	8.36	-				
	14-May-96	10:17		-	8.47	-				
	20-Jun-96			7.71	7.81	0.10		2.00		0.25
	20-Jun-96			-	8.78	-				
	20-Jun-96			-	8.69	-				
E-8	27-Jul-95	-		8.76	8.86	0.10				
	6-Dec-95	-		10.39	10.81	0.42			6"	
	27-Feb-96	9:00		7.69	7.15	0.54		1.90		
	27-Feb-96	10:00		-	7.09	-				1.9
	29-Feb-96	-		7.05	7.07	0.02				
	16-Apr-96	13:16		7.00	7.00	0.00				
	24-Apr-96	12:40		-	7.30	-				
	29-Apr-96			7.43	7.44	0.01		0.01		
	7-May-96	9:57		-	7.53	-				
	14-May-96	11:08		17.65	17.65	-				
	20-Jun-96			-	7.60	-				
PR-20	24-Feb-94	-	14.36	8.2	9.35	1.15	5.01			
	18-Mar-94	-	14.36	6.28	9.69	3.41	4.67			
	2-Jun-94	-	14.36	8.46	9.91	1.45	4.45			
	31-Aug-94	-	14.36	9.31	10.19	0.88	4.17			
	22-Dec-94	-	14.36	7.68	8.72	1.04	5.64			
	13-Mar-95	-	14.36	5.93	6.07	0.14	8.29			
	9-Jun-95	-	14.36	7.73	7.89	0.16	6.47			

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed	
	27-Jul-95	-	14.36	7.35	9.89	2.54	4.47			
	22-Sep-95	-	14.36	8.75	9.87	1.12	4.49			
	18-Dec-95	-	14.36	-	-	-	-		*probably broken tube in*	
	27-Feb-96	9:00	14.36	6.10	9.60	3.50	4.76			
	27-Feb-96	10:00	14.36	9.77	9.81	0.04	4.55	1.90		
	29-Feb-96	-	14.36	6.10	8.75	2.65	5.61			
	16-Apr-96	10:51	14.36	5.52	8.15	2.63	6.21		Depth to obstruction	
	24-Apr-96	10:45	14.36	5.88	9.17	3.29	5.19	1.00	Depth to obstruction	
	29-Apr-96		14.36	5.94	9.83	3.89	4.53	13.00		1
	29-Apr-96		14.36	-	10.20	-	4.16			
	29-Apr-96		14.36	9.11	9.59	0.48	4.77	1.50		1
	29-Apr-96		14.36	-	10.10	-	4.26			
	7-May-96		14.36	-	13.70	-	0.66		Depth to obstruction	
	14-May-96	9:19	14.36	-	13.73	-	0.63		Depth to obstruction	
	20-Jun-96		14.36	6.10	9.60	3.50	4.76	5.75		0.5
	20-Jun-96		14.36	-	10.01	-	4.35			
	20-Jun-96		14.36	9.10	9.46	0.36	4.90			
PR-21	18-Mar-94	-	14.37	6.60	9.36	2.76	5.01			
	2-Jun-94	-	14.37	9.17	10.56	1.39	3.81			
	31-Aug-94	-	14.37	10.23	10.65	0.42	3.72			
	22-Dec-94	-	14.37	8.24	10.25	2.01	4.12			
	13-Mar-95	-	14.37	5.8	9.91	4.11	4.46			
	9-Jun-95	-	14.37	7.7	10.12	2.42	4.25			
	27-Jul-95	-	14.37	8.3	10.23	1.93	4.14			
	22-Sep-95	-	14.37	9.64	10.34	0.70	4.03			
	6-Dec-95	-	14.37	10.5	10.51	0.01	3.86		2", no screen, stickup ~6	
	18-Dec-95	-	14.37	9.60	10.20	0.60	4.17			
	18-Dec-95	1:30	14.37	10.23	10.25	0.02	4.12	1.00	(brownish)	
	18-Dec-95	3:04	14.37	9.82	9.94	0.12	4.43			
	19-Dec-95	9:00	14.37	9.69	10.09	0.40	4.28			
	19-Dec-95	9:45	14.37	10.10	10.15	0.05	4.22	0.50		0.025
	19-Dec-95	9:50	14.37	10.32	10.33	0.01	4.04	0.05		0.15
	19-Dec-95	12:00	14.37	9.85	9.93	0.08	4.44	0.10		
	19-Dec-95	12:01	14.37	10.14	10.15	0.01	4.22			0.2
	19-Dec-95	12:25	14.37	10.00	10.01	0.01	4.36			
	28-Dec-95	9:30	14.37	9.60	10.20	0.60	4.17			
	27-Feb-96	9:00	14.37	6.25	9.24	2.99	5.13	7.50		
	27-Feb-96	10:00	14.37	8.95	9.10	0.15	5.27			
	29-Feb-96	-	14.37	7.23	8.00	0.77	6.37			
	16-Apr-96	12:36	14.37	6.63	9.98	3.35	4.39	7.25		1.25
	16-Apr-96	12:50	14.37	7.23	8.00	0.77	6.37			
	16-Apr-96	13:56	14.37	6.89	7.69	0.80	6.68	0.50		0.5
	16-Apr-96	14:02	14.37	-	7.69	-				
	24-Apr-96	12:09	14.37	7.32	8.66	1.34	5.71	3.00		0.5
	24-Apr-96	12:13	14.37	8.81	8.84	0.03	5.53			
	24-Apr-96	13:17	14.37	8.18	8.31	0.13	6.06	0.25		0.5
	24-Apr-96	13:21	14.37	8.39	8.41	-	5.96			
	29-Apr-96	-	14.37	7.60	8.27	0.67	6.10	1.00		0.5
	29-Apr-96	-	14.37	-	8.49	-	5.88			
	29-Apr-96	-	14.37	7.95	8.04	0.09	6.33	0.13		0.5
	29-Apr-96		14.37	-	8.28	-	6.09			
	7-May-96	9:36	14.37	7.72	8.36	0.64	6.01	1.00		0.75
	7-May-96	9:40	14.37	8.47	8.52	0.05	5.85			
	7-May-96	10:36	14.37	8.15	8.24	0.09	6.13			
	14-May-96	10:40	14.37	7.86	8.39	0.53	5.98	1.00		1
	14-May-96	10:45	14.37	8.59	8.62	0.03	5.75			
	14-May-96	11:50	14.37	8.26	8.34	0.08	6.03			
	20-Jun-96		14.37	7.9	9.40	1.50	4.97	4.00		0.25
	20-Jun-96		14.37	9.34	9.35	0.01	5.02			

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed	
	20-Jun-96		14.37	8.72	8.78	0.06	5.59			
PR-22	24-Feb-94	-	14.43	8.09	9.52	1.43	4.91			
	18-Mar-94	-	14.43	6.50	-	>3.0	-			
	2-Jun-94	-	14.43	8.71	9.61	0.90	4.82			
	31-Aug-94	-	14.43	9.69	10.16	0.47	4.27			
	22-Dec-94	-	14.43	8.34	8.38	0.04	6.05			
	13-Mar-95	-	14.43	7.70	8.30	0.60	6.13			
	9-Jun-95	-	14.43	8.06	8.77	0.71	5.66			
	27-Jul-95	-	14.43	8.08	8.76	0.68	5.67			
	22-Sep-95	-	14.43	9.08	9.79	0.71	4.64			
	6-Dec-95	-	14.43	9.95	10.02	0.07	4.41		2", no screen	
	18-Dec-95	-	14.43	9.17	9.24	0.07	5.19			
	18-Dec-95	3:05	14.43	9.16	9.25	0.09	5.18			
	19-Dec-95	9:00	14.43	9.21	9.31	0.10	5.12			
	19-Dec-95	10:00	14.43	9.54	9.57	0.03	4.86	0.10		1.4
	19-Dec-95	12:03	14.43	9.27	9.30	0.03	5.13			
	28-Dec-95	9:30	14.43	9.15	9.38	0.23	5.05			
	27-Feb-96	9:00	14.43	6.21	7.78	1.57	6.65			
	27-Feb-96	10:00	14.43	-	7.58	-	6.85	1.00		0.5
	29-Feb-96	-	14.43	6.60	7.54	0.94	6.89			
	16-Apr-96	12:53	14.43	6.55	9.32	2.77	5.11	7.00		0.25
	16-Apr-96	13:05	14.43	8.59	8.88	0.29	5.55			
	16-Apr-96	13:56	14.43	6.89	7.69	0.80	6.74	0.50		0.5
	16-Apr-96	14:02	14.43	-	7.69	0.00	6.74			
	24-Apr-96	12:15	14.43	7.28	7.71	0.43	6.72	0.25		0.25
	24-Apr-96	12:18	14.43	7.56	7.57	0.01	6.86			
	24-Apr-96	13:22	14.43	6.95	7.69	0.74	6.74	0.50		0.25
	24-Apr-96	13:26	14.43	7.52	7.53	0.01	6.90			
	29-Apr-96		14.43	6.97	7.22	0.25	7.21	0.75		0.13
	29-Apr-96		14.43	-	7.60	-	6.83			
	29-Apr-96		14.43	7.10	7.70	0.60	6.73	0.50		0.5
	29-Apr-96		14.43	-	7.58	-	6.85			
	7-May-96	9:42	14.43	7.18	7.87	0.69	6.56	0.50		0.5
	7-May-96	9:46	14.43	7.76	7.90	0.14	6.53			
	7-May-96	10:37	14.43	7.22	7.85	0.63	6.58	0.25		0.25
	7-May-96	10:41	14.43	7.71	7.73	0.02	6.70			
	14-May-96	10:47	14.43	7.30	7.99	0.69	6.44	0.50		0.5
	14-May-96	10:52	14.43	7.83	8.11	0.28	6.32	0.25		0.25
	14-May-96	10:55	14.43	7.90	8.14	0.24	6.29			
	14-May-96	11:51	14.43	7.45	7.76	0.31	6.67	0.25		0.25
	14-May-96	11:55	14.43	-	7.75	-	6.68			
	20-Jun-96		14.43	7.58	8.78	1.20	5.65	3.50		0.25
	20-Jun-96		14.43	-	8.85	-	5.58			
	20-Jun-96		14.43	7.88	8.03	0.15	6.40			
PR-23	24-Feb-94	-	14.47	8.40	8.76	0.36	5.71			
	18-Mar-94	-	14.47	6.72	7.78	1.06	6.69			
	2-Jun-94	-	14.47	8.71	9.09	0.38	5.38			
	31-Aug-94	-	14.47	9.51	9.68	0.17	4.79			
	22-Dec-94	-	14.47	7.97	8.03	0.06	6.44			
	13-Mar-95	-	14.47	5.81	6.15	0.34	8.32			
	9-Jun-95	-	14.47	7.54	7.60	0.06	6.87			
	27-Jul-95	-	14.47	8.02	8.10	0.08	6.37			
	22-Sep-95	-	14.47	8.56	8.68	0.12	5.79			
	6-Dec-95	-	14.47	9.35	9.46	0.11	5.01		2", no screen; some wat	
	18-Dec-95	-	14.47	9.33	9.43	0.10	5.04	0.25		
	18-Dec-95	1:43	14.47	9.57	9.59	0.02	4.88			
	18-Dec-95	3:06	14.47	9.33	9.35	0.02	5.12			
	19-Dec-95	9:00	14.47	9.22	9.24	0.02	5.23	0.00		

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed	
	19-Dec-95	10:05	14.47	-	9.66	-	4.81			1.5
	19-Dec-95	12:05	14.47	9.30	9.31	0.01	5.16			
	28-Dec-95	9:30	14.47	-	8.80	-	5.67			
	27-Feb-96	-	14.47	-	7.70	-	6.77			
	16-Apr-96	13:09	14.47	7.62	7.63	0.01	6.84			
	24-Apr-96	13:09	14.47	-	7.44	-	7.03			
	29-Apr-96		14.47	7.22	7.23	0.01	7.24			
	7-May-96	9:47	14.47	7.09	7.18	0.01	7.29			
	14-May-96	10:56	14.47	7.22	7.25	0.01	7.22			
	20-Jun-96		14.47	-	6.66	0.01	7.81			
PR-26	24-Feb-94	-	14.38	8.51	9.05	0.54	5.33			
	18-Mar-94	-	14.38	6.54	8.59	2.05	5.79			
	2-Jun-94	-	14.38	9.02	9.41	0.39	4.97			
	31-Aug-94	-	14.38	9.68	9.85	0.17	4.53			
	22-Dec-94	-	14.38	-	8.04	-	6.34			
	13-Mar-95	-	14.38	-	6.54	-	7.84			
	9-Jun-95	-	14.38	-	7.77	-	6.61			
	22-Sep-95	-	14.38	9.31	9.44	0.13	4.94			
	6-Dec-95	-	14.38	9.97	10.09	0.12	4.29		2", no screen showing	
	18-Dec-95	-	14.38	9.38	9.48	0.10	4.90			
	18-Dec-95	1:48	14.38	9.51	9.53	0.02	4.85	0.50		
	18-Dec-95	3:07	14.38	9.33	9.34	0.01	5.04			
	19-Dec-95	-	14.38	9.26	9.29	0.03	5.09			
	19-Dec-95	10:10	14.38	9.49	9.50	0.01	4.88	0.25		1.5
	19-Dec-95	12:04	14.38	9.33	9.34	0.01	5.04			
	28-Dec-95	9:30	14.38	-	9.18	-	5.20			
	27-Feb-96	9:00	14.38	6.90	7.17	0.27	7.21			
	27-Feb-96	10:00	14.38	-	7.20	-	7.18	0.50		0.5
	29-Feb-96	-	14.38	-	6.80	-	7.58			
	16-Apr-96	13:18	14.38	6.55	6.85	0.30	7.53			
	24-Apr-96	12:36	14.38	6.83	7.06	0.23	7.32	0.25		0.25
	24-Apr-96	12:39	14.38	-	7.28	-	7.10			
	24-Apr-96	13:33	14.38	-	7.13	-	7.25			
	29-Apr-96		14.38	7.24	7.26	0.02	7.12			
	7-May-96	9:56	14.38	7.35	7.38	0.03	7.00			
	14-May-96	11:09	14.38	7.47	7.47	-	6.91			
	20-Jun-96		14.38	7.77	7.78	0.01	6.60			
						0.00	0.00			
PR-34	24-Feb-94	-	14.49	8.37	9.54	1.17	4.95			
	18-Mar-94	-		6.2	9.01	2.81	5.48			
	2-Jun-94	-		8.96	10.03	1.07	4.46			
	31-Aug-94	-		9.72	10.09	0.37	4.40			
	22-Dec-94	-		7.51	9.96	2.45	4.53			
	13-Mar-95	-		5.38	9.44	4.06	5.05			
	9-Jun-95	-		6.35	9.89	3.54	4.60			
	27-Jul-95	-		7.65	9.95	2.30	4.54			
	22-Sep-95	-		9.00	10.03	1.03	4.46			
	6-Dec-95	-		10.89	11.16	0.27	3.33		2", w/ ~ .8' stickup	
	18-Dec-95	-		10.06	10.58	0.52	3.91	0.75	(bailer shows .2' of prod	
	18-Dec-95	11:40		11.00	11.01	0.01	3.48			
	18-Dec-95	11:50		10.80	10.85	0.05	3.64			
	18-Dec-95	12:21		10.49	10.50	0.01	3.99			
	18-Dec-95	12:45		10.39	10.46	0.07	4.03			
	18-Dec-95	1:50		10.26	10.34	0.08	4.15			
	18-Dec-95	3:09		10.21	10.31	0.10	4.18			
	19-Dec-95	9:00		10.20	10.36	0.16	4.13			
	19-Dec-95	10:20		9.83	9.84	0.01	4.65	0.20		1.3
	19-Dec-95	12:07		10.28	10.32	0.04	4.17			
	28-Dec-95	9:30		10.08	10.66	0.58	3.83			

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed
	27-Feb-96	9:00		3.37	8.47	5.10	6.02		
	27-Feb-96	10:00		9.45	9.60	0.15	4.89	5.70	1
	29-Feb-96	-		7.23	8.45	1.22	6.04		
	16-Apr-96	13:20		6.26	9.73	3.47	4.76	4.25	0.25
	16-Apr-96	13:31		9.14	9.28	0.14	5.21		
	16-Apr-96	14:03		7.76	8.02	0.26	6.47		
	24-Apr-96	12:30		7.2	8.19	0.99	6.30	1.00	0.5
	24-Apr-96	12:35		8.26	8.30	0.04	6.19		
	24-Apr-96	13:29		7.61	7.76	0.15	6.73	0.25	0.5
	24-Apr-96	13:32		7.92	7.92	-	6.57		
	29-Apr-96			7.47	7.85	0.38	6.64	0.25	0.25
	29-Apr-96			-	8.00	-	6.49		
	29-Apr-96			7.59	7.72	0.13	6.77	0.13	0.5
	29-Apr-96			-	8.00	-	6.49		
	7-May-96	9:51		7.54	7.98	0.44	6.51	0.50	0.5
	7-May-96	9:54		-	8.18	-	6.31		
	7-May-96			7.78	7.91	0.13	6.58	<0.25	0.5
	7-May-96			-	8.15	-	6.34		
	14-May-96	11:10		7.67	8.13	0.46	6.36	0.50	0.5
	14-May-96	11:14		8.32	8.35	0.03	6.14		
	14-May-96	11:59		7.91	8.00	0.09	6.49		
	20-Jun-96			7.57	9.52	1.95	4.97	2.00	0.5
	20-Jun-96			-	9.50	-	4.99		
	20-Jun-96			8.17	8.59	0.42	5.90		
PR-35	24-Feb-94	-	14.55	8.37	9.63	1.26	4.92		
	18-Mar-94	-		6.56	-	>3.0	-		
	2-Jun-94	-		7.50	9.20	1.70	5.35		
	31-Aug-94	-		9.78	9.90	0.12	4.65		
	22-Dec-94	-		8.16	8.29	0.13	6.26		
	13-Mar-95	-		6.25	7.10	0.85	7.45		
	9-Jun-95	-		7.63	8.54	0.91	6.01		
	27-Jul-95	-		8.04	8.88	0.84	5.67		
	22-Sep-95	-		9.10	9.83	0.73	4.72		
	6-Dec-95	-		9.87	10.27	0.40	4.28		2", no screen showing
	18-Dec-95	-		9.20	9.53	0.33	5.02	0.80	
	18-Dec-95	11:45		10.21	10.22	0.01	4.33		
	18-Dec-95	12:20		9.96	10.03	0.07	4.52		
	18-Dec-95	12:46		9.86	9.93	0.07	4.62		
	18-Dec-95	13:50		9.68	9.76	0.08	4.79		
	18-Dec-95	15:10		9.58	9.65	0.07	4.90		
	19-Dec-95	9:00		9.34	9.42	0.08	5.13		
	19-Dec-95	10:15		10.49	10.52	0.03	4.03	0.30	0.5 (depths rcrdd 15 min
	19-Dec-95	12:06		9.60	9.62	0.02	4.93		
	28-Dec-95	9:30		9.22	9.29	0.07	5.26		
	27-Feb-96	9:00		7.23	7.43	0.20	7.12	0.50	0.5
	27-Feb-96	10:00		7.23	7.24	0.01	7.31		
	29-Feb-96	-		6.55	6.66	0.11	7.89		
	16-Apr-96	13:13		7.07	7.34	0.27	7.21		
	24-Apr-96	12:25		7.06	7.40	0.34	7.15	0.75	0.25
	24-Apr-96	12:29		7.55	7.56	0.01	6.99		
	24-Apr-96	13:27		7.29	7.32	-	7.23		
	29-Apr-96			7.19	7.28	0.09	7.27	0.13	1
	29-Apr-96			-	7.80	-	6.75		
	7-May-96	9:49		7.29	7.37	0.08	7.18		
	14-May-96	10:58		7.41	7.54	0.13	7.01	0.25	0.25
	14-May-96	11:01		7.63	7.65	0.02	6.90		
	14-May-96	11:56		7.52	7.56	0.04	6.99		
	20-Jun-96			7.66	7.88	0.22	6.67	0.50	0.75
	20-Jun-96			-	9.25	-	5.30		

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed	
	20-Jun-96			7.91	7.95	0.04	6.60			
PR-36	24-Feb-94	-	14.40	8.35	9.48	1.13	4.92			
	18-Mar-94	-		6.83	8.26	1.43	6.14			
	2-Jun-94	-		8.63	9.76	1.13	4.64			
	31-Aug-94	-		9.72	10.09	0.37	4.31			
	22-Dec-94	-		8.08	8.27	0.19	6.13			
	13-Mar-95	-		6.76	6.91	0.15	7.49			
	9-Jun-95	-		7.81	8.04	0.23	6.36			
	27-Jul-95	-		7.7	7.92	0.22	6.48			
	22-Sep-95	-		-	dry	-	-			
	6-Dec-95	-		-	dry	-	-		2", no screen	
	18-Dec-95	-		-	dry	-	-			
	28-Dec-95	9:30		-	dry	-	-			
	27-Feb-96	9:00		6.9	7.10	0.20	7.30			
	27-Feb-96	10:00		-	7.50	-	-	0.5		0.5
	29-Feb-96	-		6.59	6.64	0.05	7.76			
	16-Apr-96	12:27		6.85	6.98	0.13	7.42			
	24-Apr-96	11:59		6.9	7.01	0.11	7.39	0.25		0.75
	24-Apr-96	12:03		7.26	7.28	0.02	7.12			
	24-Apr-96	13:15		7.15	7.19	0.04	7.21			
	29-Apr-96			7.2	7.27	0.07	7.13	0.13		0.25
	29-Apr-96			-	7.46	-	6.94			
	7-May-96	9:33		7.31	7.34	0.03	7.06			
	14-May-96	10:39		7.43	7.47	0.04	6.93			
	20-Jun-96			7.7	7.71	0.01	6.69			
PR-37	24-Feb-94	-	14.29	8.19	9.48	1.29	4.81			
	18-Mar-94	-		6.05	8.40	2.35	5.89			
	2-Jun-94	-		8.64	9.60	0.96	4.69			
	31-Aug-94	-		9.67	9.81	0.14	4.48			
	22-Dec-94	-		8.02	8.24	0.22	6.05			
	13-Mar-95	-		6.44	7.27	0.83	7.02			
	9-Jun-95	-		7.65	8.47	0.82	5.82			
	27-Jul-95	-		8.02	8.60	0.58	5.69			
	22-Sep-95	-		9.02	9.60	0.58	4.69			
	6-Dec-95	-		-	9.85	-	4.44		2", no screen	
	18-Dec-95	-		9.03	9.15	0.12	5.14			
	18-Dec-95	1:39		9.22	9.24	0.02	5.05	0.50	(0:12) (?)	
	18-Dec-95	3:03		9.12	9.14	0.02	5.15			
	19-Dec-95	9:00		9.04	9.10	0.06	5.19			
	19-Dec-95	11:55		9.30	9.31	0.01	4.98	0.05		0.4
	19-Dec-95	12:24		9.22	9.25	0.03	5.04			
	28-Dec-95	9:30		9.07	9.25	0.18	5.04			
	27-Feb-96	9:00		6.28	7.42	1.14	6.87			
	27-Feb-96	10:00		7.62	7.64	0.02	6.65	1.00		0.5
	29-Feb-96	-		6.40	6.72	0.32	7.57			
	16-Apr-96	12:29		6.85	6.98	0.13	7.31	0.25		0.75
	16-Apr-96	12:33		7.40	7.41	0.01	6.88			
	16-Apr-96			6.67	6.96	0.29	7.33			
	24-Apr-96	12:04		6.95	7.10	0.15	7.19	<0.25		0.5
	24-Apr-96	12:08		7.24	7.25	0.01	7.04			
	24-Apr-96	13:16		7.03	7.11	0.08	7.18			
	29-Apr-96			7.09	7.14	0.05	7.15	0.13		0.25
	29-Apr-96			-	7.31	-	6.98			
	7-May-96	9:36		7.19	7.24	0.05	7.05			
	14-May-96	11:02		7.3	7.40	0.10	6.89	<0.25		0.5
	14-May-96	11:06		7.51	7.75	0.24	6.54			
	14-May-96	11:58		7.4	7.45	0.05	6.84			
	20-Jun-96			7.55	7.75	0.20	6.54	0.50		0.5

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed	
	20-Jun-96			-	8.00	-	6.29			
	20-Jun-96			7.66	7.72	0.06	6.57			
PR-48	24-Feb-94	-		8.93	9.13	0.20				
	18-Mar-94	-		6.73	-	>3.0				
	2-Jun-94	-		8.95	9.78	0.83				
	31-Aug-94	-		10.04	10.11	0.07				
	22-Dec-94	-		8.39	9.82	1.43				
	13-Mar-95	-		5.16	5.80	0.64				
	9-Jun-95	-		6.46	7.11	0.65				
	27-Jul-95	-		8.4	9.34	0.94				
	22-Sep-95	-		9.39	9.89	0.50				
	6-Dec-95	-		10.32	10.86	0.54				
	18-Dec-95	-		9.65	10.05	0.40				
	18-Dec-95	12:17		10.44	10.46	0.02		1.00		
	18-Dec-95	12:47		10.35	10.41	0.06				
	18-Dec-95	14:57		10.24	10.31	0.07				
	19-Dec-95	9:00		9.89	9.97	0.08				
	19-Dec-95	11:00		10.05	10.06	0.01		0.15		0.40
	19-Dec-95	12:13		10.03	10.07	0.04				
	27-Feb-96	9:00		6.83	6.94	0.11		0.25		0.50
	27-Feb-96	10:00		-	7.34	-				
	29-Feb-96	-		6.93	6.99	0.06				
	16-Apr-96	12:09		6.80	8.05	1.25		2.00		1
	16-Apr-96	12:18		-	9.00	-				
	16-Apr-96	13:49		8.01	8.37	0.36				
	24-Apr-96	11:47		7.22	8.21	0.99		1.00		0.5
	24-Apr-96	11:52		8.46	8.47	0.01				
	24-Apr-96	13:05		8.01	8.23	0.22		0.25		0.25
	24-Apr-96	13:10		-	8.47	-				
	29-Apr-96			7.35	7.90	0.55		1.00		0.5
	29-Apr-96			-	8.55	-				
	29-Apr-96			8.17	8.27	0.10		0.06		0.25
	29-Apr-96			-	8.84	-				
	7-May-96	9:23		7.40	8.23	0.83		0.75		0.25
	7-May-96	9:28		8.41	8.41	-				
	7-May-96	10:31		8.13	8.33	0.20		0.25		0.25
	7-May-96	10:34		-	8.44	-				
	14-May-96	10:28		7.53	8.29	0.76		0.75		1
	14-May-96	10:33		-	9.04	-				
	14-May-96	11:44		8.70	8.78	0.08				
	20-Jun-96			7.44	9.50	2.06		3.00		0.5
	20-Jun-96			-	9.80	-				
	20-Jun-96			9.30	9.55	0.25				
PR-53	24-Feb-94	-		8.73	11.74	3.01				
	18-Mar-94	-		6.49	-	>3.0	-			
	2-Jun-94	-		9.02	9.63	0.61				
	31-Aug-94	-		9.73	10.22	0.49				
	22-Dec-94	-		7.96	9.48	1.52				
	13-Mar-95	-		-	5.42	-				
	9-Jun-95	-		6.76	8.31	1.55				
	27-Jul-95	-		7.92	9.39	1.47				
	22-Sep-95	-		8.81	9.89	1.08				
	6-Dec-95	-		-	9.95	-			2', no screen showing	
	18-Dec-95	-		9.35	9.47	0.12				
	18-Dec-95	14:00		9.51	9.53	0.02		0.10		
	18-Dec-95	15:11		9.44	9.49	0.05				
	19-Dec-95	9:00		9.40	9.44	0.04				
	19-Dec-95	10:30		-	9.56	-		0.05		1.00

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed
	19-Dec-95	12:08		9.46	9.50	0.04			
	28-Dec-95	9:30		9.25	9.42	0.17			
	27-Feb-96	9:00		6.35	7.25	0.90		0.50	0.50
	27-Feb-96	10:00		-	8.45	-			
	29-Feb-96	-		6.63	6.90	0.27			
	16-Apr-96		Well could not be sampled						
	24-Apr-96	11:19		6.95	7.70	0.75		0.50	0.5
	24-Apr-96	11:24		-	8.20	-			
	24-Apr-96	13:03		7.3	7.35	0.05			
	29-Apr-96			7.11	7.55	0.44		0.50	0.5
	29-Apr-96			-	8.54	-			
	7-May-96	8:52		7.21	7.66	0.45		0.25	0.25
	7-May-96	8:56		-	7.93	-			
	7-May-96	10:22		7.55	7.56	0.01			
	14-May-96	9:59		7.37	7.69	0.32		0.25	0.5
	14-May-96	10:04		-	8.32	-			
	14-May-96	11:42		-	7.68	-			
	20-Jun-96			7.47	8.48	1.01		0.75	0.25
	20-Jun-96			-	8.60	-			
	20-Jun-96			-	8.00	-			
PR-58	24-Feb-94	-		8.34	9.19	0.85			
	2-Jun-94	-		8.45	9.93	1.48			
	31-Aug-94	-		9.40	10.29	0.89			
	22-Dec-94	-		7.82	9.97	2.15			
	13-Mar-95	-		5.76	7.17	1.41			
	9-Jun-95	-		6.04	7.38	1.34			
	27-Jul-95	-		7.48	9.88	2.40			
	22-Sep-95	-		8.82	10.00	1.18			
	18-Dec-95	-		9.34	9.55	0.21			
		2:50		-	9.71	-		0.25	
		3:13		9.56	9.57	0.01			
	19-Dec-95	9:00		9.35	9.50	0.15			
		10:45		-	9.58	-		0.10	0.2
		12:10		9.46	9.50	0.04			
	28-Dec-95	9:30		9.27	9.84	0.57			
	27-Feb-96	9:00		5.93	8.60	2.67		7.50	0.5
		10:00		8.94	9.00	0.06			
	29-Feb-96	-		6.30	7.55	1.25			
	16-Apr-96	10:30		5.74	8.42	2.68		2.50	0.5
	16-Apr-96	10:35		8.82	8.95	0.13			
	16-Apr-96	11:00		7.78	8.06	0.28			
	16-Apr-96	13:34		6.64	7.11	0.47			
	24-Apr-96	10:52		6.46	7.80	1.34		1.00	0.5
	24-Apr-96	10:58		8.08	8.10	0.02			
	24-Apr-96	12:52		7	7.24	0.24		0.25	0.25
	24-Apr-96	12:56		7.38	7.38	-			
	29-Apr-96			6.58	7.45	0.87		1.00	0.5
	29-Apr-96			-	7.89	-			
	7-May-96	8:24		6.56	7.83	1.27		1.00	
	7-May-96	8:30		7.83	7.87	0.04			
	7-May-96	10:10		7.16	7.42	0.26		<0.25	0.25
	7-May-96	10:14		7.71	7.72	0.01			
	14-May-96	9:23		6.72	7.89	1.17		0.75	0.25
	14-May-96	9:32		8.01	8.05	0.04			
	14-May-96	11:32		7.3	7.52	0.22		0.25	0.25
	14-May-96	11:35		-	7.81	-			
	20-Jun-96			6.57	9.36	2.79		2.00	0.25
	20-Jun-96			9.5	9.51	0.01			
	20-Jun-96			8.77	9.13	0.36			

TABLE 1 RESULTS OF GAUGING, NESTLE COMPANY FORMER CARNATION MILK PLANT, 1310 14TH STREET OAKLAND, 1994-1996

Well No.	Date	Time	TOC Elev.	Depth to Prod.	Depth to Water	Product Thick.	GW	NAPL Bailed (l)	Water Bailed
PR-61	24-Feb-94	-		8.75	9.14	0.39			
	18-Mar-94	-		7.28	7.63	0.35			
	2-Jun-94	-		9.01	10.04	1.03			
	31-Aug-94	-		-	10.08	-			
	22-Dec-94	-		8.37	8.38	0.01			
	13-Mar-95	-		-	4.86	-			
	9-Jun-95	-		-	5.12	-			
	27-Jul-95	-		8.23	9.53	1.30			
	22-Sep-95	-		-	9.40	-			
	6-Dec-95	-		-	10.00	-			2", no screen showing
	27-Feb-96	9:00		6.26	7.74	1.48			
	27-Feb-96	10:00		7.94	7.98	0.04		3.80	0.5
	29-Feb-96	-		6.60	7.05	0.45			
	16-Apr-96	10:38		6.80	8.03	1.23		2.20	0.5
	"	10:45		7.72	7.90	0.18			
		13:36		6.98	7.50	0.52			
	24-Apr-96	10:23		7.24	7.97	0.73		0.50	0.5
	24-Apr-96	10:43		7.81	7.94	0.13			
	24-Apr-96	12:43		7.34	7.65	0.31		0.25	0.25
	24-Apr-96	12:49		7.63	7.67	0.04			
	29-Apr-96			7.45	7.78	0.33		0.50	1
	29-Apr-96			-	8.19	-			
	29-Apr-96			7.65	7.74	0.09		0.13	0.13
	29-Apr-96			-	7.88	-			
	7-May-96	8:04		7.56	7.87	0.31		0.50	0.5
	7-May-96	8:21		7.92	7.93	0.01			
	7-May-96	10:01		7.59	7.78	0.19		<0.25	0.25
	7-May-96	10:07		-	7.91	-			
	14-May-96	9:01		7.68	7.97	0.29		0.50	1
	14-May-96	9:17		-	8.35	-			
	14-May-96	11:22		7.74	7.87	0.13		<0.25	0.25
	14-May-96	11:30		-	8.01	-			
	20-Jun-96			7.84	9.80	1.96		1.50	0.25
	20-Jun-96			8.85	8.87	0.02			
	20-Jun-96			8.3	8.51	0.21			
PR-64	24-Feb-94	-		8.94	9.05	0.11			
	18-Mar-94	-		6.43	-	>3.0	-		
	31-Aug-94	-		9.85	10.91	1.06			
	22-Dec-94	-		8.09	10.24	2.15			
	13-Mar-95	-		5.55	6.58	1.03			
	9-Jun-95	-		7.89	9.06	1.17			
	27-Jul-95	-		8.55	10.67	2.12			
	22-Sep-95	-		9.70	10.85	1.15			
	6-Dec-95	-		-	11.10	-			2", no screen, ~1' sticku
	18-Dec-95	-		10.13	10.55	0.42			
	18-Dec-95	2:42		-	11.81	-		0.50	
	18-Dec-95	3:12		-	10.66	-			
	19-Dec-95	9:00		10.19	10.31	0.12			
	19-Dec-95	10:35		-	11.70	-		0.20	2
	19-Dec-95	12:09		-	10.30	-			
	28-Dec-95	9:30		9.74	10.32	0.58			
	27-Feb-96	9:00		6.36	9.44	3.08			
	27-Feb-96	10:00		9.75	9.80	0.05		3.80	0.5
	29-Feb-96	-		6.82	7.22	0.40			
	16-Apr-96	11:26	20.15	6.03	10.15	4.12		3.50	1.5
	16-Apr-96	13:40		6.71	7.94	1.23		0.50	0.25
	16-Apr-96	13:45		7.65	7.68	0.03			

TABLE 2 AMOUNTS (liters) OF NAPL BAILED FROM WELLS AT THE NESTLE SITE, OAKLAND, CALIFORNIA, 6 DECEMBER 1995--20 JUNE 1996

	Sampling Date						
Well	6 Dec--16 Apr	24-Apr-96	29-Apr-96	7-May-96	14-May-96	20-Jun-96	Total
E0	38		0.5			1	39.5
E5	19.9					0.2	20.1
MW8	0.7						0.7
MW23	2.35	0.5	0.25	0.38	0.38	0.75	4.6
MW24	0		1.5			1	2.5
PR20	1.9		13			5.75	20.7
PR21	16.9	3.25	1	1	1	4	27.2
PR22	8.6	0.75	0.75	0.75	1	3.5	15.4
PR23	0.25						0.3
PR26	1.25	0.25					1.5
PR34	10.9	1.25	0.25	0.63	0.5	2	15.5
PR35	1.6	0.75	0.13		0.25	0.5	3.2
PR36	0.5	0.25	0.13				0.9
PR37	1.8	0.25	0.13		0.13	0.5	2.8
PR48	3.4	1.25	1	1	0.75	3	10.4
PR53	0.65	0.5	0.5	0.25	0.25	0.75	2.9
PR58	10.4	1.25	1	1.2	1	2	16.9
PR61	6	0.75	0.5	0.2	0.63	1.5	9.6
PR64	8.5	3.5	2.5	3	2	2.75	22.3
Total (liters)	134	15	23	8	8	29	217
Total (gal)	35	4	6	2	2	8	57

TABLE 3 SUMMARY OF PILOT TEST RESULTS, NESTLE FORMER CARNATION DAIRY FACILITY, OAKLAND, CALIFORNIA, 1-5 APRIL 1996

Well Number	Radius of Influence (feet) ri(1% applied)	ri(0.1)	Average Soil Permeability (darcy)	TVH Conccentration (ppmv) Initial	Final	TVH Mass Removal Rate (lb/day) Initial	Final	Test Vacuum (in. H_2O)	Test Flow (CFM)	Test duration (hr:min)
MW22 VE	6	19	5.2	178	110	0.18	0	26	3	1:10
MW23 VE	25	42	32.5	3,440	1,900	57.0	31	72	48	0:50
PR47 VE	19	40	14.6	1,700	1,020	11.14	7	59	19	1:00
PR48 VE	8	38	4.1	15,320	13,400	37.0	32	80	7	1:00
PR51 VE	NC	12	2	300,000	84,000	207.0	58	46	2	1:00
PR53 VE	16	36	4.4	14,000	420	19.3	1	45	4	0:55
PR58 VE	<5	<5	2.6	7,000	860	14.0	2	125	5.8	0:55
PR61 VE	NC	NC	5.3	20,000	30,000	43.5	65	58	6.3	0:30
PR64 VE	<5	25	3.2	280,000	80,000	260.8	75	38	2.7	0:25
PR68 VE	NC	NC	5.3	3,200	6,000	5.9	11	50	5.3	0:30
V12 VE	NC	>70	6	10	10	0.08	0	60	22	0:40
V21 VE	18	31	11.5	46	62	0.44	1	36	28	0:20
V4 VE	32	52	7.7	300	480	2.38	4	42	23	0:20
V55 VE	<5	36	3.5	3,500	3,560	11.5	12	38	9.5	0:40
V7 VE	<5	<5	6.2	25	20	0.31	0	86	36	0:20
V78a VE	22	74	5.4	90	166	0.78	1	60	25	1:23
V90 VE	16	31	6	10	38	0.08	0	45	24	0:20
V94 VE	20	78	17.7	1,020	280	27.1	7	72	77	0:50
Man1 VE	--	--	--	162	180	0.78	1	56	14	1:10
Man1 VE/AS2	--	--	--	212	18,000	1.02	87	56	14	2:00
Man2 VE	--	--	--	1,340	460	18.95	7	30	41	0:50
Man2 VE/AS3	--	--	--	3,280	12,000	48.7	178	32	43	1:30
Mean total	18	40	8	3,323	1,888	39	17	58	19	
Mean V wells	22	50	8	625	577	5	3	55	31	
Mean PR/MW wells	15	31	8	6,405	3,387	66	28	60	10	

Man1 refers to vapor extraction wells PR61, PR68, PR58, V21, and V90 manifolded together.

Man2 refers to vapor extraction wells PR47, PR48, PR45, V5, and V77 manifolded together.

VE refers to samples collected during vapor extraction only; VE/AS refers to samples collected during air sparging and vapor extraction simultaneously.

Radius of influence-ri(x)=feet x = Pressure in inches of water.

-- Was not measured

NC - Not calculated due to lack of data or poor regression.

Note: mean TVH concentrations and mass removal rates do not include wells in which NAPL was suspected in the vapor extraction stream.

TABLE 4 NESTLE FORMER CARNATION DAIRY FACILITY PILOT SOIL VAPOR EXTRACTION TEST, CONCENTRATIONS OF TOTAL VOLATILE HYDROCARBONS (TVH), OXYGEN, AND CARBON DIOXIDE IN SOIL VAPOR SAMPLES (FIELD ANALYSES), OAKLAND, CALIFORNIA

Monitor Location	Date	Elapsed Time (min)	Unidentified Peaks Prior to Benzene[a] (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethyl-benzene (ppmv)	Total Xylenes (ppmv)	Unidentified Peaks After Benzene[a] (ppmv)	TVH[b] (ppmv)	TVH[c] (ppmv)	O_2 (%)	CO_2 (%)	notes
V78a VE-1	4/1/96	10	45	2	2	<1	<1	40	89	90	13.5	>5	
V78a VE-2	4/1/96	20	52	3	3	<1	<1	45	103	200	14.8	>5	
V78a VE-3	4/1/96	83	45	3	3	<1	<1	40	91	166	15.7	>5	
PR47 VE-1	4/1/96	20	500	100	170	20	80	1,000	1,870	1,700	12	>5	
PR47 VE-2	4/1/96	30	330	90	100	5	20	500	1,045	1,340	14	>5	
PR47 VE-3	4/1/96	60	250	80	80	2	10	400	822	1,020	15	>5	
MW22 VE-1	4/1/96	0	16	<10	6	<1	4	17	43	178	10.5	8	
MW22 VE-2	4/1/96	30	26	15	15	1	7	25	89	220	14.1	5	
PR48 VE-1	4/2/96	0	5,000	<2,000	2,000	<1,000	<1,000	20,000	27,000	15,000	0.6	11.5	
PR48 VE-2	4/2/96	20	1,500	200	4,000	1,000	2,000	3,000	11,700	24,600	4.6	9.2	
PR48 VE-3	4/2/96	40	1,000	200	6,000	2,000	4,000	5,000	18,200	12,400	4.3	9.8	
PR48 VE-4	4/2/96	60	800	200	3,000	1,000	2,000	3,000	10,000	13,600	4.3	10.2	
V4 VE-1	4/2/96	0	85	<20	4	<1	<1	20	109	300	8.7	7.3	
V4 VE-2	4/2/96	10	120	<20	8	<1	<1	50	178	380	9.5	7.7	
V4 VE-3	4/2/96	20	130	<20	12	<5	<5	80	222	480	11.0	7.1	
V4 VE-4	4/2/96		150	<20	10	<5	<5	50	210				
V7 VE-1	4/2/96	0	<1	<1	1	<1	<1	1	2	25	18.6	0.2	
V7 VE-2	4/2/96	20	<1	<1	1	<1	<1	1	2	20	18.0	0.6	
MW23 VE-1	4/2/96	0	300	<100	100	<100	<100	100	500	3,440	5.7	8.5	
MW23 VE-2	4/2/96	20	600	<200	160	10	30	1,300	2,100	2,220	5.7	8.2	
MW23 VE-3	4/2/96	40	400	<200	200	100	200	300	1,200	2,660	6.9	8.2	
PR51 VE-1	4/2/96	0	25,000	<4,000	4,000	400	1,000	20,000	50,400	300,000	3.1	8.1	
PR51 VE-2	4/2/96	30	23,000	<4,000	11,000	400	1,000	15,000	50,400	134,000	5.1	7.6	
PR51 VE-3	4/2/96	40	30,000	<4,000	4,000	400	1,000	15,000	50,400	116,000	5.1	7.6	
PR51 VE-4	4/2/96	60	30,000	<4,000	14,000	1,000	2,000	30,000	77,000	84,000	5.2	7.8	

notes:

a. Quantification based on response factor for toluene.

b. *Summation of all detected constituents.*

c. Foxboro Organic Vapor Analyzer reading

TABLE 4 (continued)

Monitor Location	Date	Elapsed Time (min)	Unidentified Peaks Prior to Benzene[a] (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethyl-benzene (ppmv)	Total Xylenes (ppmv)	Unidentified Peaks After Benzene[a] (ppmv)	TVH[b] (ppmv)	TVH[c] (ppmv)	O_2 (%)	CO_2 (%)	notes
PR53 VE-1	4/2/96	0	950	<200	1,300	100	400	2,500	5,250	14,000	2.4	8.1	
PR53 VE-2	4/2/96	20	150	<200	500	200	600	500	1,950	3,600	4.4	7.6	
PR53 VE-3	4/2/96	40	200	<5	20	<5	10	50	280	620	6.3	7	
PR53 VE-4	4/2/96	55	120	<5	5	<5	<5	20	145	420	7	6.7	
V94 VE-1	4/2/96	20	120	<50	8	<1	<1	50	178	350	12.4	5.3	
V94 VE-2	4/2/96	40	150	<50	10	<1	<1	80	240	370	14.0	4.6	
V94 VE-3	4/2/96	50	150	<50	10	<1	<1	80	240	380	14.7	3.7	
PR64 VE-1	4/2/96	0				off scale				280,000	2.6	6.6	
PR64 VE-2	4/2/96	25	22,000	<4,000	8,000	<4,000	<4,000	24,000	54,000	80,000	2.1	7.3	
V21 VE-1	4/3/96	0	14	<1	<1	<1	<1	10	24	46	7.4	6.3	
V21 VE-2	4/3/96	10	36	<1	<1	<1	<1	15	51	78	10.6	5.3	
V21 VE-3	4/3/96	20	36	<1	<1	<1	<1	15	51	62	12.2	4.7	
V90 VE-1	4/3/96	0	10	<1	<1	<1	<1	<1	10	10	9.0	5.1	
V90 VE-2	4/3/96	10	4	<1	<1	<1	<1	<1	4	10	10.5	4.6	
V90 VE-3	4/3/96	20	10	<1	<1	<1	<1	<1	10	38	11.9	4.2	
PR58 VE-1	4/3/96	0	2,000	<100	50	100	400	250	2,800	7,000	18.8	0.2	
PR58 VE-2	4/3/96	10	60,000	<20,000	14,000	1,000	5,000	60,000	140,000	740,000	16.8	0.1	
PR58 VE-3	4/3/96	45	<100	<100	500	500	1,500	1,000	3,500	2,000	19.2	<0.1	
PR58 VE-4	4/3/96	55	110	<10	12	<5	15	100	237	860	19.5	<0.1	
PR68 VE-1	4/3/96	0	600	<500	650	30	150	900	2,330	3,200	19.3	<0.1	
PR68 VE-2	4/3/96	10	1,100	<1000	2,300	500	2,000	1,500	7,400	6,900	19.2	0.2	
PR68 VE-3	4/3/96	30	400	<400	900	100	500	600	2,500	6,000	19.2	<0.1	
PR61 VE-1	4/3/96	0	8,200	<400	200	<200	<200	1,000	9,400	20,000	15	2.8	
PR61 VE-2	4/3/96	20	6,200	<800	400	<200	<200	1,500	8,100	16,400	18.4	0.6	
PR61 VE-3	4/3/96	30	10,000	<1000	720	<200	<200	2,000	12,720	30,000	17.7	1.0	
V55 VE-1	4/3/96	0	450	<100	50	<100	<100	330	830	3,500	2.4	6.1	
V55 VE-2	4/3/96	20	560	<100	66	<100	<100	550	1,176	3,800	5.7	5.1	
V55 VE-3	4/3/96	40	500	<100	56	<100	<100	360	916	3,560	7.7	4.6	
V12 VE-1	4/3/96	0	<1	<1	<1	<1	<1	<1	<1	10	13.2	2.7	
V12 VE-2	4/3/96	20	<1	<1	<1	<1	<1	<1	<1	10	14	2.7	

TABLE 5 NESTLE FORMER CARNATION DAIRY FACILITY PILOT SOIL VAPOR EXTRACTION/AIR SPARGING TEST, CONCENTRATIONS OF TOTAL VOLATILE HYDROCARBONS (TVH), OXYGEN, AND CARBON DIOXIDE IN SOIL VAPOR SAMPLES (FIELD ANALYSES), OAKLAND, CALIFORNIA

Monitor Location	Date	Elapsed Time (min)	Unidentified Peaks Prior to Benzene[a] (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethyl-benzene (ppmv)	Total Xylenes (ppmv)	Unidentified Peaks After Benzene[a] (ppmv)	TVH[b] (ppmv)	TVH[c] (ppmv)	O_2 (%)	CO_2 (%)	notes
Man 1 VE-1	4/4/96	0	86	<10	3	<1	<1	17	106	162	15.1	2.9	
Man 1 VE-2	4/4/96	50	77	<10	<1	<1	<1	20	97	196			
Man 1 VE-3	4/4/96	60	80	<10	<20	<1	<1	23	103	180	15.8	2.5	
Man 1 VE-4	4/4/96	70	79	<10	<20	<1	<1	21	100	180	15.8	2.5	
Man 1 VE/AS2-1	4/4/96	10	85	<10	<20	<1	<1	21	106	212	16.4	2.2	
Man 1 VE/AS2-2	4/4/96	50	1,500	<200	<200	<200	<200	<1000	1,500	5,560	16.5	1.8	
Man 1 VE/AS2-3	4/4/96	60	1,600	<200	100	<200	<200	150	1,850	7,400	16.6	1.9	
Man 1 VE/AS2-4	4/4/96	90	4,700	<200	<200	<200	<200	<1000	4,700	13,300	16.5	1.9	
Man 1 VE/AS2-5	4/4/96	120	6,100	<200	<200	<200	<200	<1000	6,100	18,000	16.4	1.9	
Man 2 VE-1	4/5/96	0	200	20	20	<5	<5	100	340	1,340	10.5	5.9	
Man 2 VE-2	4/5/96	10	150	15	15	<5	<5	80	260	840	12.2	4.9	
Man 2 VE-3	4/5/96	30	100	10	10	<5	<5	60	180	580	13.7	3.9	
Man 2 VE-4	4/5/96	50	68	7	7	<5	<5	40	122	460	14.6	3.4	
Man 2 VE	4/5/96	50		8	16	1.3	11.1						d
Man 2 VE/AS3-1	4/5/96	10	900	<200	150	10	30	600	1,690	3,280	15.4	3	
Man 2 VE/AS3-2	4/5/96	30	1,000	20	50	<100	<100	100	1,170	5,400	15.9	2.6	
Man 2 VE/AS3-3	4/5/96	40	2,700	30	40	<100	<100	100	2,870	10,760	15.7	2.7	
Man 2 VE/AS3-4	4/5/96	50	4,300	40	40	<100	<100	200	4,580	15,500	15.7	2.7	
Man 2 VE/AS3-5	4/5/96	70	5,700	80	50	<100	<100	400	6,230	18,900	15.9	2.7	
Man 2 VE/AS3-6	4/5/96	80	6,100	40	40	<100	<100	300	6,480	20,100	15.9	2.6	
Man 2 VE/AS3	4/5/96	80		49	43	<2.2	11.4						d
Man 2 VE-5	4/5/96	10	4,200	40	150	<100	<100	400	4,790	15,600	16.4	2.3	e
Man 2 VE-6	4/5/96	30	2,300	30	30	<100	<100	200	2,560	12,000	16.7	2.2	

Man 1 refers to vapor extraction wells PR61, PR68, PR58, V21, and V90 manifolded together.

Man 2 refers to vapor extraction wells PR47, PR48, PR45, V5, and V77 manifolded together.

VE refers to samples collected during vapor extraction only; VE/AS refers to samples collected during air sparging and vapor extraction simultaneously.

a. Quantification based on response factor for toluene.

b. Summation of all detected constituents.

c. Foxboro Organic Vapor Analyzer reading

d. Vacuum canister sample analyzed by Air Toxics Ltd. by EPA Method TO14.

e. Air sparging ended

Appendix A

Field Logs

BASELINE HC, O2, CO2, MEASUREMENTS

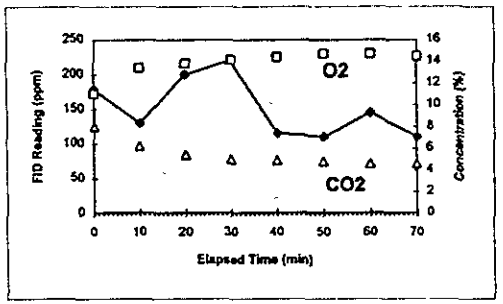
WELL ID#: MW22
WELL DIAMETER (inches): 2
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	<0.5	>5	1300

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: MW22

TIME	ELAPSED TIME (min)	FLOWRATE (cfm), 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)
1620	0	30	55	178	11	8
1630	10	22	55	130	13.4	6.2
1640	20	15	55	200	13 8	5.4
1650	30		55	220	14.1	5
1700	40	14	29	115	14.4	4.9
1710	50	3	26	110	14.7	4.8
1720	60	3	27	145	14.7	4 6
1730	70	3	26	110	14.5	4.6
					>5	



Regression Data

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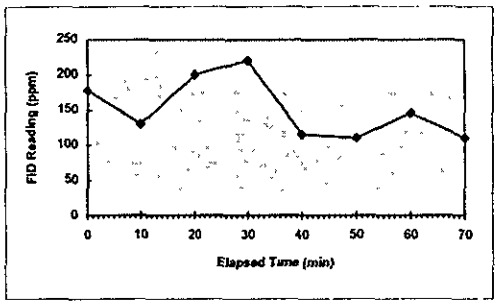
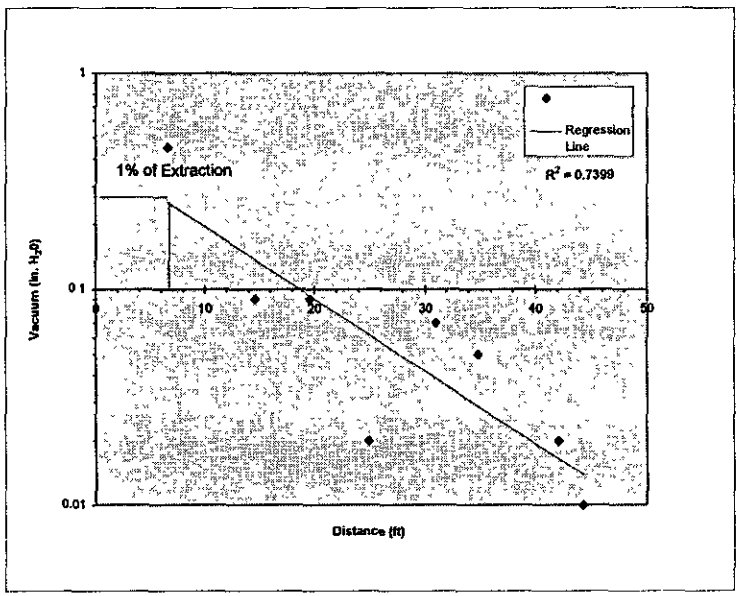
40	189.4932
30	178
22	130
15	200
14	115
3	110
3	145
3	110



SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#. MW22
FLOW RATE (cfm): 3 LAST ROUNDS
VACUUM (in H2O): 26

	ROUND	1	2 AVG.
MONITORING WELL	DISTANCE TO EXT WELL (ft)	VACUUM (in. H2O)	VACUUM (in H2O)	VACUUM (in. H2O)
V77	14.6	0.09	0 09	0 09
PR48	25	0.02	0.02	0 02
PR45	34 9	0 04	0 05	0.045
V73	19 6	0 09	0.09	0.09
V78A	31	0.06	0.07	0 065
V78B	6 6	0 45	0 45	0 45
PR43	44 3	0 02	0 01	0 015
PR51	42 1	0.01	0.02	0 015



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#	MW23
WELL DIAMETER (inches):	2
SCREEN INTERVAL (bgs):	

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	9.1	>5	9600

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm)'	WELLHEAD VACUUM (in H2O)
53	70
36	46
23	29
15	19
10	2.7

VARIATIONS: VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

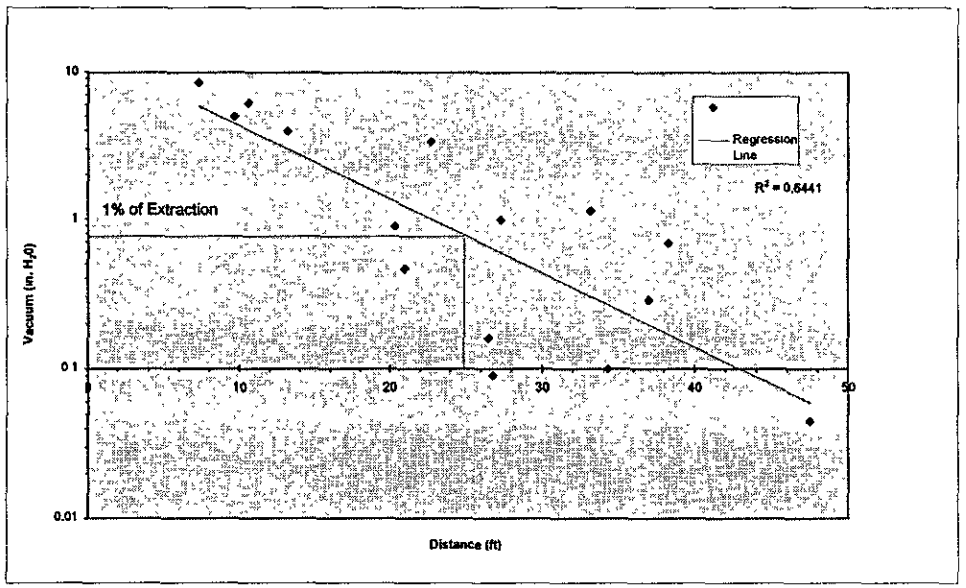
EXTRACTION W MW23

TIME	ELAPSED TIME (min)	FLOWRATE (cfm). 5-75 pref.	WELLHEAD VACUUM (in. H2O)	D READINGS (ppm)	OXYGEN (%)	CO2 (%)
1145	0	20	75	3440	5 7	8.5
1155	10	20	74	2640	5.4	7.9
1205	20	43	74	2220	5.7	8 2
1215	30	25	72	2240	6 5	8.2
1225	40	48	72	2660	6.9	8.2
1235'	60	61	70	1900	7.3	7 9

SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION W MW23
FLOW RATE (cf 48
VACUUM (in H2 72

MONITORING W	DISTANCE TO XT.WELL (ft)	ROUND 1 VACUUM (in. H2O)	2 VACUUM (in H2O)	3 VACUUM (in H2O)	4 VACUUM (in. H2O)	AVG. VACUUM (in. H2O)
PR51	13.2	4	4	3.8	4	3 95
V94	22.7	3.2	3 5	3 3	3 4	3.35
PR53	33 2	1.1	1.2	1.15	1.15	1 15
V12	37.0	0.27	0 26	0 26	0 29	0 28
V78	26.8	0.1	0.09	0.1	0.09	0.095
V66	38 3	0.6	0 7	0 7	0 7	0 675
MW22	26.5	0.15	0 16	0 16	0 16	0.1575
PR48	7.3	8 5	8	8.5	8.5	8 375
PR30	10.6	6	6	6 1	6 2	6 075
V4	20.3	0 9	0 95	0 95	0 9	0 925
V77	21.0	0 47	0 46	0 46	0.47	0.465
V73	34.3	0.1	0.1	0.1	0 1	0.1
PR45	27.3	1	1.1	1	1	1.025
V5	9.7	4 8	5	5	5	4 95
PR43	47.5	0 04	0 04	0 045	0 045	0.0425



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: PR47
WELL DIAMETER (inches). 2
SCREEN INTERVAL (bgs):

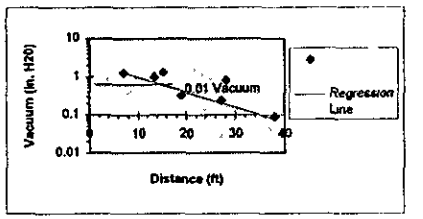
ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	0 6	>5	4400

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: PR47

TIME	ELAPSED *TIME (min)*	FLOWRATE (cfm) 5-75 pref.	WELLHEAD *VACUUM (in H2*	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)	
1458	0	20	60	NM	NM	>5	
1508	10	20	60	NM	NM	>5	
1518	20	25	57	1700	12	>5	
1520	22	23	57	1460	13.7	>5	
1528	30	22.5	57	1340	14.2	>5	
1538	40	21	57	1220	14.5	>5	
1548	50	19.5	59	1140	14.1		4 5
1558	60	19	59	1020	14.8		3.9
						>5	

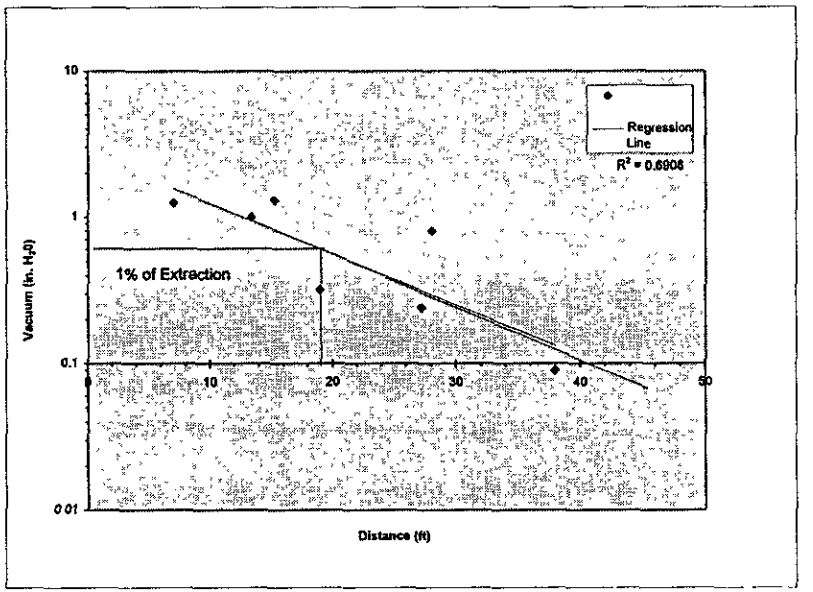
NM - not measured, sample pump malfunction



SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#. PR47
FLOW RATE (cfm): *19*
VACUUM (in H2O): 59

MONITORING WELL	ROUND DISTANCE TO EXT WELL (ft)	1 VACUUM (in. H2O)	2 VACUUM (in. H2O)	AVG. VACUUM (in. H2O)
V77	7	1.35	1 25	1.3
PR48	19	0 33	0.32	0 325
V78B	13 4	1	1	1
V73	15.2	1.35	1 3	1.325
PR45	27.2	0 29	0 24	0.265
PR43	38	0.11	0.09	0.1
V78A	28	0 8	0 8	0.8



VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm) 5-75 pref	WELLHEAD VACUUM (in H2O)
19	60
17	50
12.5	35
9	25
4.5	15
1 4	5

BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: PR48
WELL DIAMETER (inches): 2
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	17.5	>5	15000

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: PR48

TIME	*ELAPSED* TIME (min)	*FLOWRATE* (cfm) 5-75 pref.	*WELLHEAD* VACUUM (in H2	*FID READINGS* (ppm)	*OXYGEN* (%)	*CO2* (%)
855	0	7	77	15320	0.6	11.5
905	10	8.3	80	38600	4.2	9.6
915	20	7.7	80	24600	4.6	9.2
925	30	7	80	16800	5.3	9.2
935	40	7	80	12400	4.3	9.8
955*	60	7	80	13400	4.3	10.3

* Readings taken with adjacent well capped.
Emission reading after second carbon vessel = 100 ppmv.

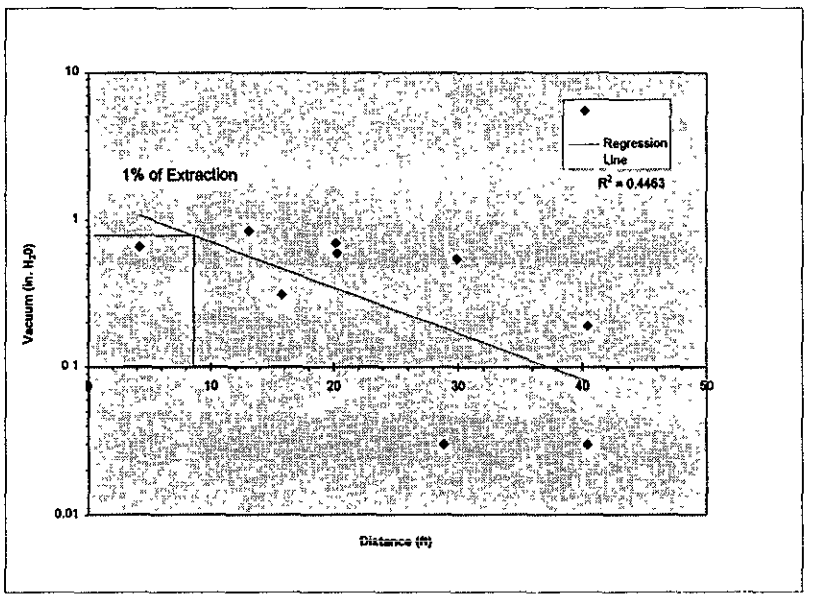
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#. *PR48*
FLOW RATE (cfm): 7 LAST ROUNDS
VACUUM (in H2O): 80

	ROUND	1	2	3	4	AVG.
MONITORING WELL	DISTANCE TO EXT.WELL (ft)	VACUUM (in. H2O)	VACUUM (in. H2O)	VACUUM (in H2O)	VACUUM (in. H2O)	VACUUM (in. H2O)
PR51	20.2	0.6	0 6	0 6	0.6	0.6
V94	29.8	0 48	0.46	0.55	0.55	0.51
PR53	40 4	0.15	0.16	0.19	0.18	0.17
PR45	20.1	0 44	0 6	0 7	0 6	0.585
V77	*15.8*	*0.25*	*0 24*	*0 31*	*0.31*	*0 2775*
V73	28.9	0 02	0.02	0.03	0 03	0.025
PR43	40.4	0.03	0.02	0 03	0.04	0.03
V4	13.1	0.6	0.8	0 85	0.85	0.775
PR30	4.2 -		0 66	0.66 -		0.66

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2O)
7	80
4	45
3	30
0.5	5



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: PR51
WELL DIAMETER (inches): 2
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	2.8	8.1	240000

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

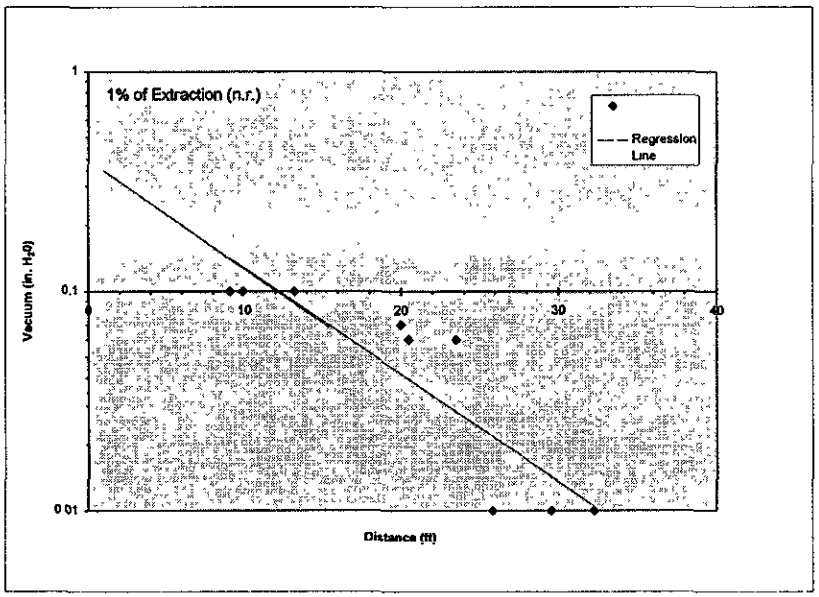
EXTRACTION WELL ID#: PR51

TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)
1257	0	4	47	300000	3.5	8 1
1307	10	3 8	47	240000	4	7 9
1317	20	2.5	49	144000	4.6	7 6
1327	30	2.5	48	134000	5.1	7.6
1337	40	2	47	116000	5 1	7.6
1347	50	2	46	116000	5.2	7.6
1357	60	1.8	45	84000	5 2	7.8

SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: PR51
FLOW RATE (cfm):
VACUUM (in H2O): NR

ROUND		1	2	3	AVG
MONITORING WELL	*DISTANCE TO EXT WELL (ft)*	*VACUUM (in. H2O)*	*VACUUM (in H2O)*	*VACUUM (in H2O)*	*VACUUM (in H2O)*
MW23	13.2	0 09	0.07	0.1	0 086666667
V94	9 9	0.1	0.1	0.1	0 1
PR53	20 5	0.03	0.04	0 06	0 043333333
V78	25.9	0.01	0.01	0.01	0 01
PR48	20	0.08	0 07	0.07	0.073333333
PR30	23.5	0 6	0 06	0.06	0 24
V4	32.3	0 02	0 01	0 01	0 013333333
V77	29 6	0.02	0 02	0 01	0.016666667
V5	9.1	0.11	0.1	0.1	0.103333333



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: PR53
WELL DIAMETER (inches): 2
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	1.1	7.3	124000

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: PR53

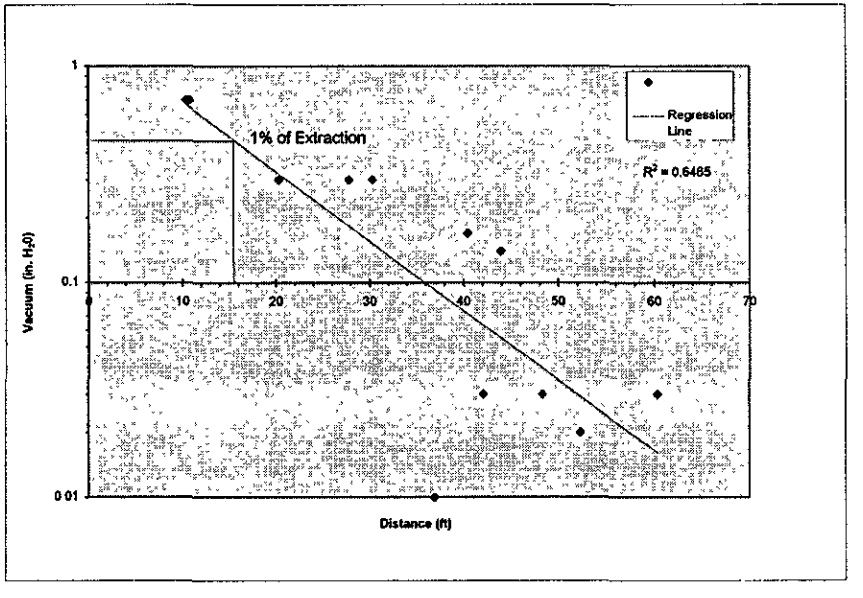
TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)
1420	0	11.5	75	14000	2.4	8.1
1430	10	8	72	10200	2.8	8
1440	20	60	72	3600	4.4	7.6
1450*	30	15	45	740	6.1	7
1500	40	7	45	620	6.3	7
1515	55	4	45	420	7	6.7

* Flowmeter probe cleaned

SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: PR53
FLOW RATE (cfm): 4
VACUUM (in H2O) 45

	ROUND	1	2 AVG.
MONITORING WELL	DISTANCE TO EXT WELL (ft)	VACUUM (in. H2O)	VACUUM (in. H2O)	VACUUM (in. H2O)
V94	10.4	0.7		0.35
MW23	30 3	0.3		0.15
V5	27 8	0.3		0.15
V64	10 8	0.7		0.35
V12	42 2	0.03		0 015
PR48	40.4	0.17		0 085
PR30	43.9	0 14		0.07
V4	52.4	0 02		0 01
PR45	60.4	0.03		0.015
V77	48.4	0.03		0.015
V78	37	0 01		0.005
PR51	20 3	0.3		0 15



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: PR58
WELL DIAMETER (inches): 2
SCREEN INTERVAL (bgs):

ROUND	*Oxygen* (%)	*Carbon dioxide* (%)	*HC* (ppm)
1	18 7	0.1	9000

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: PR58

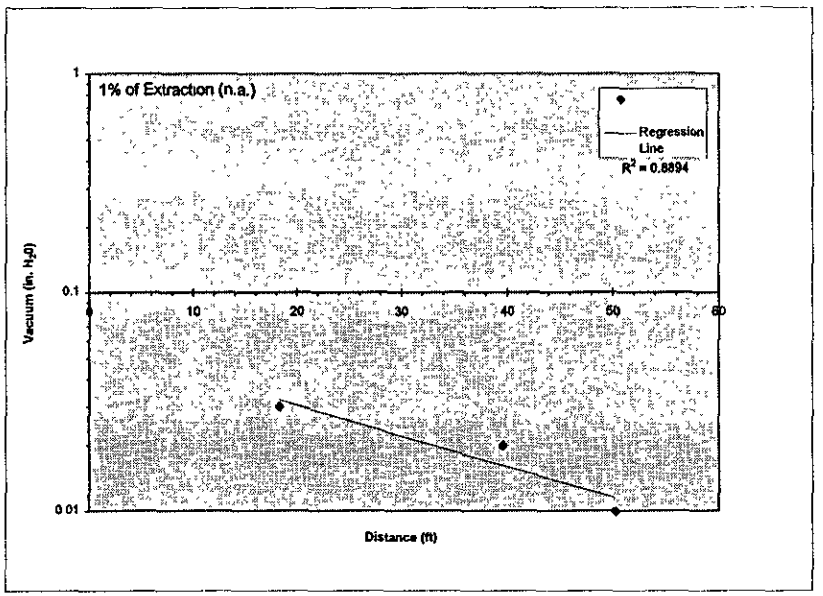
TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)	
1025	0	5 6	130	7000	18.8	0 2	
*1035**	*10*	*5.9*	*130*	*7400000*	*16.8*	*0.1*	
1110**	45	5	50	2000	19.2	0	
1120	55	4 7	47	860	19.5	0	

* Product recovered from well.
** Step vacuum down

SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: PR58
FLOW RATE (cfm): 5.8
VACUUM (in H2O): 125

MONITORING WELL	ROUND DISTANCE TO EXT.WELL (ft)	1 VACUUM (in H2O)	2* VACUUM (in H2O)	3** VACUUM (in H2O)	AVG. VACUUM (in. H2O)	
PR68	*18.3*	*0.03*	*0 03*	*0*	*0*	
PR64	39.6	0 02	0.02	0	0	
V21	50.3	0.01	0.01	0	0	
V90	31	0	0	0	0	
PR61	41.5	0	0	0	0	



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: PR61
WELL DIAMETER (inches): 2
SCREEN INTERVAL (bgs).

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	6 1	8.2	240000

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#. PR61

Time	Elapsed Time (min)	Flowrate* (cfm)	Wellhead Vacuum (in. H2O)	FID Readings (ppm)	Oxygen (%)	CO2 (%)
1220	0	7	60	20,000	15	2.8
1230	10	6.5	60	12,000	19	0 3
1240	20	6 4	58	16,400	18.4	0 6
1250	30	6.3	58	30,000	17.7	1

*Preferred range, 5--75 cfm

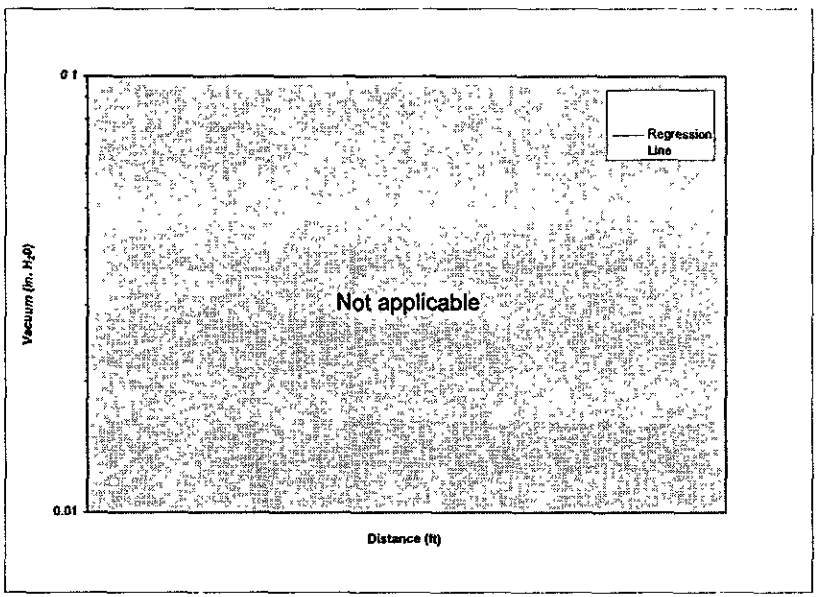
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

Extraction Well ID#: PR61
Flow Rate (cfm): 6.3
Vacuum (in. H2O) 58

		Vacuum (in H2O)			
External Well	Distance (ft)	Round 1	Round 2	Round 3	Average
PR58	41.6	0.01	0 01	0 01	0 01
PR68	44	0.22	0 16	0.13	0.17
V90	10	0 01	0	0	0.0033
PR64	22.2	0	0	0	0
V21	22.2	0	0	0	0

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm)	WELLHEAD Vacuum (in H2O)
6 3	58
3.7	25
0 5	10
0 2	5



PR61

BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: PR64
WELL DIAMETER (inches): 2
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	0.6	8.4	21400

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

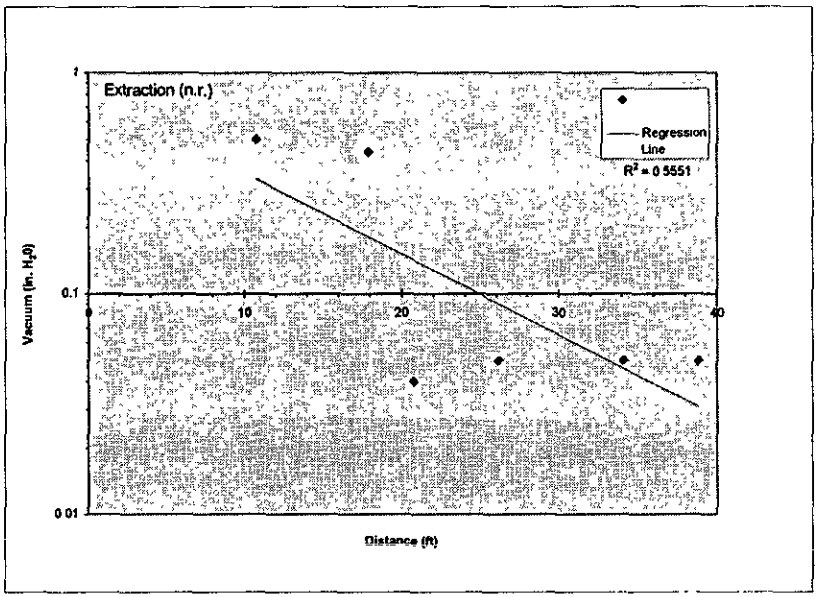
EXTRACTION WELL ID#: PR64

TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)	
1740	0	6	59	2800000	2.6		6.6
1805	25	2.7	38	800000	2 1		7 3

SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: PR64
FLOW RATE *(cfm)*:
VACUUM (in H2O). NR

	ROUND	1 AVG
MONITORING WELL	DISTANCE TO EXT.WELL (ft)	VACUUM (in. H2O)	VACUUM (in. H2O)
PR56	26.1	0 05	0.05
V21	10.7	0.5	0 5
PR60	34 1	0.05	0 05
V90	17.9	0 44	0.44
PR61	20.8	0 04	0.04
PR58	38.8	0.05	0 05



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: PR68
WELL DIAMETER (inches): 2
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	19.1	<1	100

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

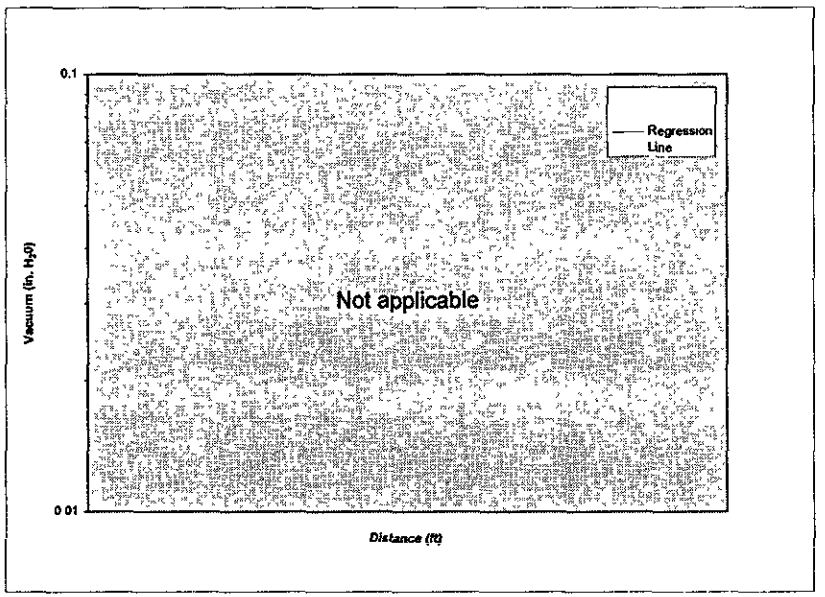
EXTRACTION WELL ID#. PR68

TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)
1135	0	5.5	50	3200	19.3	0
1145	10	5	50	6900	19.2	0.2
1155	20	5	50	5000	19.2	0
1205	30	5.3	50	6000	19 2	0

SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: PR68
FLOW RATE (cfm). 5.3
VACUUM (in H2O) 50

MONITORING WELL	ROUND	DISTANCE TO EXT.WELL (ft)	1 VACUUM (in. H2O)	2 VACUUM (in. H2O)	3 VACUUM (in. H2O)	AVG. VACUUM (in H2O)
PR58		18.3	3 6	2.7	2	2.766666667
V87		23.4	0	0	0	0
PR64		34 4	0	0	0	0
V21		44.3	0	0	0	0
V90		35	0	0	0	0
PR61		44.2	0	0	0	0



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: V4
WELL DIAMETER (inches): 4
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	NM	NM	NM

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: V4

TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)	
1020*	0	22.7	43	300	8.7	7.3	
1030	10	22.8	42	380	9.5	7.7	
1040	20	23	42	480	11	7 1	

* Top of casing flush to bottom well box Poor surface seal

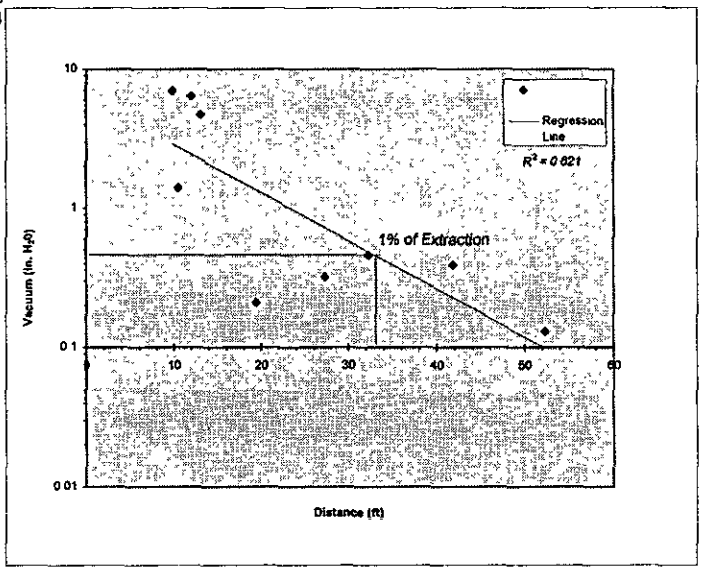
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: V4
FLOW RATE (cfm). 23 LAST ROUNDS 10 4.152368595 10 4 152369
VACUUM (in H2O): 42 20 20 2 880104
ROUND 1 AVG.

MONITORING WELL	DISTANCE TO EXT.WELL (ft)	VACUUM (in H2O)	VACUUM (in. H2O)
PR51	32.3	0 46	0 46
V94	41.9	0.39	0 39
PR53	52.3	0.13	0 13
PR45	9.9	7	7
V77	10 5	1.4	1 4
V73	19 4	0.21	0 21
PR43	27.3	0 32	0.32
PR30	12	6 4	6 4
PR48	13	4.7	4 7

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm): 5-75 pref	WELLHEAD VACUUM (in H2O)
23	42
17.5	35
8 6	8.6
5	5
3	3
0	0



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: V7
WELL DIAMETER (inches): 4
SCREEN INTERVAL (bgs).

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	NM	NM	<20

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: V7

TIME	ELAPSED TIME (min)	FLOWRATE (cfm). 5-75 pref	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)	
1055	0	36	89	25	18.6		0 2
1115	20	36	86	20	18		0.6

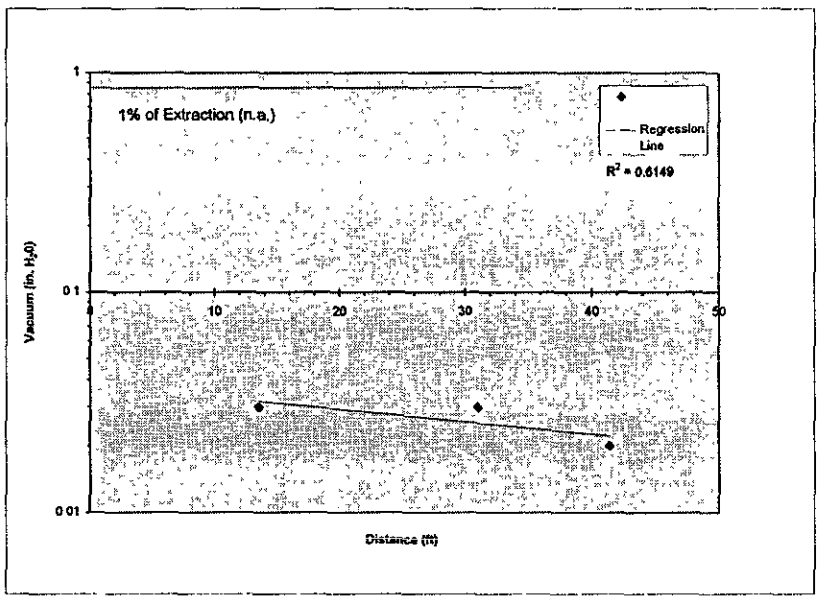
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: V7
FLOW RATE (cfm). 36
VACUUM (in H2O): 86

		LAST ROUNDS		
	ROUND	1	2	AVG.
MONITORING WELL	DISTANCE TO EXT.WELL (ft)	VACUUM (in. H2O)	VACUUM (in H2O)	VACUUM (in. H2O)
V77	41 4	0 02	0.02	0 02
V4	31	0 03	0.03	0 03
V8	13.5	0.03	0 03	0.03

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm). 5-75 pref.	WELLHEAD VACUUM (in H2O)
36	86
30	60
20	35
12	20
4	5



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: V12
WELL DIAMETER (inches): 4
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	17.1	0 5	<20

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID# V12

TIME	ELAPSED TIME (min)	FLOWRATE (cfm) 5-75 pref	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)
1440	0	21	60	10	13.2	2.7
1450	10	22	60	12	13.7	2.7
1500	20	23	60	10	14	2.7
1510	30	23	60	20	149	2 4
1520	40	23	60	10	15.7	2.7

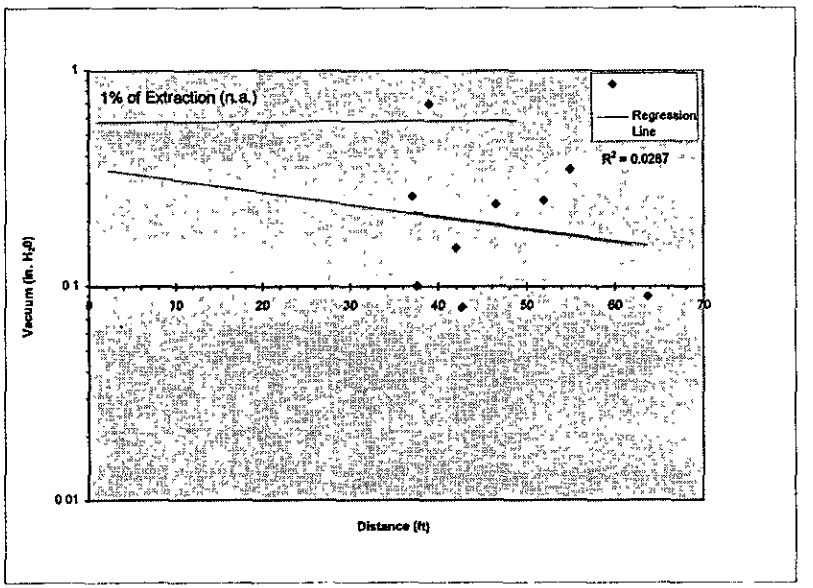
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: V12
FLOW RATE (cfm): 22
VACUUM (in H2O): 60

MONITORING WELL	ROUND / DISTANCE TO EXT.WELL (ft)	1 VACUUM (in. H2O)	2 VACUUM (in. H2O)	3 VACUUM (in. H2O)	AVG. VACUUM (in. H2O)
V53	39	0.09	0 7	0 7	0.496666667
V31	37.6	*0.13*	*0.13*	*0.1*	*0.12*
V30	46 5	0 28	0 26	0 24	0 26
V28	63.7	0 1	0 08	0 09	0 09
V56	52	0.17	0.23	0 25	0 216666667
MW23	37	*0 3*	*0 27*	*0 26*	*0.276666667*
PR45	55	0 05	0 04	0.35	0 146666667
V5	42.7	0.08	0.08	0.08	0.08
PR30	42	0.16	0 16	0.15	0.156666667

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2O)
22	60
15	40
6	18
2	8
0.5	5



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: V21
WELL DIAMETER (inches): 4
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	NM	NM	NM

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: V21

TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)
915	0	29	37	46	7 4	6 3
925	10	28	36	78	10.6	5 3
935	20	28	36	62	12.2	4.7

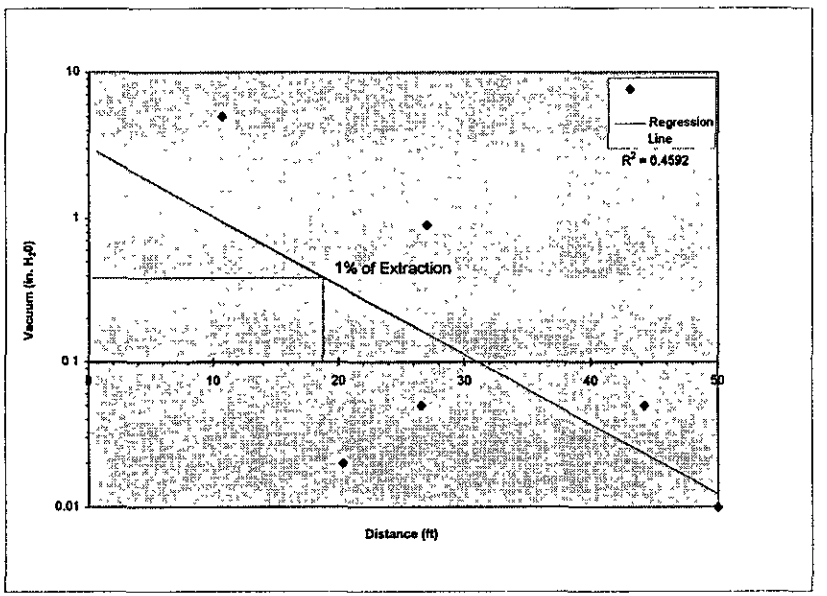
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: V21
FLOW RATE (cfm): 28
VACUUM (in H2O): 36

	ROUND	1	1 AVG.
MONITORING WELL	DISTANCE TO EXT.WELL (ft)	VACUUM (in. H2O)	VACUUM (in H2O)	VACUUM (in H2O)
PR64	10.7	5	5	5
PR56	20.4	0.02	0.01	0.01
PR58	50	0.01	0	0
V90	27	0 9	0 9	0 9
PR61	26 6	0 05	0 05	0.05
PR68	44.2	0.05	4	4
V87	42.2	0	0	0

VARIATIONS OF FLOWRATE VS VACUUM

FLOWRATE (cfm): 5-75 pref	WELLHEAD VACUUM (in H2O)
28	36
15	24
9	14
5	10
0 5	5



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: V55
WELL DIAMETER (inches): 4
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	10.5	2.6	1540

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

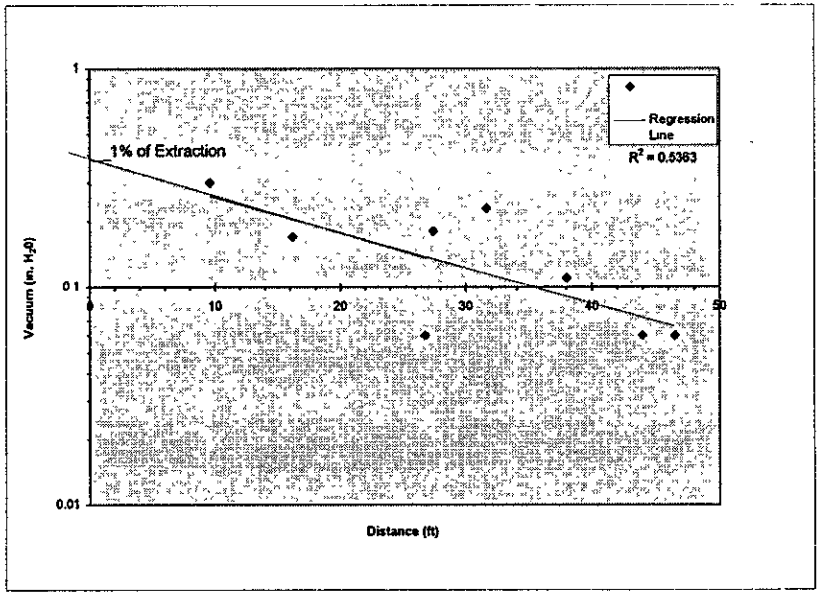
EXTRACTION WELL ID#. V55

TIME	ELAPSED TIME (min)	FLOWRATE (cfm) 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)
1340	0	9	38	3500	2.4	6.1
1350	10	9.2	38	3600	5.7	5 2
1400	20	9 3	37	3800	5 7	5.1
1410	30	9 7	38	3700	7 7	4.6
1420	40	9 6	38	3560	7.7	4.6

SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: V55
FLOW RATE (cfm) 9.5
VACUUM (in H2O): 38

MONITORING WELL	DISTANCE TO EXT.WELL (ft)	ROUND 1 VACUUM (in. H2O)	2 VACUUM (in. H2O)	3 VACUUM (in H2O)	AVG. VACUUM (in H2O)
V53	16 2	0 17	0 17	0.17	0 17
V31	26 8	0	0.02	0.06	0.026666667
V30	27.4	0.18	0.18	0 18	0 18
V28	38	0.1	0.1	0 11	0.103333333
V26	31.6	0.2	0 22	0 23	0 216666667
V56	9.6	0.2	0 25	0.3	0.25
PR68	44	0 07	0 06	0.06	0.063333333
V24	46 5	0.05	0.07	0.06	0.06



VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm). 5-75 pref.	WELLHEAD VACUUM (in H2O)
9 5	38
7.8	30
4.5	15
3.5	9
2.5	5

BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: V78A
WELL DIAMETER (inches): 4
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	11.2	>5	0

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: V78A

TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)
1246	0	20	48	12	12.7	>5
1256	10	28	66	90	13.5	>5
1306	20	26	60	200	14.8	>5
1316	30	25	60	240	13.6	>5
1326	40	25	60	240	13 9	>5
1336	50	25	60	220	14.7	>5
1356	70	25	60	190	15 1	>5
1409	83	25	59	166	15.7	>5

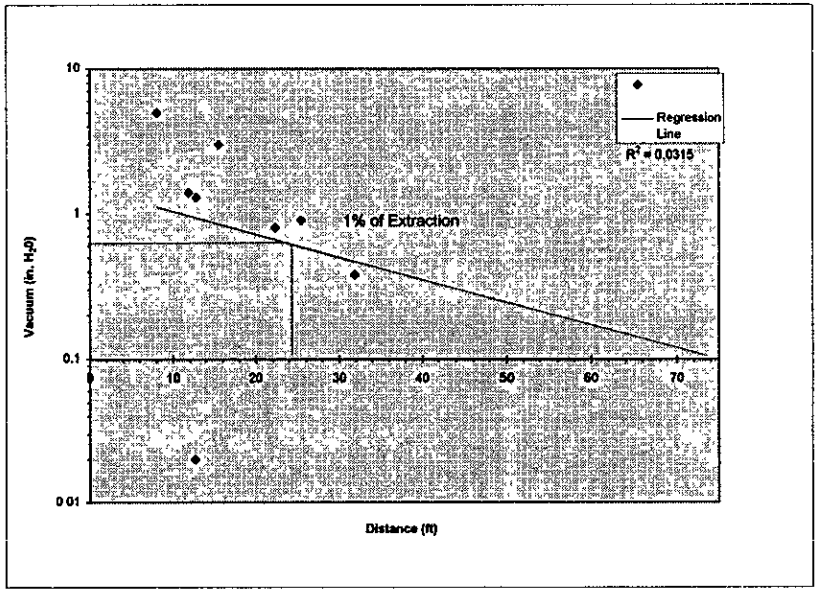
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: V78A
FLOW RATE (cfm): 25
VACUUM (in H2O): 60

MONITORING WELL	ROUND	DISTANCE TO EXT.WELL (ft)	1 VACUUM (in. H2O)	2 VACUUM (in. H2O)	AVG. VACUUM (in. H2O)
PR44		12.6	0.1	0.02	0.06
PR42		15.5	3	3	3
PR41		8 1	4.9	5	4.95
PR43		22 3	0.8	0.8	0.8
V72		11 9	1.5	1.4	1.45
V77		25.4	0.8	0 9	0 85
PR45		31 9	0.45	0 38	0 415
V73		12 8	1.3	1.3	1.3

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm). 5-75 pref.	WELLHEAD VACUUM (in H2O)
0.4	0.5
8.7	20
12	28
18	43
25	59



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: V90
WELL DIAMETER (inches): 4
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	8.2	4.8	<20

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: V90

TIME	ELAPSED TIME (min)	FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)	
950	0	21	48	10	9		5.1
1000	10	22	46	10	10.5		4.6
1010	20	24	46	38	11.9		4.2

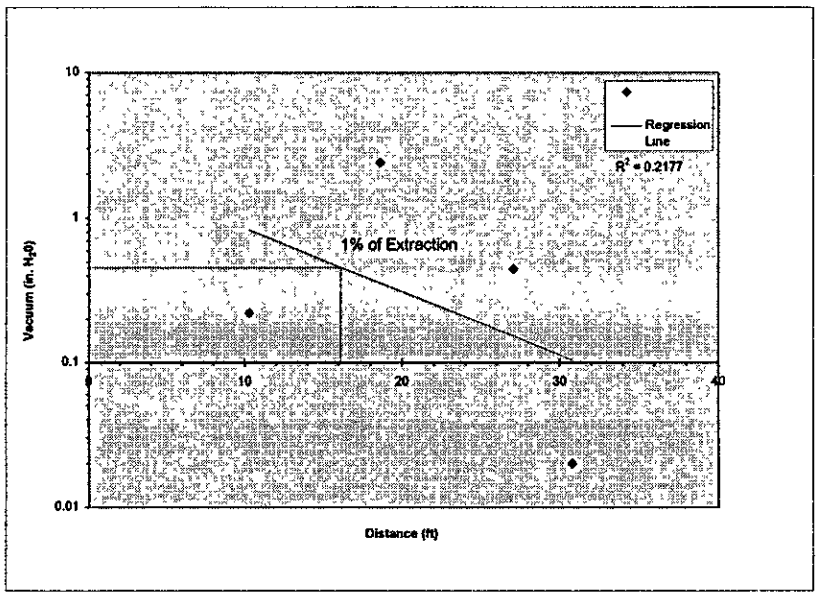
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: V90
FLOW RATE (cfm): 24
VACUUM (in H2O): 45

	ROUND	1	2	3	AVG
MONITORING WELL	DISTANCE TO EXT.WELL (ft)	VACUUM (in. H2O)	VACUUM (in H2O)	VACUUM (in. H2O)	VACUUM (in. H2O)
PR61	10 3	0 02	0.22	0.22	0.153333333
PR58	30 8	0	0.02	0.02	0.02
V21	27	0.5	0.45	0.45	0 45
PR64	18 6	2.3	2.4	2.4	2.4

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm): 5-75 pref.	WELLHEAD VACUUM (in H2O)
24	45
15	34
9	22
2	10



BASELINE HC, O2, CO2, MEASUREMENTS

WELL ID#: V94
WELL DIAMETER (inches): 4
SCREEN INTERVAL (bgs):

ROUND	Oxygen (%)	Carbon dioxide (%)	HC (ppm)
1	15.3	2.5	20

VARIATIONS VACUUM OVER FLOWRATE AND CONCENTRATIONS OVER TIME

EXTRACTION WELL ID#: V94

TIME	ELAPSED TIME (min)	FLOWRATE (cfm). 5-75 pref.	WELLHEAD VACUUM (in H2	FID READINGS (ppm)	OXYGEN (%)	CO2 (%)		
1540	0	78.5	70	1020	10.1	6 5		
1550	10	74	72	300	10.8	6.1		
1600	20	72	70	350	12 4	5.3	80	879.5034
1610	30	73	72	380	13 5	4.8	70	67.36552
1620	40	75	72	370	14	4 6		
1630	50	77	72	380	14.7	3.7		

Emisson after second carbon vessel= 16 ppmv hydrocarbons

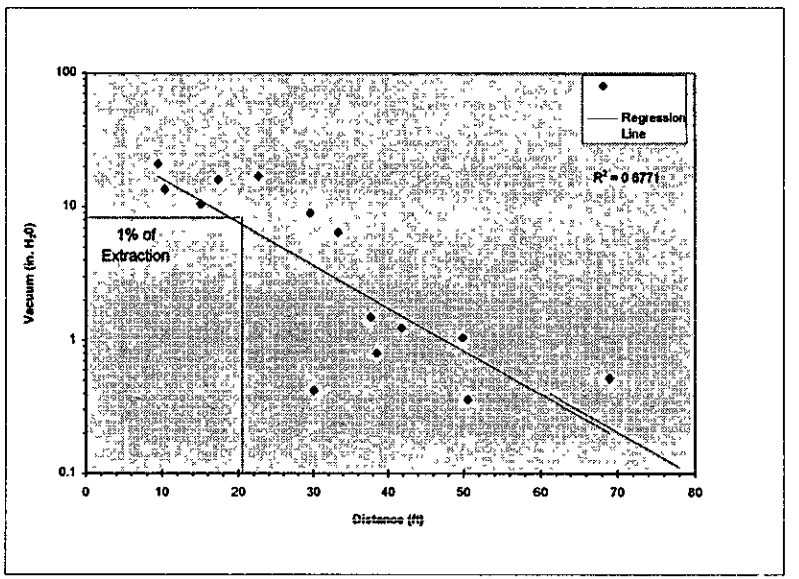
SUBSURFACE PRESSURE MEASURED AT SELECTED MONITORING POINTS

EXTRACTION WELL ID#: V94
FLOW RATE (cfm)' 77
VACUUM (in H2O)' 72

	ROUND	1	2	AVG.
MONITORING WELL	DISTANCE TO EXT.WELL (ft)	VACUUM (in. H2O)	VACUUM (in. H2O)	VACUUM (in. H2O)
PR53	10.4	13	13 5	13.25
MW23	22.7	17	17	17
V5	17.4	15	16	15.5
V64	15.1	11	10 5	10.75
V12	37.7	1 5	1 5	1.5
PR48	29.6	9 5	9	9.25
PR30	33.3	7	6 5	6.75
V4	41.8	1.1	1.25	1.175
PR45	49.8	1.1	1 05	1 075
V77	38.5	0.72	0.8	0.76
V78	30.1	0.38	0 42	0.4
PR51	9.5	21	21	21
V73	50.5	0.35	0 36	0.355
PR43	68.9	0 6	0.52	0.56

VARIATIONS OF FLOWRATE VS. VACUUM

FLOWRATE (cfm)' 5-75 pref	WELLHEAD VACUUM (in H2O)
77	72
61	59
27	35
18	25
9	16
1	10



EFFECT OF AIR SPARGING ON HYDROCARBON CONCENTRATIONS

AIR SPARGE WELL ID#:	AS2
EXT. VAC. (in H2O):	56
EXT. FLOWRATE (cfm):	14

	FID/PID reading at External Well (ppm)		
ROUND	**Before AS**	**During AS**	**During AS**
1	162	212	
2	150	1,920	
3	140	3,260	
4	140	4,400	
5	160	5,560	
6*	196	7,400	
7	180	9,560	
8	180	11,200	
9**		13,300	
		15,000	
		16,600	
		18,000	

* Increased vacuum.
** Began air sparging.

		Flow With	Flow During AS	
Extraction Well	**Flow**	**Increased Vac.**	**Round 1**	**Round 2**
V21	6	8	11	7
PR61	4	6	6	2.5
PR58	3	6.5	2	n/a
PR68	2.5	4	4	3.5

AS INJECTION RATE (cfm):	3
AS INJECTION PRESSURE (in H	10
AS He INJECT. CONC.(5% max.):	4.3
EXT. RATE (cfm):	14
EXT. WELL VAC. (in H2O):	56

	Distance from	Vacuum (in. H2O)			
OBSERVATION WELL ID#	**Well AS2 (ft)**	**Before Sparging**	**During Spargin**	**Round 1**	**Round 2**
PR64		1.75	0		
V96		0.01	0.01		
V?		0.33	0.3	0	
PR62		0.07	0.05		
PR20		0	-16	0.11	
E-0		0	-0.9	0.82	
PR60		0	-0.8	0.02	
PR65		0	-0.15	0	
V7			0	0.02	
V64			0	0.02	
PR45				0.02	
RW2				0.04	

Extraction Flow Rate	**Vacuum (in. H2O)**
11	35
11	36
16	67
15.5	67
15	60
14	56
15	58

Round	**He. concentration at Manifold**
1	0
2	0
3	0.07
4	0.08
5	0.07
6	0.06

CO2 Before	**O2 Before**	**CO2 During**	**O2 During**
2.9	15.2	2.1	16.4
2.7	15.2	2	16.4
2.6	15.2	1.9	16.5
2.8	15.2	1.8	16.5
2.6	15.4	1.9	16.6
		1.8	16.5
		1.8	16.4
		1.9	16.5
			16.4
			16.5
			16.4

EFFECT OF AIR SPARGING ON HYDROCARBON CONCENTRATIONS

AIR SPARGE WELL ID#: AS3
EXT. VAC. (In H2O):
EXT. FLOWRATE (cfm):

ROUND	FID/PID reading at External Well (ppm) Before AS	During AS	Increase
1	1,340	3,280	
2	840	3,900	
3	720	5,400	
4	580	10,760	
5	560	15,500	
6	460	17,900	
7		18,900	
8		20,100	
9		20,900	
		15,600	
		13,800	
		12,000	

Emission = 0 ppmv

Extraction Well	Stabilized Flow	Flow During AS
PR45	9.5	
PR48	6	
PR47	15	
V77	6	
V5	8	

Combined Flowrate -Before AS

Round	Extraction Flowrate	vacuum (In. H2O)
1	34	32
2	44	30
3	41	30
4	45	30
5	41	30
6		
7		

Round	Helium Concentration at Manifold	
1	0 23	
2	0 32	
3	0 48	
4	0.38	After AS
5	0.3	
6	0.23	
7	0.19	

Individual and Combined Flow Rates before Air Sparging

Round	PR45	PR48	PR47	V77	V5	COMBINED
1	9.5	6	15	6	8	34
2	3	9	13	11	12	44
3	3 5	4 3	14	13	12	41
4	4	8	13.5	17.5	13	45
5	3.2	4	13.5	13.5	13	41

Individual and Combined Well Flow Rates During Air Sparging

Round	Vacuum (in. H2O)	PR45	PR48	Well PR47	V77	V5	Combined
1	30	4	4	13	23	14	41
2	32	4	3	11.5	14.5	14	40
3	32	4.5	3	11.5	15 5	14.5	43

Before AS CO_2	Before AS O_2	During AS CO_2	During AS O_2
5.9	10.5	3	15.4
4.9	12.2	2.7	15.8
4.3	12.9	2.6	15 9
3.9	13.7	2.7	15.7
3.7	14	2.7	15.7
3.4	14.6	2.7	15 8
		2.7	15.9
		2.6	15 9
		1.7	15.2
		2.3	16.4
		2.2	16 7
		2 2	16 7

Observation Well ID#	Distance from AS Well (ft)	Avg. Vacuum (In. H2O) Before AS	During AS	Helium Concentration (%) Round 1	Round 2	Average
PR43	0.14	0.09	0	2		
PR30	6	1.89	0.11	0	1	
MW23	5 5	3.00	0.06	0.42	0.055	
V78	0.85	0.78	0	0.62	0 24	
V93	0	0.00	0	0	0.31	
E6	0	-0 07	0	0	0	
V64	0 5	0 35	0.02	0	0	
PR34	0	-0 01	0	0	0.01	
V7	0	0.00	0 04	0	0	
PR56	0	0.00	0	0.04	0.02	
V56	0	-0.27	0	0	0 02	
V30	0	0 00	0 07	0	0	
V12	0.04	0 01	0	0.04	0 035	
V94	NM	2.43	0	0	0.02	
E5	NM	-0.01	0	0	0	
PR21	NM	-0 65	0	0	0	
MW25	NM	0 00	0	0	0	
MW26	NM	0 00	0	0	0	
MW28	NM	-0.32	0	0	0	

Measurements of Pressure and Helium at Selected Monitoring Points

				After amd @ AS well		
AS Inject Rate (cfm):	1.7	6	6			
AS INJECT. PRESS. (psi):	10	10	10			
AS He INJECT. CONC.(5% max.):	4.5	3.2	2.7	P=50 in. H2O		
EXT. RATE (cfm):	41	43	43	He= 2 7%		
EXT. WELL VAC. (In H2O):	30	32	32	HC	O2	CO2
				16,000	15 2	1.70

Observation Well ID No	Before Air Sparging			During Air Sparging			
PR43	0.14	0.14	0.14	0.11	0.09	0.08	0.09
PR30	6	6	6	4.5	0 7	0 48	1.89
MW23	5 5	5 5	5 5	4.5	2 5	2	3.00
V78	0.85	0.85	0 85	0.9	0.75	0.7	0.78
V93	0	0	0	0	0	0	0.00
E6	0	0	0	-0.22	0	0	-0.07
V64	0 8	0 5	0 5	0 05	0 4	0.6	0 35
	0	0	0	-0.02	0	0	-0 01
	0	0	0	0	0	0	0 00
	0	0	0	0	0	0	0.00
	0	0	0	-0 03	-0.4	-0.38	-0 27
	0	0	0	0	0	0	0 00
	0 04	0.04	0.04	0 02	0.01	0.01	0 01
				2.6	2.3	2.4	2 43
				-0.04	0	0	-0 01
					-0 9	-0.4	-0 65
					0	0	0.00
					0	0	0 00
					-0 32	0	-0.16

7/7/16

	O_2	CO_2	FID	PV
PUMP BLANK	20.7	<0.05	<1	<1
V78A	11.2	>5	<1	<1
PR41	14.1	>5	<1	<1
PR44	3.5	>5	102 × 20 = 2,000	
PR42	11.4	>5	<20	<1
PR43	12.1	>5	<20	<1
V73	10.6	>5	<20	
V72	10.0	>5	<20	
V77	4.9	>5	14 × 20 = 280	
PR47	0.6	>5	220 × 20 = 4400	
MW22	<0.5	>5	65 × 20 = 1300	
PR45	0.7	>5	22 × 20 = 440	
PR46	=0.5	>5	1 × 20 = 20	
V78(VE)A	12.7 13.5	>5	90	
V78 ↓ A	14.8	>5	200	
V78 ↓ A	15.7	>5	166	
V78B	20.7	0.5	<20	
PR46	17.5	>5	760 × 20 = 15,000	
MW23	9.1	>5	380 × 20 = 7600	

	O_2	CO_2	FID
PR47VE	12	>5	1700
PR47VE	14.2	>5	1340
PR47VE	14.8	3.9	51 × 20 = 1040
PR30	5.0	9.5	360 × 20 = 7200
PR50	19.4	<0.1	7.7 × 20 = 154
MW22VE	11.0	8.0	178
PR51	2.8	8.1	1.2% × 20 = 24% !!!
MW22VE	14.1	>5.0	220
V5	17.4	0.6	2.5 × 20 = 45
PR53	1.1	7.3	6200 × 20 = 124,000
V94	15.3	2.5	17 × 20 = 340 MAYBE POOR SEAL

PUMP ~ 5 L/MIN.
2" WELLS 1 MIN PURGE 4"

4/2/96

	O_2	CO_2	FID	
PR48 VE	0.6	11.5	15,000	
EFFLUENT	19.1	0.6	<20	
PR48 VE	4.6	9.2	230×20 4,600	
PR48 VE	4.3	9.8	12,400	
PR48 VE	4.3	10.2	680×20 13,600	
V7			<20	
V4 VE	9.7	7.3	15×20 300	
V4 VE	9.5	7.7	390	
V4 VE	11.0	7.1	24×20 480	
V7 VE	18.6	0.2	24	
V7 VE	18.0	0.6	20	
V64	15.7	1.2	<20	
MW23VE	5.7	8.5	3440	
PR56	19.0	<0.1	70×20 1,400	
MW23VE	5.7	8.2	2,220	
PR64	0.6	8.4	1,070×20 21400	
MW23VE	6.9	8.2	2460	
PR51VE	3.1	8.1	30%	
PR51VE	5.1	7.6	11.6%	
PR51 VE	5.2	7.8	8.4%	
PR61	6.1	8.2	1.2×20 24%	
PR53 VE	2.4	8.1	14,000	

OF EA SW SM DALE OR ENV. SUP.

MAIN DOOR SEAL

FAN PROBLEM

PR53 VE	4.4	7.6	3600
PR58	18.7	0.1	450×20 9,000
PR53 VE	6.3	7.0	670
PR53 VE	7.0	6.7	420
PR68	19.0	<0.1	25×20 100
V94 VE	10.1	6.5	1020
V94 VE	12.4	5.3	350
V94 VE	14	4.6	370
V90	4.8	8.2	<20
V94 VE	14.7	3.7	390
V12	17.1	0.5	<20
V55	10.5	2.6	77×20 1540
PR64 VE	2.6	6.6	1.4%×20 28,000 (28%)
PR64VE	2.1	7.3	80,000

POSSIBLE LEAK COULD HEAR AIR SUCKING AROUND SEAL SUDDENLY

4/3/96

4/3/96

	O_2	CO_2	FID
V12	13.2	2.7	10
V12	14	2.7	10

	O_2	CO_2	FID	
V21VE	7.4	6.3	46	
V21VE	10.6	5.3	78	
V21VE	12.2	4.7	62	
V90 VE	9.0	5.1	<20	
V90 VE	10.5	4.6	<20	
V90 VE	11.9	4.2	36	
PR58VE	18.8	0.2	7,000	MAYBE LEAKING 1GALLON OF PRODUCT IN VE HOSE
PR58 VE	16.8	0.1	74%	
TRY W/ LOWER VACUUM				
PR56 VE	19.2	<0.1	2,000	
PR58VE	19.5	<0.1	800	
PR66 VE	19.3	<0.1	3200	
PR66 VE	19.2	0.2	6900	
PR67 VE	19.2	<0.1	6000	
PR61 VE	15	2.8	20,000	
PR61 VE	19	0.3	12,000	
PR61 VE	18.4	0.6	16,400	
PR61 VE	17.7	1.0	30,000	
PV55VE	2.4	6.1	3,500	
V55 VE	5.2	5.1	3,800	
V55 VE	7.7	4.6	3560	

4/4/96

CLR. 60° 75°
DALE ENV. SUPP. - DPZ SWZ 3M DEO } IA

MANIFOLD PR61, PR68, PR58, V21, V90 AND EXTRACT - CALL IT MAN/

		CO_2	FID
MAN/VE	15.1	2.9	162
(BACK UP VAPOR FLOW) MAN/VE			190
MAN/VE	15.8	2.5	180
MAN/VE	15.8	2.5	180
MAN/VE/(1250) AS	16.4	2.2	212

~1300 - DP NOTICES PRODUCT BUBBLING FROM PR58

1315 LOWER VACUUM TO 42" H_2O

PRODUCT STILL COMING UP SLOWLY → REACHES > 2 FT. ABOVE GROUND SURFACE IN TUBE

LOWERED VACUUM TO 22" H_2O

PRODUCT LEVEL STABLIZES AT ~ 2 FT. AGS AT PR58

	DTP	DTB	
PR20	1.95	4.0	- PROBABLY PRODUCT RECOVERY HOSE STUCK ~4' DOWN

PULL UP W/BAILER

~2.0' NAPL 0.1' H_2O

	DTP	DTW	DTB
PR64	5.00	8.25	12.45

BEGIN He INJ. ~ 1430

	He
INF 1	5.6 %
2	4.4
3	2.1
4	7.6
5	4.0

	O_2	CO_2	FID	He (%)
MAN/VE/AS	16.5	1.8	5,560	<0.01
MAN/VE/AS	16.6	1.9	7400	

~~EFFLUENT~~	He (%)	FLOW (CFM)
INF.	4.3	3.0

MAN/VE/AS	16.5	1.9	13,300
"	16.4	1.9	18,000

4/5/96

CLR 60°F

DACE ?? / ENV. ?? / SUPP. PC } EA

PR47, PR48, V5, PR45, V77
(MAN 2)

	O_2	CO_2	FID	
MAN 2VE	10.5	5.9	1340	
MAN 2VE	12.2	4.9	840	
MAN 2VE	13.7	3.9	580	
1040 ↓ 1050 COLLECT SUMMA SAMPLE				
MAN2VE/AS	14.6	3.4	460	
1110	15.4	3.0	3,280	FLOW INCREASED 4.5CFM
MAN 2VE/AS	15.9	2.6	5400	
"	15.7	2.7	10,800	
"	15.7	2.7	15,500	
	15.9	2.7	18,900	
	15.9	2.6	20,100	
AS3	15.2	1.7	16,000	He 2.8
MAN 2VE/~~AS~~	16.4	2.3	15,600	He-0.30
MAN 2VE	16.	2.	12,000	

4/16/96

PC 60°F

STEVE DAILEY
JTM

PROBE -10 FT.

	DTP	DTW	NOTES
V55	15.83	15.84	PROBE LOOKS NASTY (BLACK)
PR57	—	16.34	

V55 SUCK SOME OUT ANYWAY
SUCK ~0.5L H_2O BLACK GLOBULS FLOATING ON TOP

	DTP	DTW	NOTES
1030 PR58	15.74	18.42	2.5 L NAPL 0.5 L H_2O
1035 PR58	18.82	18.85	
1037 PR65	—	16.75	
1038 PR61	16.80	18.03	22 L NAPL 0.5 L H_2O
V90	DTB 13.15		
1045 PR61	17.72	17.90	
1051 PR20	15.52	18.15	← DEPTH TO OBSTRUCTION
1053 PR68	—	16.63	
1055 E-0	17.38	18.55	8L NAPL 1L H_2O
1100 PR58	17.78	18.06	
1123 PR67	—	16.10	
1126 PR64	16.03	20.15	3.5 L NAPL 1.5 L H_2O
1136 PR54	—	16.98	
1137 PR55	DTB 16.49		
1158 PR56	—	14.52	

[illegible]-94		[illegible]	[illegible]	[illegible]	[illegible]	3.81	
13-Mar-95	-	14.[illegible]	8.24	10.[illegible]	0.42	3.72	
9-Jun-95	-	14.37	5.8	10.25	2.01	4.12	
27-Jul-95	-	14.37	7.7	9.91	4.11	4.46	
22-Sep-95	-	14.37	8.3	10.12	2.42	4.25	
6-Dec-95	-	14.37	9.64	10.23	1.93	4.14	
18-Dec-95	-	14.37	10.5	10.34	0.70	4.03	
18-Dec-95	1:30	14.37	9.60	10.51	0.01	3.86	2", no scr
		14.[illegible]		10.20	0.60	4.17	
				[illegible] 25	0.02	4.12	1n (brown
					0.12	4.43	
					0.40	4.28	
					0.05	4.22	0.5n 0.025
					0.01	4.04	0.05n 0.15
					0.08	4.44	
					0.01	4.22	0.1n 0.2w
					0.01	4.36	
					0.60	4.17	
					2.99	5.13	( )
					0.15	5.27	(7.5n
					0.77	6.37	
					3.35	4.39	7.25n 1.25w
					0.77	6.37	
					0.80	6.68	0.5n 0.5w
					-		

Feb

Appendix B

Calculations of Permeability of Soil to Air and Equations Used

CALCULATIONS

PERMEABILITY TO AIR FLOW

Induced vacuum measurements at the extraction wells were used to calculate the permeability of the soil to air flow. Permeabilities were calculated using the following equation, which was derived directly from the equations of Johnson (Johnson 1990):

$$k = \frac{Q_m \mu R T_v \ln (r/R_w)}{\pi MW_{air} H (P_w^2 - P_r^2)}$$

where:

- k = soil permeability to air flow (cm^2)
- Q_m = mass flow rate
- μ = viscosity of air
- R = universal gas constant
- T_v = absolute temperature of extracted vapors
- r = distance from extraction well to remote monitoring point
- R_w = radius of extraction well borehole
- MW_{air} = molecular weight of air
- H = well sand pack length (exposed)
- P_w = absolute pressure in the extraction well
- P_r = absolute pressure in the observation well

MASS REMOVAL RATE

The mass removal rate of volatile hydrocarbons from the extraction well (ER) was calculated from the following equation:

$$ER = 1{,}440*Q*MW*(10^{-6})*C/v$$

where:

- ER = extraction rate of gasoline vapors (lb/day)
- Q = volumetric flow rate (CFM)
- MW = average molecular weight of gasoline vapors
- C = vapor concentration (ppm by volume)
- v = molar specific volume (standard cubic feet per pound-mole)

CALCULATED INTRINSIC PERMEABILITIES FOR WELL MW22

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	V77	PR48	PR45	V73	V78A	V78B	PR43	pr51	
INPUT PARAMETERS									
Q=	3	3	3	3	3	3	3	3	
T (K)=	288	288	288	288	288	288	288	288	
h=	2	2	2	2	2	2	2	2	
P(ew)=	26	26	26	26	26	26	26	26	
P(ob)=	0.09	0.02	0.05	0.09	0.07	0.45	0.01	0.02	
r(d)=	14.6	25	34.9	19.6	31	6.6	44.3	42.1	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
	-2.04E+04	-2.05E+04	-2.04E+04	-2.04E+04	-2.04E+04	-2.01E+04	-2.05E+04	-2.05E+04	
	-1.27E+11	-1.27E+11	-1.27E+11	-1.27E+11	-1.27E+11	-1.25E+11	-1.27E+11	-1.27E+11	
	4.07E+00	4.61E+00	4.94E+00	4.36E+00	4.82E+00	3.27E+00	5.18E+00	5.13E+00	
k=	4.7	5.3	5.7	5.0	5.5	3.8	5.9	5.9	mean= 5.2

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL MW23

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

INPUT PARAMETERS	PR51	V94	PR53	V12	V78	V66	MW22	PR48	PR30	V4	V77	V73	PR45	V5	PR43	
Q=	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
T (K)=	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288	
h=	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
P(ew)=	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	
P(ob)=	4	3.4	1.15	0.29	0.09	0.7	0.16	8.5	6 2	0 9	0 47	0.1	1	5	0.045	
r(d)=	13 2	22 7	33 2	37	26.8	38 3	26 5	7.3	10 6	20.3	21	34 3	27.3	9.7	47 5	
r(w)=	0.25	0.25	0.25	0.25	0 25	0.25	0.25	0.25	0.25	0.25	0.25	0 25	0.25	0.25	0 25	
	-5.02E+04	-5 06E+04	-5.25E+04	-5 32E+04	-5 33E+04	-5 28E+04	-5.33E+04	-4 66E+04	-4 84E+04	-5.27E+04	-5.30E+04	-5 33E+04	-5 26E+04	-4.94E+04	-5.34E+04	
	-3.11E+11	-3 14E+11	-3.26E+11	-3 30E+11	-3.31E+11	-3.28E+11	-3 31E+11	-2.89E+11	-3.00E+11	-3 27E+11	-3 29E+11	-3.31E+11	-3 26E+11	-3 06E+11	-3 31E+11	
	3 97E+00	4 51E+00	4.89E+00	5.00E+00	4.67E+00	5 03E+00	4.66E+00	3.37E+00	3 75E+00	4 40E+00	4.43E+00	4.92E+00	4 69E+00	3.66E+00	5.25E+00	
k=	29.7	33.4	35 0	35 3	32.9	35.8	32 9	27.2	29.1	31.4	31.4	34 7	33 5	27.8	36 9	mean= 32 5

Notes:
- k= Soil permeability to air flow (Darcy)
- Q= Volumetric flow rate (SCFM)
- T(K)= Soil vapor temperature (degrees K)
- h= Extraction well sand pack length (feet)
- P(ew)= Vacuum applied to the extraction well (inches of water)
- P(ob)= Vacuum measured at observation well (inches of water)
- r(d)= Distance between extraction and observation well (feet)
- r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL PR47

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	V77	PR48	V78B	V73	PR45	PR43	V78A	
INPUT PARAMETERS								
Q=	19	19	19	19	19	19	19	
T (K)=	288	288	288	288	288	288	288	
h=	2	2	2	2	2	2	2	
P(ew)=	59	59	59	59	59	59	59	
P(ob)=	1.25	0.32	1	1.3	0.24	0.09	0.8	
r(d)=	7	19	13.4	15.2	27.2	38	28	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
	-4.35E+04	-4.43E+04	-4.37E+04	-4.35E+04	-4.43E+04	-4.44E+04	-4.39E+04	
	-2.70E+11	-2.75E+11	-2.71E+11	-2.70E+11	-2.75E+11	-2.76E+11	-2.72E+11	
	3.33E+00	4.33E+00	3.98E+00	4.11E+00	4.69E+00	5.02E+00	4.72E+00	
								mean=
k=	11.4	14.5	13.5	14.0	15.7	16.8	16.0	14.6

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL PR48

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	PR51	V94	PR53	PR45	V77	V73	PR43	V7	V4	PR30	
INPUT PARAMETERS											
Q=	7	7	7	7	7	7	7	7	7	7	
T (K)=	288	288	288	288	288	288	288	288	288	288	
h=	2	2	2	2	2	2	2	2	2	2	
P(ew)=	80	80	80	80	80	80	80	80	80	80	
P(ob)=	0.6	0.55	0.19	0.7	0.31	0.03	0.03	0	0.85	0.66	
r(d)=	20.2	29.8	40.4	20.1	15.8	28.9	40.4	30.5	13.1	4.2	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
	-5.82E+04	-5.82E+04	-5.85E+04	-5.81E+04	-5.84E+04	-5.87E+04	-5.87E+04	-5.87E+04	-5.80E+04	-5.82E+04	
	-3.61E+11	-3.61E+11	-3.63E+11	-3.61E+11	-3.63E+11	-3.64E+11	-3.64E+11	-3.64E+11	-3.60E+11	-3.61E+11	
	4.39E+00	4.78E+00	5.09E+00	4.39E+00	4.15E+00	4.75E+00	5.09E+00	4.80E+00	3.96E+00	2.82E+00	
k=	4.1	4.5	4.8	4.1	3.9	4.4	4.7	4.5	3.7	2.7	mean= 4.1

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL PR51

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	MW23	V94	PR53	V78	PR48	PR30	V4	V77	V5	
INPUT PARAMETERS										
Q=	2	2	2	2	2	2	2	2	2	
T (K)=	288	288	288	288	288	288	288	288	288	
h=	2	2	2	2	2	2	2	2	2	
P(ew)=	46	46	46	46	46	46	46	46	46	
P(ob)=	0.1	0.1	0.06	0.01	0.07	0.06	0.01	0.01	0.1	
r(d)=	13.2	9.9	20.5	25.9	20	23.5	32.3	29.6	9.1	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
	-3.52E+04	-3.52E+04	-3.53E+04	-3.53E+04	-3.53E+04	-3.53E+04	-3.53E+04	-3.53E+04	-3.52E+04	
	-2.19E+11	-2.19E+11	-2.19E+11	-2.19E+11	-2.19E+11	-2.19E+11	-2.19E+11	-2.19E+11	-2.19E+11	
	3.97E+00	3.68E+00	4.41E+00	4.64E+00	4.38E+00	4.54E+00	4.86E+00	4.77E+00	3.59E+00	
										mean=
k=	1.8	1.6	2.0	2.1	1.9	2.0	2.2	2.1	1.6	2.0

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL PR53

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	V94	MW23	V5	V64	V12	PR48	PR30	V4	PR45	V77	V78	PR51	
INPUT PARAMETERS													
Q=	4	4	4	4	4	4	4	4	4	4	4	4	
T (K)=	288	288	288	288	288	288	288	288	288	288	288	288	
h=	2	2	2	2	2	2	2	2	2	2	2	2	
P(ew)=	45	45	45	45	45	45	45	45	45	45	45	45	
P(ob)=	0.7	0.3	0.3	0.7	0.03	0.17	0.14	0.02	0.03	0.03	0.01	0.3	
r(d)=	10.4	30.3	27.8	10.8	42.2	40.4	43.9	52.4	60.4	48.4	37	20.3	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
	-3.40E+04	-3.43E+04	-3.43E+04	-3.40E+04	-3.46E+04	-3.44E+04	-3.45E+04	-3.46E+04	-3.46E+04	-3.46E+04	-3.46E+04	-3.43E+04	
	-2.11E+11	-2.13E+11	-2.13E+11	-2.11E+11	-2.14E+11	-2.14E+11	-2.14E+11	-2.15E+11	-2.14E+11	-2.14E+11	-2.15E+11	-2.13E+11	
	3.73E+00	4.80E+00	4.71E+00	3.77E+00	5.13E+00	5.09E+00	5.17E+00	5.35E+00	5.49E+00	5.27E+00	5.00E+00	4.40E+00	
													mean=
k=	3.4	4.4	4.3	3.5	4.6	4.6	4.7	4.8	5.0	4.8	4.5	4.0	4.4

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL PR58

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BEL

	PR68	V87	PR64	V21	V90	PR61	
INPUT PARAMETERS							
Q=	5.8	5.8	5.8	5.8	5.8	5.8	
T (K)=	288	288	288	288	288	288	
h=	2	2	2	2	2	2	
P(ew)=	125	125	125	125	125	125	
P(ob)=	0.03	0	0.02	0.01	0	0	
r(d)=	18.3	40.5	39.6	50.3	31	41.5	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	
	-8.61E+04	-8.61E+04	-8.61E+04	-8.61E+04	-8.61E+04	-8.61E+04	
	-5.34E+11	-5.34E+11	-5.34E+11	-5.34E+11	-5.34E+11	-5.34E+11	
	4.29E+00	5.09E+00	5.07E+00	5.30E+00	4.82E+00	5.11E+00	
							mean=
k=	2.3	2.7	2.7	2.8	2.5	2.7	2.6

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL PR61

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BEL

	PR58	PR68	V87	PR64	V21	V90	
INPUT PARAMETERS							
Q=	6.3	6.3	6.3	6.3	6.3	6.3	
T (K)=	288	288	288	288	288	288	
h=	2	2	2	2	2	2	
P(ew)=	58	58	58	58	58	58	
P(ob)=	0.01	0.13	0	0	0	0	
r(d)=	41.6	44	52.5	22.2	22.2	10	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	
	-4.38E+04	-4.37E+04	-4.38E+04	-4.38E+04	-4.38E+04	-4.38E+04	
	-2.72E+11	-2.71E+11	-2.72E+11	-2.72E+11	-2.72E+11	-2.72E+11	
	5.11E+00	5.17E+00	5.35E+00	4.49E+00	4.49E+00	3.69E+00	
							mean=
k=	5.8	5.8	6.0	5.0	5.0	4.1	5.3

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL PR64

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENT

	PR56	V21	PR60	V90	PR61	PR58	
INPUT PARAMETERS							
Q=	2.7	2.7	2.7	2.7	2.7	2.7	
T (K)=	288	288	288	288	288	288	
h=	2	2	2	2	2	2	
P(ew)=	38	38	38	38	38	38	
P(ob)=	0.05	0.5	0.05	0.44	0.04	0.05	
r(d)=	26.1	10.7	34.1	17.9	20.8	38.8	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	
	-2.94E+04	-2.91E+04	-2.94E+04	-2.91E+04	-2.94E+04	-2.94E+04	
	-1.83E+11	-1.80E+11	-1.83E+11	-1.81E+11	-1.83E+11	-1.83E+11	
	4.65E+00	3.76E+00	4.92E+00	4.27E+00	4.42E+00	5.04E+00	
							mean=
k=	3.3	2.7	3.5	3.1	3.2	3.6	3.2

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL PR68

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENT

	PR58	V87	PR64	V21	V90	PR61	
INPUT PARAMETERS							
Q=	5.3	5.3	5.3	5.3	5.3	5.3	
T (K)=	288	288	288	288	288	288	
h=	2	2	2	2	2	2	
P(ew)=	50	50	50	50	50	50	
P(ob)=	2	0	0	0	0	0	
r(d)=	18.3	23.4	34.4	44.3	35	44.2	
r(w)=	0.25	0.25	0.25	0.25	0.25	0.25	
	-3.66E+04	-3.82E+04	-3.82E+04	-3.82E+04	-3.82E+04	-3.82E+04	
	-2.27E+11	-2.37E+11	-2.37E+11	-2.37E+11	-2.37E+11	-2.37E+11	
	4.29E+00	4.54E+00	4.92E+00	5.18E+00	4.94E+00	5.18E+00	
							mean=
k=	4.9	4.9	5.3	5.6	5.4	5.6	5.3

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL V4

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	PR51	V94	PR53	PR45	V77	V73	PR43	V7	PR30	PR48	
INPUT PARAMETERS											
Q=	23	23	23	23	23	23	23	23	23	23	
T (K)=	288	288	288	288	288	288	288	288	288	288	
h=	6	6	6	6	6	6	6	6	6	6	
P(ew)=	42	42	42	42	42	42	42	42	42	42	
P(ob)=	0.46	0.39	0.13	7	1.4	0.21	0.32	0	6.4	4.7	
r(d)=	32.3	41.9	52.3	9.9	10.5	19.4	27.3	31	12	13	
r(w)=	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	
	-3.20E+04	-3.21E+04	-3.23E+04	-2.68E+04	-3.13E+04	-3.22E+04	-3.21E+04	-3.24E+04	-2.72E+04	-2.86E+04	
	-1.99E+11	-1.99E+11	-2.00E+11	-1.66E+11	-1.94E+11	-2.00E+11	-1.99E+11	-2.01E+11	-1.69E+11	-1.77E+11	
	4.35E+00	4.61E+00	4.83E+00	3.17E+00	3.23E+00	3.84E+00	4.18E+00	4.31E+00	3.36E+00	3.44E+00	
k=	8.1	8.6	9.0	7.1	6.2	7.1	7.8	8.0	7.4	7.2	mean= 7.7

Notes:

- k= Soil permeability to air flow (Darcy)
- Q= Volumetric flow rate (SCFM)
- T(K)= Soil vapor temperature (degrees K)
- h= Extraction well sand pack length (feet)
- P(ew)= Vacuum applied to the extraction well (inches of water)
- P(ob)= Vacuum measured at observation well (inches of water)
- r(d)= Distance between extraction and observation well (feet)
- r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL V7

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	V77	V4	V8	
INPUT PARAMETERS				
Q=	36	36	36	
T (K)=	288	288	288	
h=	6	6	6	
P(ew)=	86	86	86	
P(ob)=	0.02	0.03	0.03	
r(d)=	41.4	31	13.5	
r(w)=	0.417	0.417	0.417	
	-6.26E+04	-6.25E+04	-6.25E+04	
	-3.88E+11	-3.88E+11	-3.88E+11	
	4.60E+00	4.31E+00	3.48E+00	
				mean=
k=	6.9	6.5	5.2	6.2

Notes:

- k= Soil permeability to air flow (Darcy)
- Q= Volumetric flow rate (SCFM)
- T(K)= Soil vapor temperature (degrees K)
- h= Extraction well sand pack length (feet)
- P(ew)= Vacuum applied to the extraction well (inches of water)
- P(ob)= Vacuum measured at observation well (inches of water)
- r(d)= Distance between extraction and observation well (feet)
- r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL V12

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	V53	V31	V30	V28	V56	MW23	V7	PR45	V5	PR30	
INPUT PARAMETERS											
Q=	22	22	22	22	22	22	22	22	22	22	
T (K)=	288	288	288	288	288	288	288	288	288	288	
h=	6	6	6	6	6	6	6	6	6	6	
P(ew)=	60	60	60	60	60	60	60	60	60	60	
P(ob)=	0.7	0.1	0.24	0.09	0.25	0.26	0	0.35	0.08	0.15	
r(d)=	39	37.6	46.5	63.7	52	37	40.5	55	42.7	42	
r(w)=	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	
	-4.46E+04	-4.51E+04	-4.50E+04	-4.51E+04	-4.50E+04	-4.50E+04	-4.52E+04	-4.49E+04	-4.52E+04	-4.51E+04	
	-2.77E+11	-2.80E+11	-2.79E+11	-2.80E+11	-2.79E+11	-2.79E+11	-2.81E+11	-2.79E+11	-2.80E+11	-2.80E+11	
	4.54E+00	4.50E+00	4.71E+00	5.03E+00	4.83E+00	4.49E+00	4.58E+00	4.88E+00	4.63E+00	4.61E+00	
k=	5.8	5.7	6.0	6.4	6.2	5.7	5.8	6.2	5.9	5.9	mean= 6.0

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL V21

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BEL

	PR64	PR56	PR58	V90	PR61	PR68	V87	
INPUT PARAMETERS								
Q=	28	28	28	28	28	28	28	
T (K)=	288	288	288	288	288	288	288	
h=	6	6	6	6	6	6	6	
P(ew)=	36	36	36	36	36	36	36	
P(ob)=	5	0.01	0	0.9	0.05	4	0	
r(d)=	10.7	20.4	50	27	26.6	44.2	42.2	
r(w)=	0.417	0.417	0.417	0.417	0.417	0.417	0.417	
	-2.40E+04	-2.80E+04	-2.80E+04	-2.73E+04	-2.80E+04	-2.48E+04	-2.80E+04	
	-1.49E+11	-1.74E+11	-1.74E+11	-1.69E+11	-1.73E+11	-1.54E+11	-1.74E+11	
	3.24E+00	3.89E+00	4.79E+00	4.17E+00	4.16E+00	4.66E+00	4.62E+00	
k=	9.9	10.2	12.5	11.2	10.9	13.8	12.0	mean= 11.5

Notes:

- k= Soil permeability to air flow (Darcy)
- Q= Volumetric flow rate (SCFM)
- T(K)= Soil vapor temperature (degrees K)
- h= Extraction well sand pack length (feet)
- P(ew)= Vacuum applied to the extraction well (inches of water)
- P(ob)= Vacuum measured at observation well (inches of water)
- r(d)= Distance between extraction and observation well (feet)
- r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL V55

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	V53	V31	V30	V28	V26	V56	PR68	V24	
INPUT PARAMETERS									
Q=	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	
T (K)=	288	288	288	288	288	288	288	288	
h=	6	6	6	6	6	6	6	6	
P(ew)=	38	38	38	38	38	38	38	38	
P(ob)=	0.17	0.06	0.18	0.11	0.23	0.3	0.06	0.06	
r(d)=	16.2	26.8	27.4	38	31.6	9.6	44	46.5	
r(w)=	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	
	-2.93E+04	-2.94E+04	-2.93E+04	-2.94E+04	-2.93E+04	-2.92E+04	-2.94E+04	-2.94E+04	
	-1.82E+11	-1.83E+11	-1.82E+11	-1.82E+11	-1.82E+11	-1.81E+11	-1.83E+11	-1.83E+11	
	3.66E+00	4.16E+00	4.19E+00	4.51E+00	4.33E+00	3.14E+00	4.66E+00	4.71E+00	
k=	3.1	3.5	3.5	3.8	3.7	2.7	3.9	4.0	mean= 3.5

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL V78A

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	PR44	PR42	PR41	PR43	V72	V77	PR45	V73	
INPUT PARAMETERS									
Q=	25	25	25	25	25	25	25	25	
T (K)=	288	288	288	288	288	288	288	288	
h=	6	6	6	6	6	6	6	6	
P(ew)=	60	60	60	60	60	60	60	60	
P(ob)=	0.02	3	5	0.8	1.4	0.9	0.38	1.3	
r(d)=	12.6	15.5	8.1	22.3	11.9	25.4	31.9	12.8	
r(w)=	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	
	-4.52E+04	-4.28E+04	-4.12E+04	-4.46E+04	-4.41E+04	-4.45E+04	-4.49E+04	-4.42E+04	
	-2.80E+11	-2.65E+11	-2.55E+11	-2.77E+11	-2.74E+11	-2.76E+11	-2.79E+11	-2.74E+11	
	3.41E+00	3.62E+00	2.97E+00	3.98E+00	3.35E+00	4.11E+00	4.34E+00	3.42E+00	
k=	4.9	5.5	4.7	5.8	5.0	6.0	6.3	5.1	mean= 5.4

Notes:

- k= Soil permeability to air flow (Darcy)
- Q= Volumetric flow rate (SCFM)
- T(K)= Soil vapor temperature (degrees K)
- h= Extraction well sand pack length (feet)
- P(ew)= Vacuum applied to the extraction well (inches of water)
- P(ob)= Vacuum measured at observation well (inches of water)
- r(d)= Distance between extraction and observation well (feet)
- r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL V90

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENT

	PR61	PR58	PR68	V87	V21	PR64	
INPUT PARAMETERS							
Q=	25	25	25	25	25	25	
T (K)=	288	288	288	288	288	288	
h=	6	6	6	6	6	6	
P(ew)=	60	60	60	60	60	60	
P(ob)=	0.22	0.02	0	0	0.45	2.4	
r(d)=	10.3	30.8	35	46.6	27	18.6	
r(w)=	0.417	0.417	0.417	0.417	0.417	0.417	
	-4.50E+04	-4.52E+04	-4.52E+04	-4.52E+04	-4.49E+04	-4.33E+04	
	-2.79E+11	-2.80E+11	-2.81E+11	-2.81E+11	-2.78E+11	-2.68E+11	
	3.21E+00	4.30E+00	4.43E+00	4.72E+00	4.17E+00	3.80E+00	
							mean=
k=	4.6	6.2	6.4	6.8	6.1	5.7	6.0

Notes:

k= Soil permeability to air flow (Darcy)
Q= Volumetric flow rate (SCFM)
T(K)= Soil vapor temperature (degrees K)
h= Extraction well sand pack length (feet)
P(ew)= Vacuum applied to the extraction well (inches of water)
P(ob)= Vacuum measured at observation well (inches of water)
r(d)= Distance between extraction and observation well (feet)
r(w)= Radius of extraction well bore hole

CALCULATED INTRINSIC PERMEABILITIES FOR WELL V94

AIR PERMEABILITIES (k) CALCULATED FROM SINGLE EQUILIBRATED VACUUM READINGS AND MEASUREMENTS SHOWN BELOW

	PR53	MW23	V5	V64	V12	PR48	PR30	V4	PR45	V77	V78	PR51	V73	PR43	
INPUT PARAMETERS															
Q=	77	77	77	77	77	77	77	77	77	77	77	77	77	77	
T (K)=	288	288	288	288	288	288	288	288	288	288	288	288	288	288	
h=	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
P(ew)=	72	72	72	72	72	72	72	72	72	72	72	72	72	72	
P(ob)=	13.5	17	16	10.5	1 5	9	6.5	1.25	1.05	0.8	0.42	21	0.36	0 52	
r(d)=	10.4	22.7	17.4	15.1	37.7	29.6	33.3	41.8	49.8	38.5	30.1	9.5	50.5	68.9	
r(w)=	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	
	-4.26E+04	-3.99E+04	-4.06E+04	-4.50E+04	-5 22E+04	-4.62E+04	-4.81E+04	-5.24E+04	-5.25E+04	-5.27E+04	-5.31E+04	-3.68E+04	-5.31E+04	-5.30E+04	
	-2.64E+11	-2.47E+11	-2.52E+11	-2.79E+11	-3.24E+11	-2.86E+11	-2.99E+11	-3.25E+11	-3.26E+11	-3.27E+11	-3.29E+11	-2.28E+11	-3.30E+11	-3.29E+11	
	3.22E+00	4.00E+00	3.73E+00	3.59E+00	4.50E+00	4.26E+00	4.38E+00	4.61E+00	4.78E+00	4.53E+00	4.28E+00	3.13E+00	4.80E+00	5.11E+00	
k=	15.2	20.1	18 4	16.0	17.3	18.5	18.3	17.7	18.3	17.2	16.2	17.1	18.1	19.4	mean= 17.7

Notes:
- k= Soil permeability to air flow (Darcy)
- Q= Volumetric flow rate (SCFM)
- T(K)= Soil vapor temperature (degrees K)
- h= Extraction well sand pack length (feet)
- P(ew)= Vacuum applied to the extraction well (inches of water)
- P(ob)= Vacuum measured at observation well (inches of water)
- r(d)= Distance between extraction and observation well (feet)
- r(w)= Radius of extraction well bore hole

Appendix C

Principles and Techniques of Soil Vapor Surveys

PRINCIPLES AND TECHNIQUES OF SOIL VAPOR SURVEY

SVCA PRINCIPLES

The soil vapor survey, or SVCA, technique takes advantage of the behavior of hydrocarbon mixtures and the physicochemical properties of the individual components in the subsurface. Following a subsurface gasoline release, liquid-phase hydrocarbons (LPH) will migrate downward toward the groundwater; some of the gasoline will volatilize, and some will adsorb to the soils. In the case of a spill of sufficient volume to exceed the soil binding capacity, LPH will reach groundwater, at which point it will float and may begin to vaporize and solubilize.

Gasoline is a complex mixture of many compounds, each with its own physicochemical properties. The hydrocarbons found in groundwater located beneath a layer of floating hydrocarbon are generally the less-hydrophobic constituents and are generally found in concentrations roughly proportional to the hydrocarbon/water partition coefficient (i.e., the relative solubility of a given compound in the bulk hydrocarbon to its solubility in water) and to their percent composition in the gasoline. It may be noted that the concentration of total benzene, toluene, and xylenes in product-saturated water may exceed 10–20 mg/L (API 1985).

Hydrocarbons will also volatilize into the air- or gas-filled soil interstices. Volatilization is largely a function of vapor pressure. The natures of the hydrocarbons, in terms of specific constituent component mixtures, in the aqueous and vapor phases are distinctly different from each other and from that of the gasoline as a whole. The more hydrophilic hydrocarbons will be more likely to move into groundwater, while the more volatile compounds are more likely to move into the vapor phase, and the compounds that are both less volatile and more hydrophobic are more likely to remain in LPH or be adsorbed to soils (Hinchee and Reisinger 1987).

Hydrocarbons not remaining in the liquid phase will partition into either groundwater or soil vapor and migrate as the result of a variety of interacting forces. In groundwater, hydrocarbons will migrate with the groundwater, interacting with the rock or soil geological medium. As the hydrocarbons pass through a medium, organic constituents in the medium interact with the hydrocarbons, and some are adsorbed or bound to particle surfaces (Bruell and Hoag 1986). The result is a net retardation in the velocity of movement of those compounds relative to that of the groundwater in which they are dissolved. The process is analogous to laboratory chromatography. The compound with the least affinity for the porous medium is least retarded and therefore moves most rapidly. This compound, then, is present at the leading edge of the dissolved hydrocarbon plume.

The affinity of a compound for the soil porous medium is partly a function of the compound's hydrophobicity--that is, the more hydrophobic a compound the more likely it is to adsorb to the solid medium. Aqueous solubility is a good indicator of hydrophobicity: the more soluble

a compound is, the less hydrophobic and more hydrophilic it is, and vice versa. Vapor pressure is a good indicator of volatility; compounds with higher vapor pressures are more volatile.

In determining the environmental fate of various hydrocarbon compounds in a hydrocarbon mixture such as gasoline, those which have a high vapor pressure are more likely to move into the vapor phase, or evaporate. Compounds with high solubility are more likely to move into groundwater from the LPH and, once in groundwater, tend to move more rapidly. Compounds of low vapor pressure and low solubility tend to remain in the LPH or be adsorbed to the solid matrix and remain relatively immobile.

Dissolved compounds will tend to volatilize from the aqueous phase. The Henry's Law constant is the equilibrium ratio of a compound's concentration in the vapor phase to its concentration in the aqueous phase. The higher a compound's Henry's Law constant, the greater its tendency to volatilize from water into air.

Figure A-1 graphically illustrates the vapor pressures, aqueous solubilities, and Henry's Law constants for selected hydrocarbons typically found in gasoline. The Henry's Law constant is approximated here as the ratio of vapor pressure to solubility.

The Henry's Law constant is directly related to the tendency of compounds to volatilize rather than solubilize. Compounds with Henry's Law constants greater than 0.001 ($atm \cdot m^3/mole$) volatilize from water into air very rapidly (Lyman et al. 1982); those with Henry's Law constants greater than 0.01 ($atm \cdot m^3/mole$) are generally volatilized so rapidly that they are seldom found in gasoline-impacted groundwater. It may be observed (Figure A-1) that tetraethyl lead (TEL) has an extremely low solubility and a relatively low vapor pressure. As a result, this constituent would not be expected to solubilize and migrate in groundwater, and although its low vapor pressure would indicate slow volatilization, its Henry's Law constant indicates that it may be more rapidly volatilized than solubilized. The fate of TEL would be expected to be long-term binding to the soil.

On the basis of these properties it can be seen that associated with any hydrocarbons in groundwater or soil or in the liquid phase are vapor-phase hydrocarbons. The SVCA technique takes advantage of this, and through the collection and analysis of soil vapor permits a rapid, cost-effective delineation of the extent of impacted soil or groundwater.

SVCA TECHNIQUES

To collect and analyze a soil vapor sample, a hollow steel sampling probe (Figure A-2) with a slotted tip is driven into the soil to a specified depth below ground surface and a vacuum pump is attached to purge approximately five probe volumes of vapor. Purging vapors from the probe ensures that the sample of vapor taken at the specified depth is not affected by vapors collected higher in the probe and that the sample represents vapor in the soil at that depth. Purging requires between 1 and 20 minutes. A vacuum gauge on the sampling apparatus measures the vacuum between the tip of the probe and the pump. After the appropriate

purging period, a valve is closed and the vacuum in the probe decays. The vacuum reading during the purge and the vacuum release time are recorded on the SVCA data sheet.

In general, the soil's permeability to gas is indicated by the vacuum during purge and the vacuum release time. A short vacuum release time suggests that soil gases flow freely through the vadose zone to the probe; a long vacuum release time indicates a high resistance to soil gas transport, which may result in a hydrocarbon concentration measurement that is below the actual level. In most situations, vacuum release is rapid (within three minutes), and the sample is considered to be representative of the soil vapor at the sampled depth.

The samples are collected through a septum with a microliter syringe and injected into a Photovac 10S50 gas chromatograph for analysis. The Photovac 10S50 is a portable, programmable, integrating gas chromatograph with a photoionization detector (PID). The PID is a nondestructive flow-through detector that uses high-energy ultraviolet radiation as its ionization source. Vapor samples are injected into the gas chromatograph, separated on an analytical column, and sensed by the detector. The high-energy radiation ionizes compounds, generating an energy increase in the detector which appears as an electrical signal, measured in volts; this is integrated across time by the instrument to give a value for the peak in volt-seconds (V-sec). Blanks are run to verify that the system is free of hydrocarbons. Standards are run every 8–12 samples to ensure system reproducibility. The instrument is initially calibrated with the second of two consecutive standard runs in which the recovery of each component in the second run is within 70–130 percent of the corresponding component of the first run. If a standard falls out of the 70–130 percent range, the instrument is recalibrated.

The instrument is calibrated with a multicomponent standard consisting of 21.2 ppm benzene, 26.5 ppm toluene, 20.5 ppm o-xylene, 42.4 ppm m- and p-xylenes, and 16.4 ppm ethylbenzene. A standard containing 11.2 ppm trichloroethene (TCE) and 9.65 ppm perchloroethene (PCE) is also used. During calibration the integrator calculates and stores the response ratio, V-sec:ppm, for each of these constituents. Those ratios are used to quantify the concentrations of identifiable vapors in field samples according to their V-sec values.

The concentrations of unidentified compounds are estimated in a similar manner. In the table describing the results of the assessment, the column titled "Peaks Prior to Benzene" represents the sum of the responses in V-sec for all peaks eluting before benzene, proportioned to the calibrated V-sec response for toluene. Similarly, the column titled "Unidentified Peaks after Benzene" represents the sum of V-sec responses for unidentified components eluting after benzene, also proportioned to the average V-sec response for toluene. The column titled "Total Volatile Hydrocarbons" represents the sum of estimated and measured values (ppm) for all detected components.

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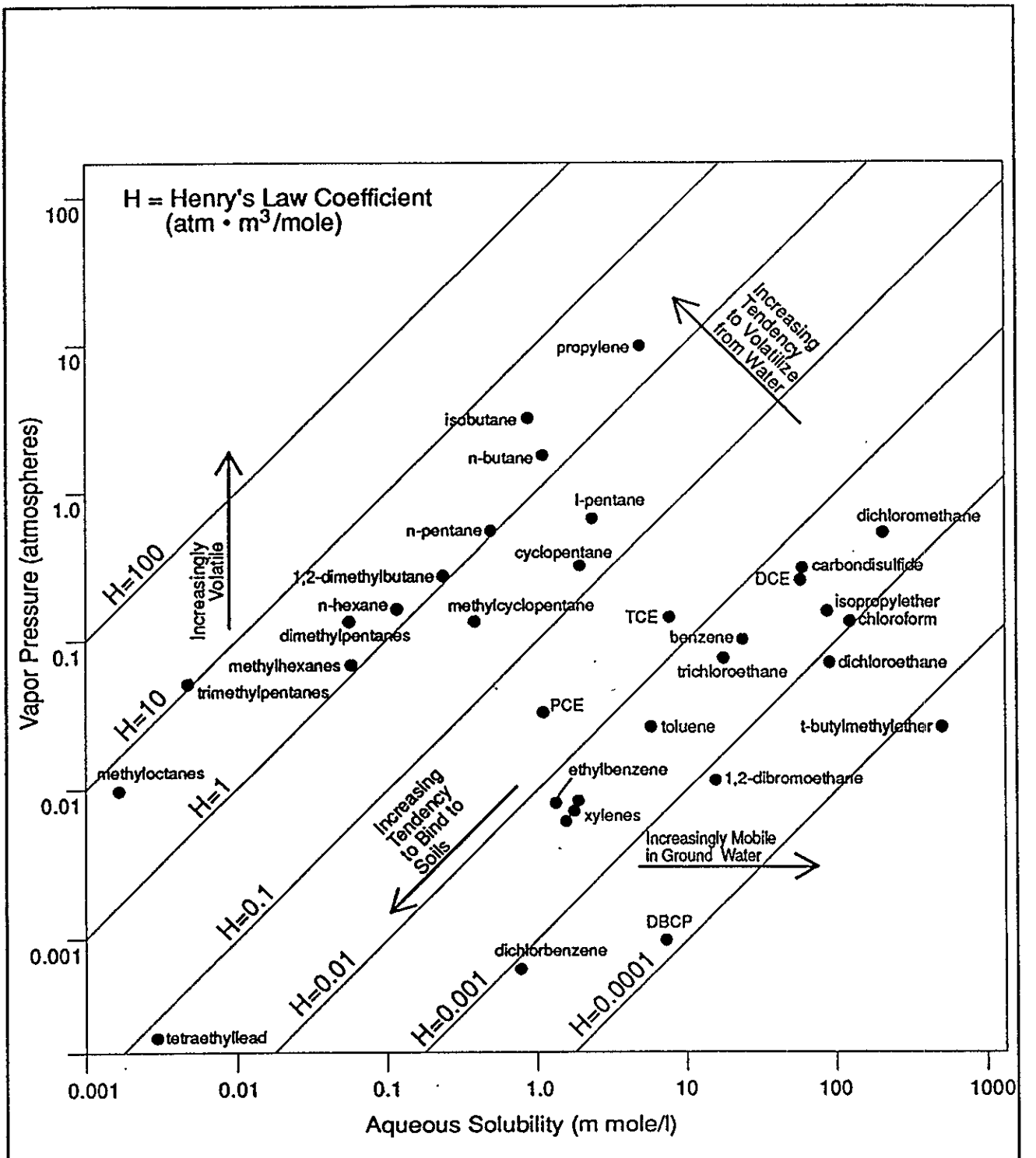

Figure 1. Vapor pressures, solubilities, and corresponding Henry's Law constants of selected volatile chemicals.

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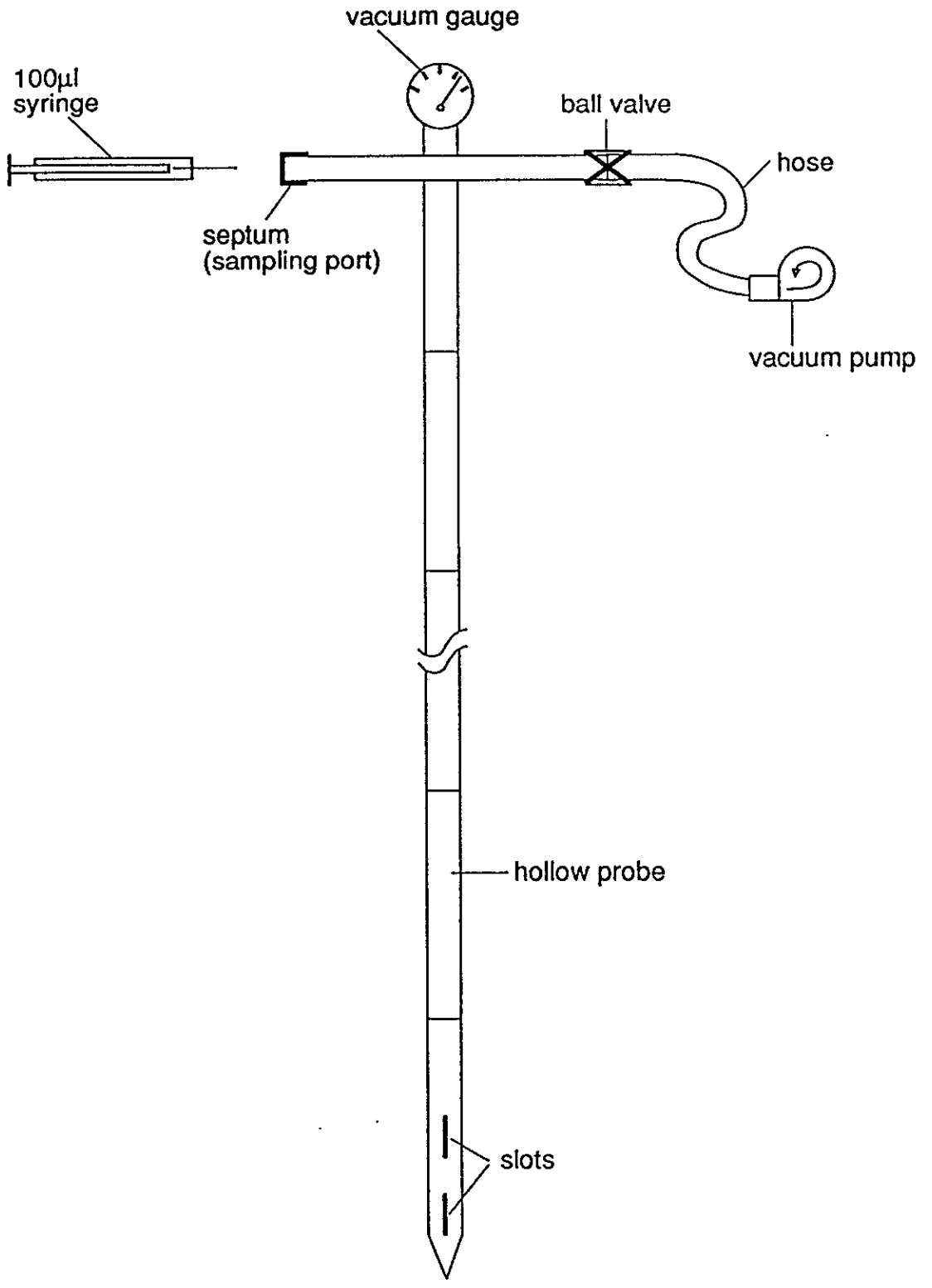

Figure 2. Schematic diagram of soil-gas sampling apparatus.

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Appendix D

Air Sparging Well Installation

TABLE E-1 CONSTRUCTION DETAILS FOR AIR SPARGING WELLS, NESTLE FACILITY, 1310 14th STREET, OAKLAND, CALIFORNIA, 18 MARCH 1996

Well Number	Elevation TOC (ft msl)	Casing Material	Total Depth (ft)	Well Depth (ft)	Borehole Diameter (inches)	Casing Diameter (inches)	Screened Interval (ft)	Slot Size (inches)	Filter Pack Interval (ft)	Filter Pack Material
AS1	NM	PVC	17.4	17.4	8.25	2	15.4-17.4	0.020	14-17.4	#3 Lonestar Sand
AS2	NM	PVC	19.5	19.5	8.25	2	17.5-19.5	0.020	17-19.5	#3 Lonestar Sand
AS3	NM	PVC	20	20	8.25	2	18-20	0.020	17-20	#3 Lonestar Sand

NM Not measured.

D. AIR SPARGING WELL CONSTRUCTION

D.1 SITE GEOLOGY AND HYDROGEOLOGY

The soils observed during drilling consisted primarily of clayey, silty, fine-grained sand from below the concrete surface down to a depth of 20 feet bgs, the total depth explored. A localized sandy clay layer approximately 0.5 feet thick was encountered in boring AS1 at a depth of 6.5 feet bgs. Groundwater stabilized at depths of 6.48 feet bgs (AS1), 6.12 feet bgs (AS2), and 12.87 feet bgs (AS3), measured from the top of the well casing. EA personnel left the site before AS3 stabilized, therefore the depth measured on 18 March 1996 does not represent the actual static water level. Soil boring logs and well completion diagrams are included in the appendix.

D.2 DRILLING OF SOIL BORINGS AND WELLS

The locations of wells AS1–AS3 are shown inFigure E-1.

Soil borings AS1–S3 were drilled on 18 March 1996. The soil beneath each boring location was exposed by cutting the concrete and hand-augering down to 5 feet below ground surface. The borings were drilled by Woodward Drilling of Rio Vista, California (C57 License #581639), using a truck-mounted rotary drill equipped with hollow-stem augers. Borings AS1- AS3 were drilled with 8.25-inch hollow stem augers to depths of 17.4 feet bgs (AS1), 19.5 feet bgs (AS2), and 20 feet bgs (AS3). The augers were decontaminated by steam cleaning prior to drilling and before drilling each new borehole. Decontamination water was collected in a trough, pumped into a 55-gallons drum, and stored on the site Boring logs and well construction diagrams are presented in this appendix. A detailed description of drilling methods and procedures is provided in Attachment 1 to this appendix..

D.3 SOIL SAMPLING

Soil samples were collected continuously from 5 to 17.4 feet bgs while drilling AS1. During the drilling of AS2, soil samples were collected every 5 feet for the first 15 feet, and then continuously to 19.5 feet bgs; the bottom of the boring. AS3 was drilled inside the service garage. Due to low clearance in the garage, Woodward was unable to raise the mast on the drill rig, so no samples were collected during drilling. The soil samples were obtained by driving an 18-inch by 2.5-inch California-modified split-spoon sampler, containing three 2-inch by 6-inch brass liners, ahead of the augers into undisturbed soil. The contents of the liners were examined for soil characteristics and screened with an organic vapor analyzer (OVA) to determine the relative hydrocarbon content. The soils are described and the OVA readings are shown on the soil boring logs. The lithology encountered in borehole AS3 was described by looking at drill cuttings rather than split spoon samples. All soil cuttings accumulated during drilling were placed on and covered with Visqueen plastic sheeting and stored at the site.

D.4 AIR SPARGING WELL INSTALLATION

Boreholes AS1–AS3 were completed as three air sparging wells in accordance with the *Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites* (RWQCB 1990) and EA's protocols (Attachment 1 to this appendix), under well permit conditions issued by the Alameda County Flood Control and Water Conservation District, Zone 7. Table D-1 provides a summary of well construction details.

Wells AS1–AS3 were constructed with 2-inch diameter Schedule 40 PVC well casing. All three wells were screened with 2 feet of 0.020-inch machine slotted schedule 40 PVC casing, placed from 15.4 to 17.4 feet bgs (AS1), 17.5–19.5 feet bgs (AS2), and 18–20 feet bgs (AS3). A filter pack of #3 Monterey sand was placed from 14 to 17.4 feet bgs (AS1), 17–19.5 feet bgs (AS2), and 17–20 feet bgs (AS3). The wells were sealed with a 2-foot layer of hydrated bentonite pellets, followed by a neat cement grout to the ground surface.

D.5 AIR SPARGING WELL DEVELOPMENT

An attempt was made to develop the air sparge wells on 2 April 1996 by surging with a 2-inch surge block. The surge block became lodged in AS1 during development. The well became unusable after many unsuccessful attempts to free the surge block. Wells AS2 and AS3 were purged with a 2-inch PVC pipe connected to a truck-mounted vacuum until the water appeared to be free of silt and turbidity.

D.6 GROUNDWATER SAMPLING

Groundwater grab samples were collected from AS3 on 3 April and from MW25, MW26, and MW28 (Figure D-1) on 4 April 1996. Samples were collected using clean diposable bailer without purging. The samples were labeled with the time, date, location, and sample identification number and placed in a cooler filled with ice for delivery to Nestle U.S.A. Quality Assurance laboratory in Dublin, Ohio. The samples were analyzed for VOCs by EPA Methods 8010 and 8020. Samples were collected to provide baseline data prior to air sparging. The laboratory report is included in Appendix E.

D.7 REFERENCES

RWQCB (Regional Water Quality Control Board). 1990. Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Storage Tank Sites. RWQCB, San Francisco Bay Region, Oakland, CA.

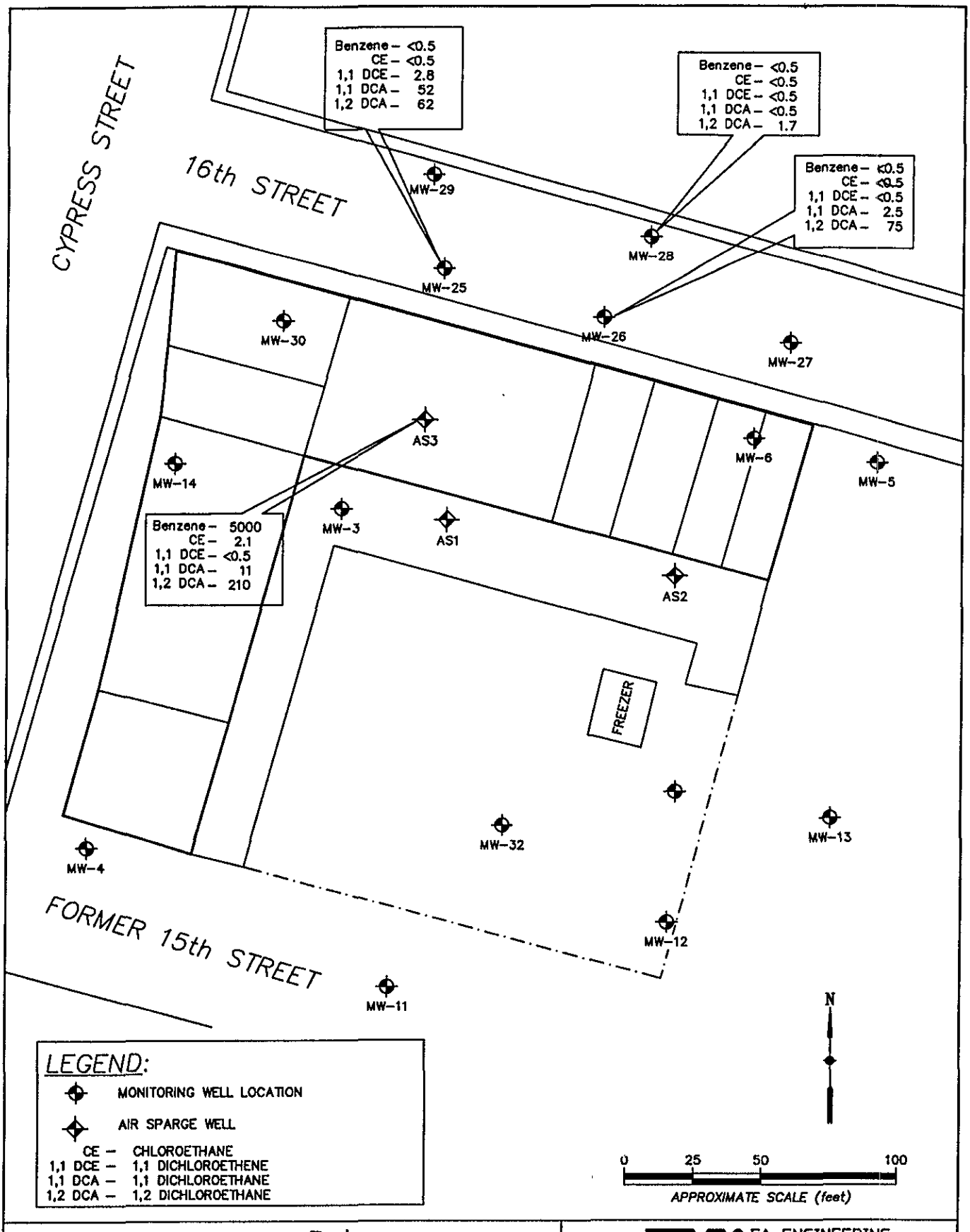


FIGURE E-1
GROUNDWATER SAMPLING
ANALYTICAL RESULTS (ug/L) SUMMARY
NESTLE FACILITY, OAKLAND, CALIFORNIA
3,4 APRIL 1996

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

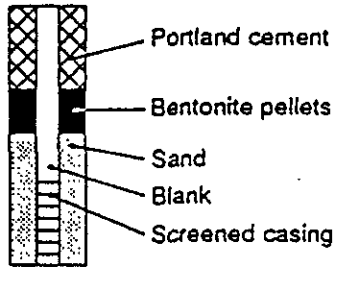
PROJECT NO.	DATE
60966.01.0008	6/6/96
FILE NAME: NESTLE.DWG	REVIEWED BY: J. MUEHLECK

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

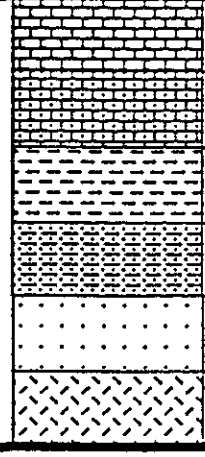
UNIFIED SOIL CLASSIFICATION SYSTEM AND SYMBOLS USED ON EA DRILL LOGS

Major Divisions					Typical Names
COARSE-GRAINED SOILS more than half is coarser than No. 200 sieve	GRAVELS more than half coarse fraction is larger than No. 4 sieve size	clean gravels with little or no fines	GW		Well graded gravels with or without sand, little or no fines.
			GP		Poorly graded gravels with or without sand, little or no fines.
		gravels with over 12% fines	GM		Silty gravels, silty gravels with sand.
			GC		Clayey gravels, clayey gravels with sand.
	SANDS more than half coarse fraction is smaller than No. 4 sieve size	clean sands with little or no fines	SW		Well graded sands with or without gravel, little or no fines.
			SP		Poorly graded sands with or without gravels, little or no fines.
		sands with over 12% fines	SM		Silty sands with or without gravel.
			SC		Clayey sands with or without gravel.
FINE-GRAINED SOILS more than half is finer than No. 200 sieve	SILTS AND CLAYS liquid limit 50% or less		ML		Inorganic silts and very fine sands, rock flour, silts with sands and gravels.
			CL		Inorganic clays of low to medium plasticity, clays with sands and gravels, lean clays.
			OL		Organic silts or clays of low plasticity.
	SILTS AND CLAYS liquid limit greater than 50%		MH		Inorganic silts, micaceous or diatomacious, fine sandy or silty soils, elastic silts.
			CH		Inorganic clays of high plasticity, fat clays.
			OH		Organic silts or clays of medium to high plasticity.
HIGHLY ORGANIC SOILS			Pt		Peat and other highly organic soils.

SYMBOLS



DRILL LOG ROCK TYPES



Limestone

Dolomite

Mudstone

Siltstone

Sandstone

Igneous

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LOG OF SOIL BORING **AS1**

Coordinates

CLIENT	PROJECT NUMBER	LOCATION
Nestle USA	60966.01	1310 14th Street Oakland, CA

DRILLING AND SAMPLING METHODS: Hollow Stem Auger, 8.25" O.D., 2.5" Split Spoon Sampler.

				DRILLING START	DRILLING FINISH
Water Level	8.7	6.48			
Time	1100	1535		TIME 0930	TIME 1030
Date	3/18/96	3/18/96		DATE 3/18/96	DATE 3/18/96
Reference	Ground Surface	Ground Surface			

SURFACE CONDITIONS: Concrete (5")

DESCRIPTION by: D. Conkle

Inches Driven	Inches Recovered	Blows/6" Sampler	OVA Reading	WELL DETAIL	DEPTH (feet)	GRAPHIC LOG
					0	
					1	
					2	
					3	SM/SC
					4	
18	18	16, 22	8,500		5	
18	18	25, 12	>10,000 (2% LEL)		6	
		16, 25			7	CL
18	14	8, 10	>10,000 (>2% LEL)		8	
18	18	10, 10			9	SM/SC
		12, 12			10	
					11	
					12	
18	18	8, 10	710,000 (5% LEL)		13	SM/SC
		12			14	
18	18	3, 4	>10,000 (>3% LEL)		15	SC
		5			16	
					17	SM/SC
18	13	3, 6	1,920		18	
		7			19	
					20	

Concrete

At 0.5' - dusky yellowish brown (10YR 2/2) silty sand, trace fines and clay, fine grained, poorly graded, well rounded, loose, slightly moist, no odor.

Lighter color with depth.

At 5' - moderate brown (5YR 4/4), silty clayey sand, trace fines (10-15%), fine grained, poorly graded, well rounded, dense, moist, HC odor.
At 6.5' - sandy clay, increase in clay (>50%), dense, sand is fine grained, HC odor.
At 7' - moderate brown (5YR 4/4) clayey silty sand, trace fines (10-15%), poorly graded, well rounded, very moist to wet, HC odor.

At 11' - moderate brown (5YR 4/4) clayey silty sand, trace fines (10-15%), fine grained, poorly graded, well rounded, very moist to wet, HC odor.

At 13' - olive gray with dark blue mottling clayey silty sand, fine grained, well rounded, poorly graded, medium dense, very moist, HC odor.

At 15' - moderate brown (5YR 4/4) with gray mottling clayey sand, increase in clay (30%), poorly graded, well rounded, very moist, HC odor.

At 17' - moderate brown (5YR 4/4) with dark brown mottling clayey silty sand, decrease in clay (<10%), wet, HC odor.

TOTAL DEPTH: 17.4'

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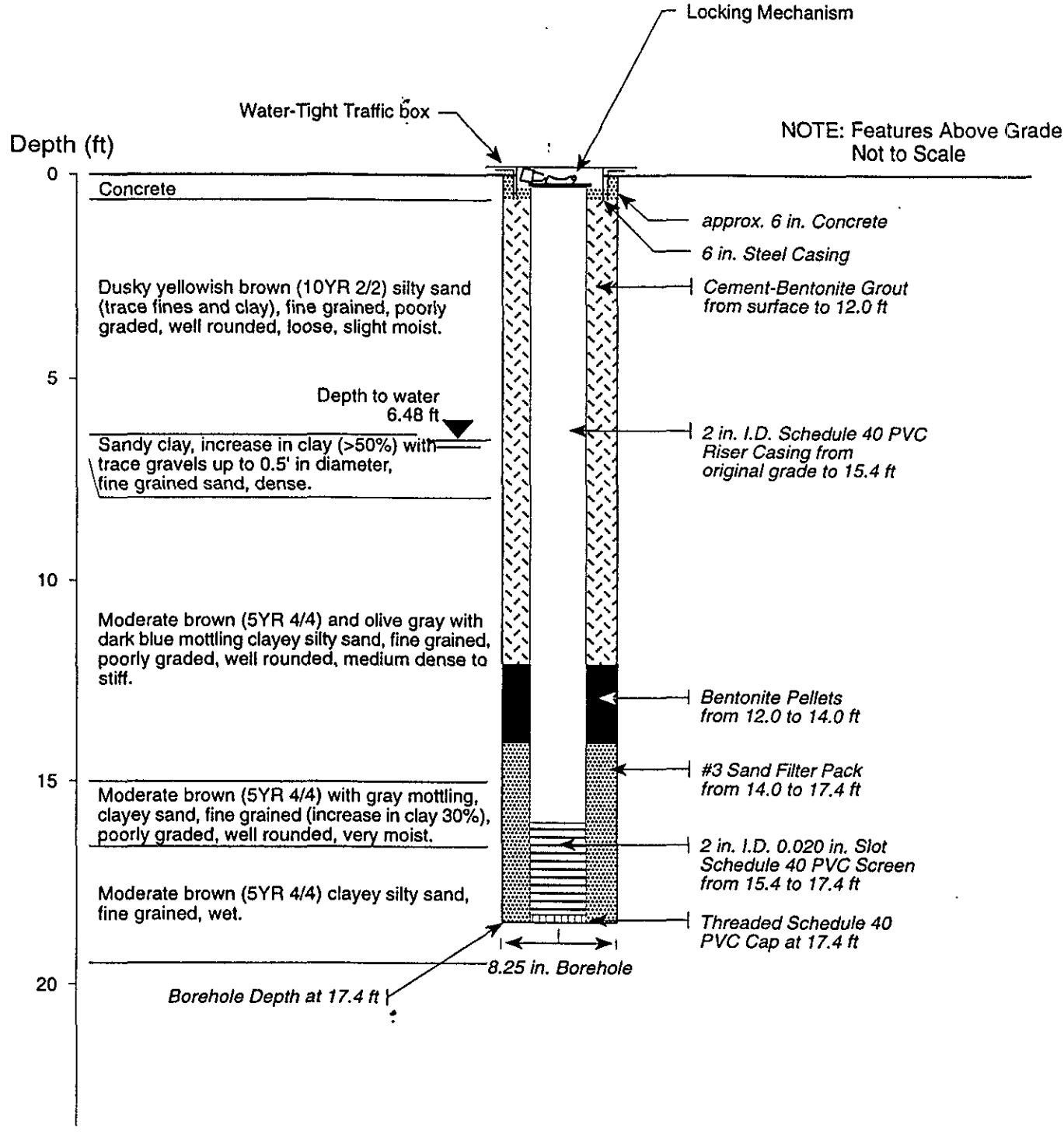
WELL COMPLETION DIAGRAM FOR AIR SPARGING WELL AS1



EA ENGINEERING, SCIENCE, AND TECHNOLOGY

Client: Nestle, U.S.A.

Site: 60966.01

Location: 1310 14th Street, Oakland, California.

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

LOG OF SOIL BORING **AS2**

Coordinates

CLIENT	PROJECT NUMBER	LOCATION
Nestle USA	60966.01	1310 14th Street Oakland, CA

DRILLING AND SAMPLING METHODS: Hollow Stem Auger, 8.25" O.D., 2.5" Split Spoon Sampler.

				DRILLING START	DRILLING FINISH
Water Level	7.20	6.12			
Time	1235	1525		TIME 1100	TIME 1200
Date	3/18/96	3/18/96		DATE 3/18/96	DATE 3/18/96
Reference	TOC	TOC			

SURFACE CONDITIONS: Concrete (6")

DESCRIPTION by: D. Conkle

Inches Driven	Inches Recovered	Blows/6" Sampler	OVA Reading	WELL DETAIL	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION
					0		Concrete.
					1		At 0.5' - dusky yellowish brown (10YR 2/2) silty sand, trace fines and clay, fine grained, poorly graded, well rounded, slightly moist, no odor.
					2	SM/SC	
					3		
					4		
					5		
18	18	14	>10,000 (1.3% LEL)			SM	Dark yellowish brown (10YR 2/2) with rusty mottling silty sand, trace fines, fine grained, poorly graded, well rounded, slightly moist, HC odor.
		20			6		
		25			7		
					8		
					9		
					10		
18	18	10	>10,000 (1.5% LEL)				Dark yellowish brown (10YR 2/2) clayey silty sand, (trace fines and clay), fine grained, poorly graded, well rounded, medium dense, very moist to wet, HC odor.
		12			11		At 11.5' - olive gray (staining).
		14			12	SM/SC	
					13		
					14		
					15		At 15' - moderate brown (5YR 4/4) to dark yellowish brown (10YR 4/2) clayey silty sand, increase in clay (30%), poorly graded, well rounded, loose, very moist to wet, HC odor.
18	18	2					
		3			16		At 16.5' - dark yellowish brown (10YR 4/2) to dark olive gray silty sand, poorly graded, well rounded, very moist to wet.
18	18	5	3,095				
		10			17		At 18' - olive gray silty sand, trace fines, well sorted, poorly graded, wet, HC odor.
		12				SM	
		14			18		At 19' - moderate brown (5YR 3/4) silty sand, few fines poorly graded, well rounded, wet, no HC odor.
18	18	20	365				TOTAL DEPTH: 19.5'
		25			19		
		33					
					20		

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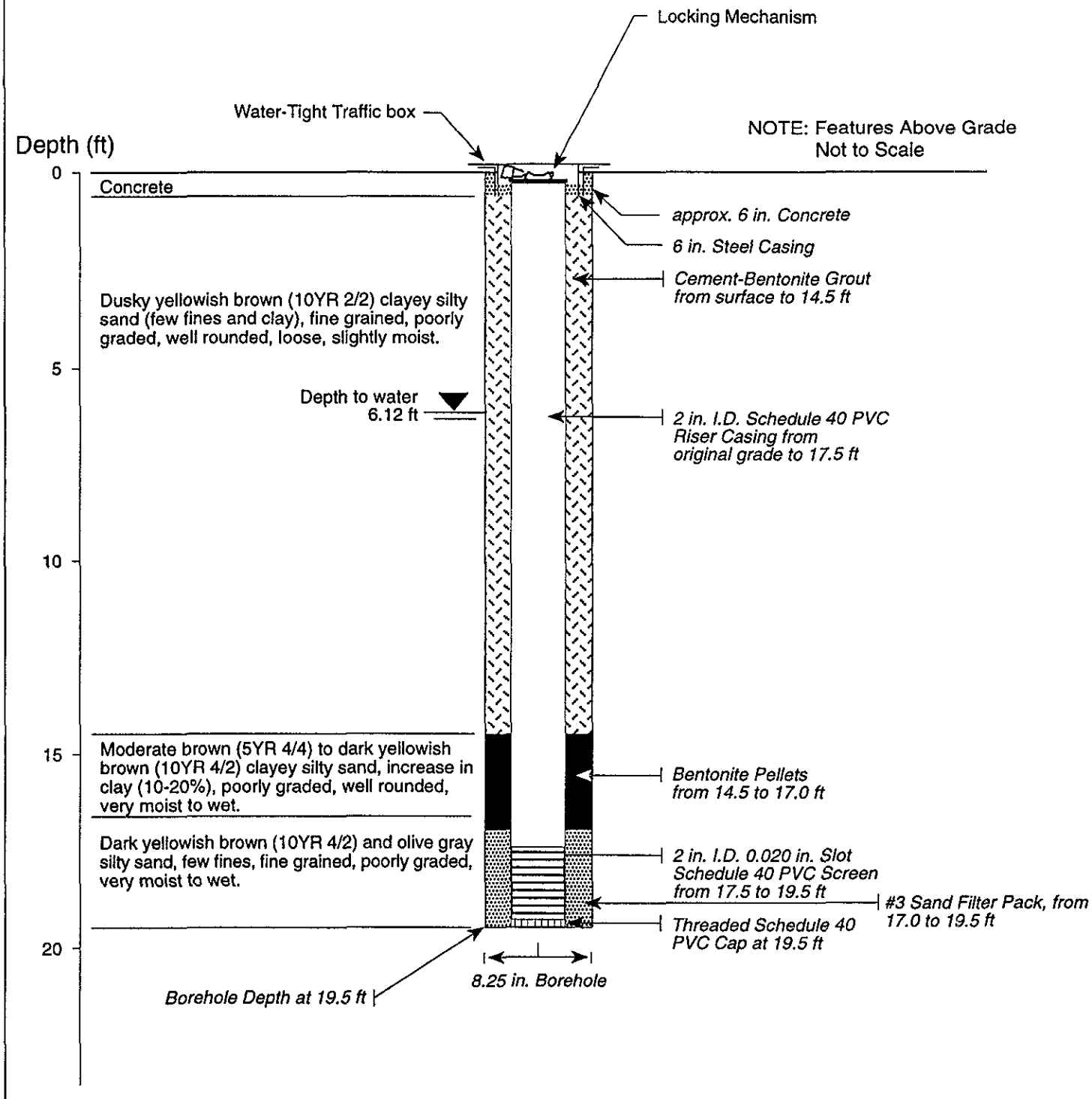
WELL COMPLETION DIAGRAM FOR AIR SPARGING WELL AS2



EA ENGINEERING, SCIENCE, AND TECHNOLOGY

Client: Nestle, U.S.A.

Site: 60966.01

Location: 1310 14th Street, Oakland, California.

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EA® EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

LOG OF SOIL BORING **AS3**

Coordinates

CLIENT	PROJECT NUMBER	LOCATION
Nestle USA	60966.01	1310 14th Street Oakland, CA

DRILLING AND SAMPLING METHODS: Hollow Stem Auger, 8.25 O.D.
No samples collected. (Drilled with mast down.)

				DRILLING	
				START	FINISH
Water Level	12.87			TIME 1300	TIME 1340
Time	1555				
Date	3/18/96			DATE 3/18/96	DATE 3/18/96
Reference	Ground Surface				

SURFACE CONDITIONS: Concrete (6")

DESCRIPTION by: D. Conkle

Inches Driven	Inches Recovered	Blows/6" Sampler	OVA Reading	WELL DETAIL	DEPTH (feet)	GRAPHIC LOG
					0	
					1	Fill
					2	
					3	
					4	SM/SC
					5	
					6	
					7	
					8	SC
					9	
					10	
					11	SM/SC
					12	
					13	
					14	
					15	SM/SC
					16	
					17	SC
					18	
					19	
			>10,000 1.0% LEL		20	

Concrete.
Dark brown to black silty sand, fill material, fine grained, well sorted, loose, slightly moist, no odor.
Lighter color with depth.
At 1.5' - dusky brown (5YR 2/2) clayey silty sand, trace fines, fine grained, poorly graded, loose, dry to slightly moist, no odor.

At 5.5' - moderate brown (5YR 4/3) clayey silty sand, increase in clay with depth, HC and musty odor.
At 7' - moderate brown (5YR 4/4) to moderate brown (5YR 3/4) clayey sand, (20% clay), fine grained, poorly graded, dense, slightly moist, HC and musty odor.

Decrease in clay.

At 15' - moderate brown (5YR 4/4) clayey silty sand, few fines, fine grained, well sorted, moist, HC and musty odor.

At 18' - moderate brown (5YR 3/4) clayey silty sand, increase in clay (>20%), fine grained, well sorted, very moist to wet, HC and musty odor.
TOTAL DEPTH: 20.0'

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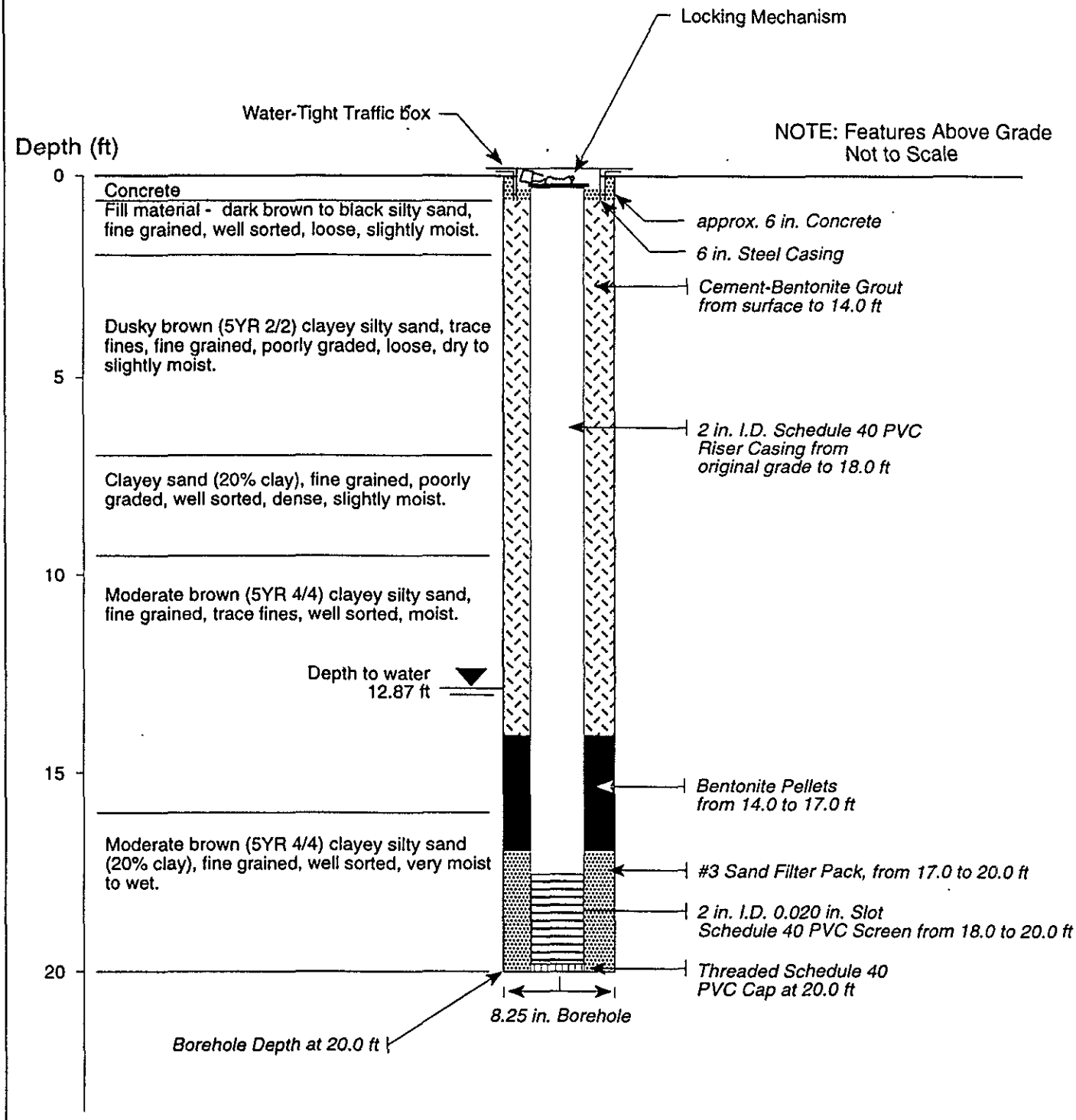
WELL COMPLETION DIAGRAM FOR AIR SPARGING WELL AS3



EA ENGINEERING, SCIENCE, AND TECHNOLOGY

Client: Nestle, U.S.A.

Site: 60966.01

Location: 1310 14th Street, Oakland, California.

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ATTACHMENT 1

PROTOCOLS FOR WELL DRILLING, COMPLETION, DEVELOPMENT, AND SAMPLING

1. DRILLING

Boreholes are drilled with a truck-mounted rotary drill, using hollow-stem continuous-flight augers. The diameter of the augers is selected to provide an annular space between the boring wall and the well casing of no less than 2 inches. The borehole is drilled 10 feet below the static water level but will not be allowed to penetrate a competent clay layer that might act as an effective aquitard: drilling is terminated after two consecutive samples indicate comparable, apparently impermeable clays below static water.

All augers, sampling rods, samplers, and other pieces of downhole equipment are steam cleaned before drilling begins and before each new borehole is drilled. All drill cuttings and fluids from the steam cleaning are contained on the site in sealed 55-gallon drums. The drums are labeled with the borehole number, site description (including owner's name), depth interval of soil contents, date, and monitoring equipment readings. The drill cuttings are disposed of at proper facilities on the basis of soil sample analysis.

A log of drilling and the borehole are recorded by an EA geologist overseeing the drilling operations and well installation. The boring logs, which are signed and dated by the geologist, contain detailed geological information, including descriptions of the soils classified according to the Unified Soil Classification System, blow counts, OVA readings, moisture content of the soils, and initial and static water levels.

2. SOIL SAMPLING

Soil samples are collected at 5-foot intervals and at any substantial change of soil type, beginning at 5 feet below ground surface, with a 2-inch-diameter, 18-inch modified California split-spoon sampler containing three 6-inch brass liners. The sampler and liners are steam cleaned before use in each hole; they are scrubbed in deionized water and Alconox detergent and rinsed with deionized water after use at each sampling interval. Soil samples are collected to the total depth of the borehole unless heaving sand is encountered. Every attempt is made to collect a soil sample just above or at the water table.

At each sample depth, the sampler is driven 18 inches ahead of the augers into undisturbed soil. When the sampler is retrieved, either the lowermost or the middle sample liner is removed and the ends of the tube are covered with aluminum foil and sealed with plastic caps, which are secured to the liner with tape. The soil-filled liner is labeled with the location, sample number, date, time, depth, sampler, and borehole number. The samples are placed in zip-lock bags and stored in a cooler containing ice.

Soil is removed from the other two liners and examined. The soil is scanned with a Foxboro Century 128 organic vapor analyzer with a flame ionization detector (FID), and the OVA readings are noted on the logs. The soil is examined and classified according to the Unified Soil Classification System.

Soil samples are delivered, under chain of custody, to a laboratory certified by the California Department of Health Services (DHS) for hazardous materials analyses. The samples are analyzed for petroleum hydrocarbons in accordance with Table 2 of the "Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites" (RWQCB 1990).

3. WELL INSTALLATION

The boreholes are completed as groundwater monitoring wells, vapor extraction wells, or air sparging wells. The wells are constructed by installing Schedule 40 PVC flush-threaded casing through the inner opening of the auger. The screened interval consists of slotted casing of the appropriate slot size, placed from 10 feet below the water table to 5 feet above it for groundwater monitoring wells. A threaded end plug or a slip cap secured with a stainless steel screw is placed on the bottom of the well.

A filter pack of clean sand of appropriate size is placed in the annular space around the well screen to approximately two feet above the top of the screen. The sand is placed through the inner opening of the augurs as they are slowly removed. The sand is sealed by adding 1–2 feet of bentonite pellets and hydrating them with deionized water. A surface seal is then created by placing a cement grout containing less than 5 percent bentonite from the bentonite spacer to the surface with a tremie pipe or grout pump.

The well is finished at the surface with a slightly raised, 12-inch-diameter traffic-rated, water-tight steel traffic box set in concrete. The traffic box is secured against unauthorized entry with a cap that requires a special wrench to open; the casing is further secured with a locking well cap.

4. WELL DEVELOPMENT

The wells are developed 2–3 days after completion. Development consists of surging the screened interval of the well with a 4-inch flapper valve surge block for approximately 15 minutes. The well is then purged, with a submersible electric pump, centrifugal pump, air-lift pump, or PVC bailer, of 2–6 casing volumes of water. The surging and pumping are repeated until the water is free of silt and apparent turbidity, for a maximum of 4 hours.

A record of the purging methods and volumes of water purged is maintained. All purge water is contained on the site in properly labeled 55-gallon drums. Purged water is disposed of at an appropriate facility on the basis of the laboratory analytical results.

5. WELL SURVEY

The elevation of the top of the well casing is surveyed relative to an established datum with a Lietz C-3 automatic level and a stadia rod. A small notch is cut in the top of the well casing to mark the survey point, to ensure that this point is used for all future water level measurements. A loop originating and ending at the datum is closed to ± 0.01 feet according to standard methods (Brinker and Wolfe 1977).

6. GROUNDWATER SAMPLING

The new wells are sampled no less than 24 hours after development.

6.1 Sampling Equipment Preparation

To the extent possible, well measurement and sampling equipment is constructed of inert material. Sampling bailers are made of Teflon. Stainless steel submersible or airlift pumps, surface centrifugal pumps with dedicated polyethylene tubing, or PVC bailers are used to purge the well prior to sampling, depending on the depth to water. All sampling equipment is decontaminated in the following manner prior to introduction into each well:

1. Bailers, pumps, suspension rope and lines, and well sounding tapes are rinsed thoroughly with clean, fresh water to remove dust and dirt.

2. All equipment is cleaned with Alconox detergent and deionized (DI) water inside and out. The equipment may be cleaned offsite and stored and transported in steam-cleaned and protected inert containers. Fluids that have been used to decontaminate equipment on the site are stored with other purge water. Nitrile gloves are worn at all times during sample equipment cleaning, handling, and sample collection.

3. All equipment is thoroughly rinsed with deionized (DI) water immediately after cleaning.

4. All equipment is thoroughly rinsed with DI water twice before insertion into a well.

5. Bailers and pumps are suspended on clean, DI-water-rinsed lengths of polypropylene rope. The rope is discarded after each well.

6.2 Presampling Measurements

Prior to purging and sampling, the depth to standing water and the total depth of the well are measured with a decontaminated optical or sonic interface probe. A decontaminated clear acrylic bailer is then inserted into the well to just below the static water level and removed to confirm the presence or absence of any floating liquid-phase hydrocarbons. These presample

measurement data are recorded on a Record of Well Gauging and Purging and used to calculate the volume of standing water in the well (one well casing volume). Measurements are made to the nearest 0.01 foot and referenced to the survey reference point on the well casing.

6.3 Well Purging

To ensure that the sample collected is as representative as possible of groundwater in the aquifer, standing water in the well and the surrounding sand pack is purged. Between 4 and 6 casing volumes of well water are purged to ensure that all stagnant water has been removed. The well is purged with a submersible, airlift, or surface pump or with a bailer, decontaminated as described above in Section 6.1.

Should the well pump dry after the casing is initially dewatered, purging is discontinued and the well allowed to recover. Purging is continued to obtain the desired purge volume.

Field parameters of pH, temperature, and electrical conductance are measured as the well is purged. Measurements are taken and recorded approximately every 5 gallons. If any of the three field parameters has not stabilized by the time the 4–6 casing volumes have been purged, additional well water is pumped until the parameters have stabilized (but no more than 10 casing volumes). "Stabilized" is defined as a change in the reading amounting to less than 10 percent of the previous reading.

All purge water is contained in 55-gallon drums labeled with well number, date, contents, and facility identification. After the well has been purged of the required volume of water, the purging equipment is removed. A Teflon sampling bailer is used to collect four separate samples for presample field parameter measurements, to confirm field parameter stability and, therefore, representative aquifer samples.

6.4 Well Sampling

All samples are collected with a Teflon bailer cleaned as discussed in Section 6.1. The bailer is operated by hand on a new, 1/4-inch polypropylene rope or on Teflon-coated stainless steel wire. The sampling personnel wear clean Nitrile gloves during sampling operations and while handling sample bottles.

The collected groundwater samples are emptied from the bailer with a bottom-emptying device directly into the sample bottles. The samples are collected in either 40-ml glass VOA vials or 1-liter amber bottles with Teflon-lined septum caps. The sample bottles contain appropriate preservatives, typically hydrochloric acid. The samples are contained in the containers free of headspace (i.e., with no air bubbles).

The filled sample containers are labeled with well number, date, location, sampler's initials, and preservative in indelible ink, and the sample labels are covered with clear waterproof tape.

The sample vials are placed in an iced cooler for delivery to a DHS-certified laboratory for analysis. Standard chain-of-custody procedures are followed.

6.5 Blanks

In addition to the groundwater samples, a trip blank and a decontamination blank are analyzed during each sampling round. A 40-ml glass VOA bottle with a Teflon septum lid, filled with DI water at the laboratory, functions as a trip blank. This trip blank travels with the sample kit from the laboratory to the facility and back to the laboratory again in the sample cooler. The blank is analyzed for the same parameters as the samples to indicate if the samples have been contaminated, from whatever source, during the trip from the site to the laboratory.

A decontamination blank is prepared in the field during well sampling. After the first well is sampled, DI water is poured into the clean, rinsed sampling bailer that is to be used for sampling the next well. This DI water is then emptied, as a sample, into a preserved 40-ml VOA bottle for analysis with the samples and trip blank. The decontamination blank indicates if any of the samples are contaminated from the sampling equipment or decontamination process.

6.6 Sample Analysis

All groundwater well samples, the trip blank, and the decontamination blank are analyzed by the laboratory according to Table 2 of the "Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites," typically for Total Petroleum Hydrocarbons as gasoline (TPH-g) by DHS-modified EPA Method 8015 and for the aromatic hydrocarbons benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8020.

Appendix E

Laboratory Analytical Reports

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 9604081

Work Order Summary

CLIENT:	Mr. Joe Muehleck EA Engineering 3468 Mt. Diablo Blvd., Suite B100 Lafayette, CA 94549	**BILL TO:**	Mr. Tom Randall EA Engineering 19 Loveton Circle Sparks, MD 21152
PHONE:	510-283-7077	**INVOICE #**	10156
FAX:	510-283-3894	**P.O. #**	60966.01
DATE RECEIVED:	4/9/96	**PROJECT #**	60966.01 NESTLE
DATE COMPLETED:	4/22/96	**AMOUNT$:**	$596.48

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	PRICE
01A	MAN2 VE	TO-14	4.0 "Hg	$270.00
02A	MAN2 VE AS	TO-14	2.5 "Hg	$270.00
03A	Lab Blank	TO-14	NA	NC

Misc. Charges	1 Liter Summa Canister Preparation (2) @ $15.00 each.	$30.00
	Shipping (3/28/96)	$26.48

CERTIFIED BY: Linda L. Truman
Laboratory Director

DATE: 4/22/96

180 BLUE RAVINE ROAD, SUITE B • FOLSOM, CA 95630
(916) 985-1000 • FAX (916) 985-1020

AIR TOXICS LTD.

SAMPLE NAME: MAN2 VE

ID#: 9604081-01A

EPA METHOD TO-14 GC/MS Full Scan

File Name:	**5041709**	**Date of Collection: 4/5/96**
Dil. Factor:	**291**	**Date of Analysis: 4/17/96**

Compound	Det. Limit (ppbv)	Amount (ppbv)
Freon 12	150	Not Detected
Freon 114	150	Not Detected
Chloromethane	150	Not Detected
Vinyl Chloride	150	Not Detected
Bromomethane	150	Not Detected
Chloroethane	150	Not Detected
Freon 11	150	Not Detected
1,1-Dichloroethene	150	Not Detected
Freon 113	150	Not Detected
Methylene Chloride	150	Not Detected
1,1-Dichloroethane	150	Not Detected
cis-1,2-Dichloroethene	150	Not Detected
Chloroform	150	Not Detected
1,1,1-Trichloroethane	150	Not Detected
Carbon Tetrachloride	150	Not Detected
Benzene	150	8300
1,2-Dichloroethane	150	Not Detected
Trichloroethene	150	Not Detected
1,2-Dichloropropane	150	Not Detected
cis-1,3-Dichloropropene	150	Not Detected
Toluene	150	16000
trans-1,3-Dichloropropene	150	Not Detected
1,1,2-Trichloroethane	150	Not Detected
Tetrachloroethene	150	Not Detected
Ethylene Dibromide	150	Not Detected
Chlorobenzene	150	Not Detected
Ethyl Benzene	150	1300
m,p-Xylene	150	7400
o-Xylene	150	3700
Styrene	150	Not Detected
1,1,2,2-Tetrachloroethane	150	Not Detected
1,3,5-Trimethylbenzene	150	1100
1,2,4-Trimethylbenzene	150	2400
1,3-Dichlorobenzene	150	Not Detected
1,4-Dichlorobenzene	150	Not Detected
Chlorotoluene	150	Not Detected
1,2-Dichlorobenzene	150	Not Detected
1,2,4-Trichlorobenzene	150	Not Detected
Hexachlorobutadiene	150	Not Detected

AIR TOXICS LTD.

SAMPLE NAME: MAN2 VE

ID#: 9604081-01A

EPA METHOD TO-14 GC/MS Full Scan

File Name:	**5041709**	**Date of Collection: 4/5/96**
Dil. Factor:	**291**	**Date of Analysis: 4/17/96**

Compound	Det. Limit (ppbv)	Amount (ppbv)
Propylene	580	Not Detected
1,3-Butadiene	580	Not Detected
Acetone	580	Not Detected
Carbon Disulfide	580	Not Detected
2-Propanol	580	Not Detected
trans-1,2-Dichloroethene	580	Not Detected
Vinyl Acetate	580	Not Detected
Chloroprene	580	Not Detected
2-Butanone (Methyl Ethyl Ketone)	580	Not Detected
Hexane	580	19000
Tetrahydrofuran	580	Not Detected
Cyclohexane	580	15000
1,4-Dioxane	580	Not Detected
Bromodichloromethane	580	Not Detected
4-Methyl-2-pentanone	580	Not Detected
2-Hexanone	580	Not Detected
Dibromochloromethane	580	Not Detected
Bromoform	580	Not Detected
4-Ethyltoluene	580	1700
Ethanol	580	Not Detected
Methyl tert-Butyl Ether	580	Not Detected
Heptane	580	7800

Container Type: 1 Liter Summa Canister

Surrogates	% Recovery	Method Limits
Octafluorotoluene	**99**	**70-130**
Toluene-d8	**93**	**70-130**
4-Bromofluorobenzene	**91**	**70-130**

Appendix F

Calculation of Helium Recovery

Calculations for Helium Recovery

Because concentration is inversely proportional to volume:

$$\frac{volume\ of\ air\ injected}{volume\ of\ air\ extracted} = \frac{concentration\ of\ helium\ extracted}{concentration\ of\ helium\ injected}$$

where:

volume of air injected/extracted - CFM
concentration of helium injected/extracted - %

$$\%\ recovery = \frac{measured\ helium\ concentration\ of\ extracted\ air}{expected\ helium\ concentration\ of\ extracted\ air} * 100$$

AS2

$$\frac{3\ CFM\ injected}{14\ CFM\ extracted} = \frac{x\%\ extracted}{4.3\%\ injected}$$

x = expected concentration if 100% recovery
x = (3CFM/14CFM)*4.3% = 0.92%

% recovery = (0.08/0.92) * 100 = 8.7%

AS3

$$\frac{6\ CFM\ injected}{41\ CFM\ extracted} = \frac{x\%\ extracted}{4.5\%\ injected}$$

x = expected concentration if 100% recovery
x = (6CFM/41CFM)*4.5% = 0.66%

% recovery = (0.48/0.66) * 100 = 73%

AIR TOXICS LTD.

SAMPLE NAME: MAN2 VE AS

ID#: 9604081-02A

EPA METHOD TO-14 GC/MS Full Scan

File Name:	**5041712**	**Date of Collection:**	**4/5/96**
Dil. Factor:	**4400**	**Date of Analysis:**	**4/17/96**

Compound	Det. Limit (ppbv)	Amount (ppbv)
Freon 12	2200	Not Detected
Freon 114	2200	Not Detected
Chloromethane	2200	Not Detected
Vinyl Chloride	2200	Not Detected
Bromomethane	2200	Not Detected
Chloroethane	2200	Not Detected
Freon 11	2200	Not Detected
1,1-Dichloroethene	2200	Not Detected
Freon 113	2200	Not Detected
Methylene Chloride	2200	Not Detected
1,1-Dichloroethane	2200	Not Detected
cis-1,2-Dichloroethene	2200	Not Detected
Chloroform	2200	Not Detected
1,1,1-Trichloroethane	2200	Not Detected
Carbon Tetrachloride	2200	Not Detected
Benzene	2200	49000
1,2-Dichloroethane	2200	Not Detected
Trichloroethene	2200	Not Detected
1,2-Dichloropropane	2200	Not Detected
cis-1,3-Dichloropropene	2200	Not Detected
Toluene	2200	43000
trans-1,3-Dichloropropene	2200	Not Detected
1,1,2-Trichloroethane	2200	Not Detected
Tetrachloroethene	2200	Not Detected
Ethylene Dibromide	2200	Not Detected
Chlorobenzene	2200	Not Detected
Ethyl Benzene	2200	Not Detected
m,p-Xylene	2200	7900
o-Xylene	2200	3500
Styrene	2200	Not Detected
1,1,2,2-Tetrachloroethane	2200	Not Detected
1,3,5-Trimethylbenzene	2200	Not Detected
1,2,4-Trimethylbenzene	2200	Not Detected
1,3-Dichlorobenzene	2200	Not Detected
1,4-Dichlorobenzene	2200	Not Detected
Chlorotoluene	2200	Not Detected
1,2-Dichlorobenzene	2200	Not Detected
1,2,4-Trichlorobenzene	2200	Not Detected
Hexachlorobutadiene	2200	Not Detected

AIR TOXICS LTD.

SAMPLE NAME: MAN2 VE AS

ID#: 9604081-02A

EPA METHOD TO-14 GC/MS Full Scan

File Name: 5041712 **Date of Collection: 4/5/96**

Dil. Factor: 4400 **Date of Analysis: 4/17/96**

Compound	Det. Limit (ppbv)	Amount (ppbv)
Propylene	8800	Not Detected
1,3-Butadiene	8800	Not Detected
Acetone	8800	Not Detected
Carbon Disulfide	8800	Not Detected
2-Propanol	8800	Not Detected
trans-1,2-Dichloroethene	8800	Not Detected
Vinyl Acetate	8800	Not Detected
Chloroprene	8800	Not Detected
2-Butanone (Methyl Ethyl Ketone)	8800	Not Detected
Hexane	8800	460000
Tetrahydrofuran	8800	Not Detected
Cyclohexane	8800	130000
1,4-Dioxane	8800	Not Detected
Bromodichloromethane	8800	Not Detected
4-Methyl-2-pentanone	8800	Not Detected
2-Hexanone	8800	Not Detected
Dibromochloromethane	8800	Not Detected
Bromoform	8800	Not Detected
4-Ethyltoluene	8800	Not Detected
Ethanol	8800	Not Detected
Methyl tert-Butyl Ether	8800	Not Detected
Heptane	8800	58000

Container Type: 1 Liter Summa Canister

Surrogates	% Recovery	Method Limits
Octafluorotoluene	**101**	**70-130**
Toluene-d8	**95**	**70-130**
4-Bromofluorobenzene	**80**	**70-130**

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 9604081-03A

EPA METHOD TO-14 GC/MS Full Scan

File Name:	**5041704**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 4/17/96**

Compound	Det. Limit (ppbv)	Amount (ppbv)
Freon 12	0.50	Not Detected
Freon 114	0.50	Not Detected
Chloromethane	0.50	Not Detected
Vinyl Chloride	0.50	Not Detected
Bromomethane	0.50	Not Detected
Chloroethane	0.50	Not Detected
Freon 11	0.50	Not Detected
1,1-Dichloroethene	0.50	Not Detected
Freon 113	0.50	Not Detected
Methylene Chloride	0.50	Not Detected
1,1-Dichloroethane	0.50	Not Detected
cis-1,2-Dichloroethene	0.50	Not Detected
Chloroform	0.50	Not Detected
1,1,1-Trichloroethane	0.50	Not Detected
Carbon Tetrachloride	0.50	Not Detected
Benzene	0.50	Not Detected
1,2-Dichloroethane	0.50	Not Detected
Trichloroethene	0.50	Not Detected
1,2-Dichloropropane	0.50	Not Detected
cis-1,3-Dichloropropene	0.50	Not Detected
Toluene	0.50	Not Detected
trans-1,3-Dichloropropene	0.50	Not Detected
1,1,2-Trichloroethane	0.50	Not Detected
Tetrachloroethene	0.50	Not Detected
Ethylene Dibromide	0.50	Not Detected
Chlorobenzene	0.50	Not Detected
Ethyl Benzene	0.50	Not Detected
m,p-Xylene	0.50	Not Detected
o-Xylene	0.50	Not Detected
Styrene	0.50	Not Detected
1,1,2,2-Tetrachloroethane	0.50	Not Detected
1,3,5-Trimethylbenzene	0.50	Not Detected
1,2,4-Trimethylbenzene	0.50	Not Detected
1,3-Dichlorobenzene	0.50	Not Detected
1,4-Dichlorobenzene	0.50	Not Detected
Chlorotoluene	0.50	Not Detected
1,2-Dichlorobenzene	0.50	Not Detected
1,2,4-Trichlorobenzene	0.50	Not Detected
Hexachlorobutadiene	0.50	Not Detected

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 9604081-03A

EPA METHOD TO-14 GC/MS Full Scan

File Name:	**5041704**	**Date of Collection:**	**NA**
Dil. Factor:	**1.00**	**Date of Analysis:**	**4/17/96**

Compound	Det. Limit (ppbv)	Amount (ppbv)
Propylene	2.0	Not Detected
1,3-Butadiene	2.0	Not Detected
Acetone	2.0	Not Detected
Carbon Disulfide	2.0	Not Detected
2-Propanol	2.0	Not Detected
trans-1,2-Dichloroethene	2.0	Not Detected
Vinyl Acetate	2.0	Not Detected
Chloroprene	2.0	Not Detected
2-Butanone (Methyl Ethyl Ketone)	2.0	Not Detected
Hexane	2.0	Not Detected
Tetrahydrofuran	2.0	Not Detected
Cyclohexane	2.0	Not Detected
1,4-Dioxane	2.0	Not Detected
Bromodichloromethane	2.0	Not Detected
4-Methyl-2-pentanone	2.0	Not Detected
2-Hexanone	2.0	Not Detected
Dibromochloromethane	2.0	Not Detected
Bromoform	2.0	Not Detected
4-Ethyltoluene	2.0	Not Detected
Ethanol	2.0	Not Detected
Methyl tert-Butyl Ether	2.0	Not Detected
Heptane	2.0	Not Detected

Container Type: NA

Surrogates	% Recovery	Method Limits
Octafluorotoluene	**89**	**70-130**
Toluene-d8	**96**	**70-130**
4-Bromofluorobenzene	**102**	**70-130**

[redacted] Company Name: [redacted] [redacted] [redacted] roject[redacted]ager [redacted]ntact[redacted] [redacted]ram[redacted]Meth[redacted]umb[redacted]r Ana[redacted] [redacted] [redacted]hain[redacted]Cust[redacted]y Re[redacted]

Company Name: EA ENGINEERING

Project Manager / Contact: JOE MUEHLECK / DOUG ORAM

Phone: 510-283-7077

Project No. 60966.01

Project Name: NESTLE

Dept.: 6415 Task: 0005

Sample Storage Location:

ATO Number:

Page 1 of 1

Report #:

EA Laboratories
19 Loveton Circle
Sparks, MD 21152
Telephone: (410) 771-4920
Fax: (410) 771-4407

Report Deliverables: 1 2 3 4 D E

EDD: Yes/No

DUE TO CLIENT: ____________

	Date	Time	Water	Soil (AIR)	Sample Identification 19 Characters	No. of Containers	TO14											EA Labs Accession Number	Remarks
01A	4/5/96	10:40		X	MANZ VE	1	X								4.0"Hg				LPM: CAN # 94918
02A	4/5/96	15:00		X	MANZ VE AS	1	X								2.5"Hg				CAN # 94905
															4/4/96				FID READING - 500 PPM
																			FID READING 20,000 PPM

Samples by: (Signature) [signature] Date/Time 4/5/96

Relinquished by: (Signature) Date/Time

Relinquished by: (Signature) Date/Time

Received by: (Signature) Date/Time

Received by Laboratory: (Signature) Scott Amerian AIL Date/Time 4/9/96 10:30

Airbill Number: UNP

Sample Shipped by: (Circle) Fed Ex. Puro. UPS Hand Carried Other: GOLDEN STATE OVERNIGHT

Custody Seals Intact ☐ Yes ☐ No

Cooler Temp.____C pH: ☐ Yes ☐ No Comments:

NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.

Shaded Areas for Lab Use Only

WHITE—EA Laboratories YELLOW—EA Laboratories PINK—Project Manager

Custody Seal intact? Y N (None) Temp ambient

NESTLÉ USA, INC.

QUALITY ASSURANCE LABORATORY
PO BOX 1516
6625 EITERMAN ROAD
DUBLIN, OH 43017-6516
TEL (614) 791-9144
FAX (614) 793-5353

- Laboratory Report -

Client: Binayak Acharya
Company: Nestle USA - Glendale, CA

Sample Description: Water - Oakland, CA
Sample ID: AS3
Submitted by EA Laboratories
PO/Ref/Disp#:

Sample Received: 4/9/96
Report Date: 4/18/96
Sampling Date 4/6/96

Lab#: 9604110038
LV#: 96APR0295-0

cc: Doug Oram

Test	Result	Units	MDL	Method	Date Analyzed
Benzene	5000	µg/L	0.5	EPA 8020	4/17/96
Toluene	13000	µg/L	0.5	EPA 8020	4/17/96
Ethylbenzene	1600	µg/L	0.5	EPA 8020	4/17/96
m&p Xylenes	5000	µg/L	0.5	EPA 8020	4/17/96
o-Xylene	2400	µg/L	0.5	EPA 8020	4/17/96
Total Xylene	7400	µg/L	0.5	EPA 8020	4/17/96
Dichlorodifluoromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Vinyl Chloride	ND	ug/L	0.5	EPA 8010	4/12/96
Bromomethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloroethane	2.1	ug/L	0.5	EPA 8010	4/12/96
Trichlorofluoromethane	ND	ug/L	0.5	EPA 8010	4/12/96
1,1-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
Methylene Chloride	ND	ug/L	0.5	EPA 8010	4/12/96
t 1,2-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
cis 1,2-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
1,1-Dichloroethane	11	ug/L	0.5	EPA 8010	4/12/96
Chloroform	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,1-Trichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Carbon Tetrachloride	ND	ug/L	0.5	EPA 8010	4/12/96
1,2-Dichloroethane	210	ug/L	0.5	EPA 8010	4/12/96
Trichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
1,2-Dichloropropane	ND	ug/L	0.5	EPA 8010	4/12/96
Bromodichloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
c 1,3-Dichloropropene	ND	ug/L	0.5	EPA 8010	4/12/96

ND: Not Detected

NESTLÉ USA, INC.

QUALITY ASSURANCE LABORATORY
P.O. BOX 1516
6625 EITERMAN ROAD
DUBLIN, OH 43017-6516
TEL (614) 791-9144
FAX (614) 793-5353

- Laboratory Report -

Client: Binayak Acharya
Company: Nestle USA - Glendale, CA

Sample Description: Water - Oakland, CA
Sample ID: AS3
Submitted by EA Laboratories
PO/Ref/Disp#:

Sample Received: 4/9/96
Report Date: 4/18/96
Sampling Date 4/6/96

Lab#: 9604110038
LV#: 96APR0295-0

cc: Doug Oram

t 1,3-Dichloropropene	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,2-Trichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Tetrachloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
Dibromochloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Bromoform	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
1,3-Dichlorobenzene	ND	ug/L	0.5	EPA 8010	4/12/96
1,4-Dichlorobenzene	ND	µg/L	0.5	EPA 8010	4/12/96
1,2-Dichlorobenzene	ND	ug/L	0.5	EPA 8010	4/12/96

--- Surrogate Recoveries ---

Test	Result	True Conc.	Units	%R:	QC Limits		QC Flag
BFB	18.9	30	µg/L	63	39 -	150	P
BCMA	28.3	30	ug/L	94	46 -	160	P
a,a,a,-TFT	32.0	30	µg/L	107	76 -	126	P

ND: Not Detected

NESTLÉ USA, INC.

QUALITY ASSURANCE LABORATORY
PO BOX 1516
6625 EITERMAN ROAD
DUBLIN, OH 43017-6516
TEL (614) 791-9144
FAX (614) 793-5353

- Laboratory Report -

Client: Binayak Acharya
Company: Nestle USA - Glendale, CA

Sample Description: Water - Oakland, CA
Sample ID: MW28
Submitted by EA Laboratories
PO/Ref/Disp#:

Sample Received: 4/9/96
Report Date: 4/18/96
Sampling Date 4/6/96

Lab#: 9604110039
LV#: 96APR0295-1

cc: Doug Oram

Test	Result	Units	MDL	Method	Date Analyzed
Benzene	ND	µg/L	0.5	EPA 8020	4/12/96
Toluene	ND	µg/L	0.5	EPA 8020	4/12/96
Ethylbenzene	ND	µg/L	0.5	EPA 8020	4/12/96
m&p Xylenes	ND	µg/L	0.5	EPA 8020	4/12/96
o-Xylene	ND	µg/L	0.5	EPA 8020	4/12/96
Total Xylene	ND	µg/L	0.5	EPA 8020	4/12/96
Dichlorodifluoromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Vinyl Chloride	ND	ug/L	0.5	EPA 8010	4/12/96
Bromomethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Trichlorofluoromethane	ND	ug/L	0.5	EPA 8010	4/12/96
1,1-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
Methylene Chloride	ND	ug/L	0.5	EPA 8010	4/12/96
t 1,2-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
cis 1,2-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
1,1-Dichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloroform	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,1-Trichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Carbon Tetrachloride	ND	ug/L	0.5	EPA 8010	4/12/96
1,2-Dichloroethane	1.7	ug/L	0.5	EPA 8010	4/12/96
Trichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
1,2-Dichloropropane	ND	ug/L	0.5	EPA 8010	4/12/96
Bromodichloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
c 1,3-Dichloropropene	ND	ug/L	0.5	EPA 8010	4/12/96

ND: Not Detected

NESTLÉ USA, INC.

QUALITY ASSURANCE LABORATORY
PO BOX 1516
6625 EITERMAN ROAD
DUBLIN, OH 43017-6516
TEL (614) 791-9144
FAX (614) 793-5353

- Laboratory Report -

Client: Binayak Acharya
Company: Nestle USA - Glendale, CA

Sample Description: Water - Oakland, CA
Sample ID: MW28
Submitted by EA Laboratories
PO/Ref/Disp#:

Sample Received: 4/9/96
Report Date: 4/18/96
Sampling Date 4/6/96

Lab#: 9604110039
LV#: 96APR0295-1

cc: Doug Oram

t 1,3-Dichloropropene	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,2-Trichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Tetrachloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
Dibromochloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Bromoform	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
1,3-Dichlorobenzene	ND	ug/L	0.5	EPA 8010	4/12/96
1,4-Dichlorobenzene	ND	µg/L	0.5	EPA 8010	4/12/96
1,2-Dichlorobenzene	ND	ug/L	0.5	EPA 8010	4/12/96

--- Surrogate Recoveries ---

Test	Result	True Conc.	Units	%R:	QC Limits		QC Flag
BFB	18.5	30	µg/L	62	39 -	150	P
BCMA	27.5	30	ug/L	92	46 -	160	P
a,a,a,-TFT	31.0	30	µg/L	103	76 -	126	P

ND: Not Detected

NESTLÉ USA, INC.

QUALITY ASSURANCE LABORATORY
P.O BOX 1516
6625 EITERMAN ROAD
DUBLIN, OH 43017-6516
TEL (614) 791-9144
FAX (614) 793-5353

- Laboratory Report -

Client: Binayak Acharya
Company: Nestle USA - Glendale, CA

Sample Description: Water - Oakland, CA
Sample ID: MW25
Submitted by EA Laboratories
PO/Ref/Disp#:

Sample Received: 4/9/96
Report Date: 4/18/96
Sampling Date 4/6/96

Lab#: 9604110040
LV#: 96APR0295-2

cc: Doug Oram

Test	Result	Units	MDL	Method	Date Analyzed
Benzene	ND	µg/L	0.5	EPA 8020	4/12/96
Toluene	ND	µg/L	0.5	EPA 8020	4/12/96
Ethylbenzene	ND	µg/L	0.5	EPA 8020	4/12/96
m&p Xylenes	ND	µg/L	0.5	EPA 8020	4/12/96
o-Xylene	ND	µg/L	0.5	EPA 8020	4/12/96
Total Xylene	ND	µg/L	0.5	EPA 8020	4/12/96
Dichlorodifluoromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Vinyl Chloride	ND	ug/L	0.5	EPA 8010	4/12/96
Bromomethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Trichlorofluoromethane	ND	ug/L	0.5	EPA 8010	4/12/96
1,1-Dichloroethene	2.8	ug/L	0.5	EPA 8010	4/12/96
Methylene Chloride	ND	ug/L	0.5	EPA 8010	4/12/96
t 1,2-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
cis 1,2-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
1,1-Dichloroethane	52	ug/L	0.5	EPA 8010	4/12/96
Chloroform	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,1-Trichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Carbon Tetrachloride	ND	ug/L	0.5	EPA 8010	4/12/96
1,2-Dichloroethane	62	ug/L	0.5	EPA 8010	4/12/96
Trichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
1,2-Dichloropropane	ND	ug/L	0.5	EPA 8010	4/12/96
Bromodichloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
c 1,3-Dichloropropene	ND	ug/L	0.5	EPA 8010	4/12/96

ND: Not Detected

NESTLÉ USA, INC.

QUALITY ASSURANCE LABORATORY
P.O. BOX 1516
6625 EITERMAN ROAD
DUBLIN, OH 43017-6516
TEL (614) 791-9144
FAX (614) 793-5353

- Laboratory Report -

Client: Binayak Acharya
Company: Nestle USA - Glendale, CA

Sample Description: Water - Oakland, CA
Sample ID: MW25
Submitted by EA Laboratories
PO/Ref/Disp#:

Sample Received: 4/9/96
Report Date: 4/18/96
Sampling Date 4/6/96

Lab#: 9604110040
LV#: 96APR0295-2

cc: Doug Oram

t 1,3-Dichloropropene	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,2-Trichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Tetrachloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
Dibromochloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Bromoform	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
1,3-Dichlorobenzene	ND	ug/L	0.5	EPA 8010	4/12/96
1,4-Dichlorobenzene	ND	µg/L	0.5	EPA 8010	4/12/96
1,2-Dichlorobenzene	ND	ug/L	0.5	EPA 8010	4/12/96

--- Surrogate Recoveries ---

Test	Result	True Conc.	Units	%R:	QC Limits		QC Flag
BFB	18.0	30	µg/L	60	39 -	150	P
BCMA	32.4	30	ug/L	108	46 -	160	P
a,a,a,-TFT	29.4	30	µg/L	98	76 -	126	P

ND: Not Detected

NESTLÉ USA, INC.

Nestlé

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P.O. BOX 1516
6625 EITERMAN ROAD
DUBLIN, OH 43017-6516
TEL (614) 791-9144
FAX (614) 793-5353

- Laboratory Report -

Client: Binayak Acharya
Company: Nestle USA - Glendale, CA

Sample Description: Water - Oakland, CA
Sample ID: MW26
Submitted by EA Laboratories
PO/Ref/Disp#:

Sample Received: 4/9/96
Report Date: 4/18/96
Sampling Date 4/6/96

Lab#: 9604110041
LV#: 96APR0295-3

cc: Doug Oram

Test	Result	Units	MDL	Method	Date Analyzed
Benzene	ND	µg/L	0.5	EPA 8020	4/17/96
Toluene	ND	µg/L	0.5	EPA 8020	4/17/96
Ethylbenzene	ND	µg/L	0.5	EPA 8020	4/17/96
m&p Xylenes	ND	µg/L	0.5	EPA 8020	4/17/96
o-Xylene	ND	µg/L	0.5	EPA 8020	4/17/96
Total Xylene	ND	µg/L	0.5	EPA 8020	4/17/96
Dichlorodifluoromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Vinyl Chloride	ND	ug/L	0.5	EPA 8010	4/12/96
Bromomethane	ND	ug/L	0.5	EPA 8010	4/12/96
Chloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Trichlorofluoromethane	ND	ug/L	0.5	EPA 8010	4/12/96
1,1-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
Methylene Chloride	ND	ug/L	0.5	EPA 8010	4/12/96
t 1,2-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
cis 1,2-Dichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
1,1-Dichloroethane	2.5	ug/L	0.5	EPA 8010	4/12/96
Chloroform	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,1-Trichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Carbon Tetrachloride	ND	ug/L	0.5	EPA 8010	4/12/96
1,2-Dichloroethane	75	ug/L	0.5	EPA 8010	4/12/96
Trichloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
1,2-Dichloropropane	ND	ug/L	0.5	EPA 8010	4/12/96
Bromodichloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
c 1,3-Dichloropropene	ND	ug/L	0.5	EPA 8010	4/12/96

ND: Not Detected

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P.O. BOX 1516
6625 EITERMAN ROAD
DUBLIN, OH 43017-6516
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FAX (614) 793-5353

- Laboratory Report -

Client: Binayak Acharya
Company: Nestle USA - Glendale, CA

Sample Description: Water - Oakland, CA
Sample ID: MW26
Submitted by EA Laboratories
PO/Ref/Disp#:

Sample Received: 4/9/96
Report Date: 4/18/96
Sampling Date 4/6/96

Lab#: 9604110041
LV#: 96APR0295-3

cc: Doug Oram

t 1,3-Dichloropropene	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,2-Trichloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
Tetrachloroethene	ND	ug/L	0.5	EPA 8010	4/12/96
Dibromochloromethane	ND	ug/L	0.5	EPA 8010	4/12/96
Bromoform	ND	ug/L	0.5	EPA 8010	4/12/96
1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	EPA 8010	4/12/96
1,3-Dichlorobenzene	ND	ug/L	0.5	EPA 8010	4/12/96
1,4-Dichlorobenzene	ND	µg/L	0.5	EPA 8010	4/12/96
1,2-Dichlorobenzene	ND	ug/L	0.5	EPA 8010	4/12/96

--- Surrogate Recoveries ---

Test	Result	True Conc.	Units	%R:	QC Limits		QC Flag
BFB	16.3	30	µg/L	54	39 -	150	P
BCMA	33.6	30	ug/L	112	46 -	160	P
a,a,a,-TFT	32.0	30	µg/L	107	76 -	126	P

ND: Not Detected

Approved By: John Heuser

Chain of Custody Record

EA Laboratories
19 Loveton Circle
Sparks, MD 21152
Telephone: (410) 771-4920
Fax: (410) 771-4407

Company Name: NESTLE / EA

Project Manager or Contact: DOUG ORAM / JOE MUELLER

Phone: 510-283-

Project No. 60966.01

Project Name: 7077 FORMER CARNATION DAIRY OAKLAND, CA

Dept.: 6415 Task: 0005

Sample Storage Location:

ATO Number:

Page 1 of 1

Report #:

Report Deliverables: 1 2 3 4 D E

EDD: Yes/No

DUE TO CLIENT: _____

Parameters/Method Numbers for Analysis

Date	Time	Water	Soil	Sample Identification 19 Characters	No. of Containers	BTEX (8020)	8010	EA Labs Accession Number	Remarks
4/3	1650	X		AS3	4	X	X		LPM:
4/4	1020			MW28					
	1030			MW25					
↓	1045	↓		MW26	↓	↓	↓		

Samples by: (Signature) | Date/Time | Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time

Relinquished by: (Signature) | Date/Time | Received by Laboratory: (Signature) | Date/Time | Airbill Number:

Sample Shipped by: (Circle) Fed Ex. Puro. UPS Hand Carried Other:

Cooler Temp.____C pH: ☐ Yes ☐ No Comments: Custody Seals Intact ☐ Yes ☐ No

NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.

WHITE—EA Laboratories YELLOW—EA Laboratories PINK—Project Manager *Shaded Areas for Lab Use Only*