ARCO Products Company
Environmental Engineering
2155 South Bascom Avenue, Suite 202
Campbell, California 95008

ENVIRONMENTAL PROTECTION

95 MAY 16 PM 3: 08

Date: 5/10/95

Re: ARCO Station # 6002

" I declare, that to the best of my knowledge at the present time, that the information and/or recommendations contained in the attached proposal or report are true and correct."

Submitted by:

Michael R. Whelan

Michael R. Whelan
Environmental Engineer

EMCON
1921 Ringwood Avenue • San Jose, California 95131-1721 • (408) 453-7300 • Fax (408) 437-9526

May 10, 1995
Project 0805-131.02

Ms. Juliet Shin
Alameda County Health Care Services Agency
Department of Environmental Health
1131 Harbor Bay Parkway, Room 250
Alameda, California 94502-6577

Re: Temporary monitoring points, ARCO station 6002, 6235 Seminary Avenue, Oakland, California

Dear Ms. Shin:

As stated in EMCON's workplan addendum dated March 6, 1995, and discussed during our conversation on April 15, 1995, EMCON, on behalf of ARCO Products Company (ARCO), proposes to install four temporary monitoring points (PWP-1 through PWP-4) to monitor groundwater at the referenced site. Although the monitoring points are referred to as "temporary," EMCON plans to leave them in place for approximately one year and sample them for at least four quarters.

Temporary monitoring points were proposed instead of standard groundwater monitoring wells because of the limited access available for a drill rig at three (PWP-2, PW-3, and PWP-4) of the four locations (Figure 1). Temporary monitoring point PWP-2 is proposed for the rear of an apartment complex, which cannot be accessed by a drilling rig; PWP-3 and PWP-4 are proposed beneath low overhead telephone lines, which would obstruct the mast of a drilling rig.

The well point installation procedures were discussed in the workplan addendum. Although no sand pack will be installed around the well screen, the soil lithology at the site consists of enough coarse-grained material (clayey sand and clayey gravel) to allow for the collection of acceptable groundwater samples. Before sampling, the well points will be developed to remove fine-grained materials and open clogged pore spaces.

Useful groundwater analytical data have been obtained from open and temporarily-cased boreholes, and by using HydroPunch™ sampling techniques on numerous occasions by EMCON and other consulting firms. In 1991, *Groundwater Monitoring Review* published a study performed by EMCON comparing the results obtained from HydroPunch sampling and those from permanent monitoring wells. A copy of the article is attached.

EMCON believes the data obtained from the temporary monitoring points will be useful for determining the lateral extent of the dissolved petroleum hydrocarbons in groundwater underlying the site. Based on the information gathered from the temporary monitoring points, permanent wells could be installed in the appropriate locations for long-term monitoring, if needed.

Sincerely,

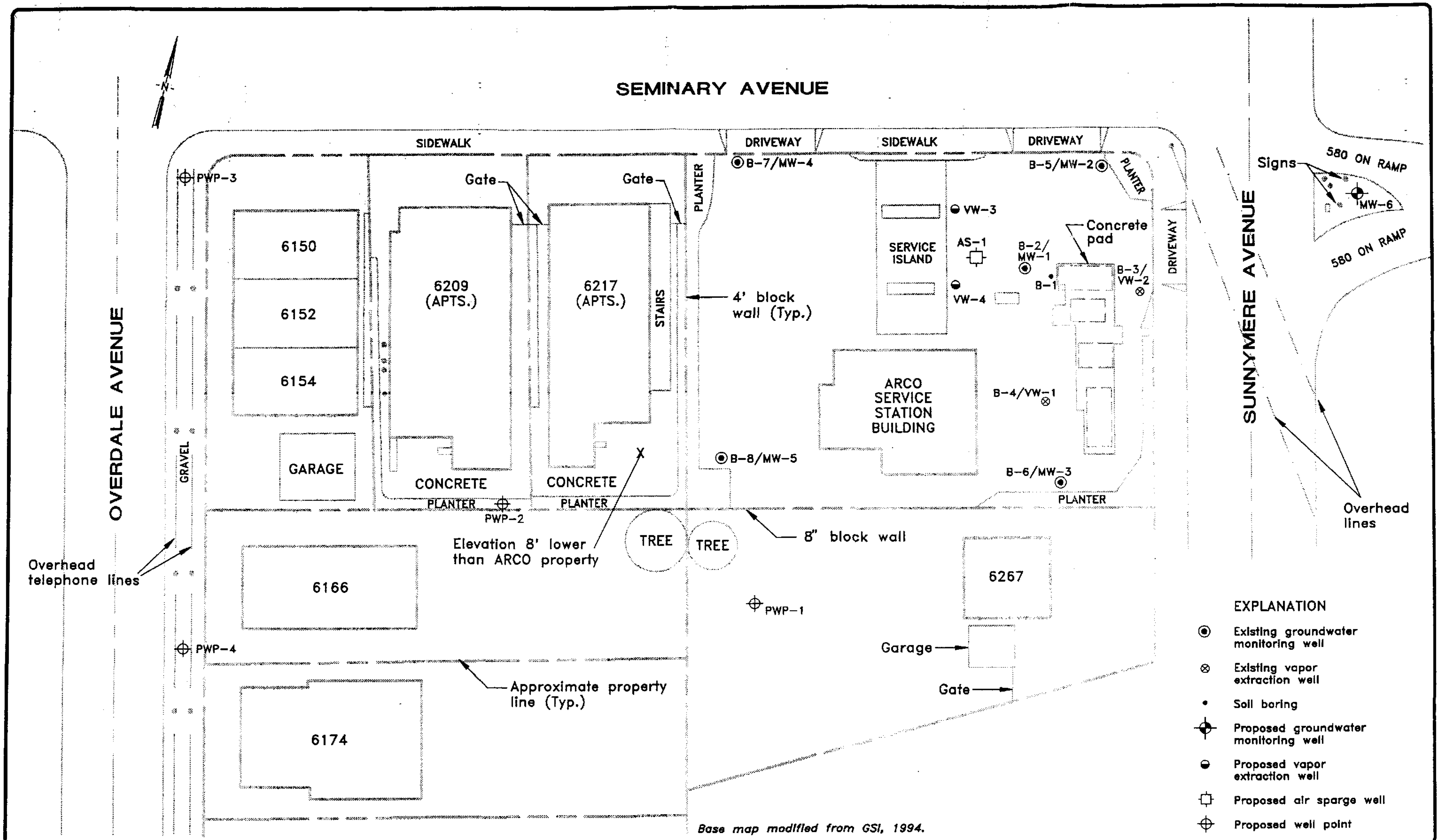
EMCON

Peter T. Christianson
Project Geologist

John C. Young
Project Manager

Attachments: Figure 1 - Proposed Well Location Map
Groundwater Monitoring Review article

cc: Michael Whelan, ARCO Products Company



EMCON Associates

SCALE: 0 30 60 FEET

ARCO PRODUCTS COMPANY
SERVICE STATION 6002, 6235 SEMINARY AVE.
WORK PLAN
OAKLAND, CALIFORNIA

PROPOSED WELL LOCATION MAP

FIGURE NO. 1

PROJECT NO. 805-131.02

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Reprinted from *Ground Water Monitoring Review*, Spring 1991

FOCUS

Cone Penetrometer Tests and HydroPunch® Sampling: A Screening Technique for Plume Definition

by Mark Smolley and Janet C. Kappmeyer

Abstract

Cone penetrometer tests and HydroPunch® sampling were used to define the extent of volatile organic compounds in ground water. The investigation indicated that the combination of these techniques is effective for obtaining ground water samples for preliminary plume definition. HydroPunch samples can be collected in unconsolidated sediments and the analytical results obtained from these samples are comparable to those obtained from adjacent monitoring wells. This sampling method is a rapid and cost-effective screening technique for characterizing the extent of contaminant plumes in soft sediment environments. Use of this screening technique allowed monitoring wells to be located at the plume boundary, thereby reducing the number of wells installed and the overall cost of the plume definition program.

Introduction

In 1982, EMCON Associates of San Jose, California, began investigating a ground water contaminant plume associated with a major semiconductor manufacturing facility in Santa Clara, California. The semiconductor facility stored waste solvents in single-walled underground storage tanks that eventually developed leaks, allowing volatile organic compounds (VOCs) to enter the shallow water-bearing zones beneath the site. Between 1982 and March 1988, 92 monitoring wells were installed to define the lateral and vertical extent of VOCs in four separate shallow aquifers. In March 1988, four additional monitoring wells were installed approximately 1.5 miles downgradient from the site to complete plume definition in the upper two aquifers. It was discovered that the plume extended beyond the area once believed to be affected by VOCs.

In order to complete plume definition rapidly and cost-effectively, several new and existing field techniques were evaluated. The selected technique combined cone penetrometer tests (CPTs) and HydroPunch sampling. The CPTs were used to define the stratigraphy, differentiating between aquifer and aquitard materials. The HydroPunch sampler was then used to collect water samples from the sandy aquifer materials, at the appropriate depths in a separate hole adjacent to the CPT locations.

General Setting

The plume definition program was conducted in commercial and residential areas downgradient from the facility and several other semiconductor manufacturing sites. Most work was done in city easements after the locations of the underground utilities were marked. The small diameter (1.5 inches) of the CPT and HydroPunch holes caused minimal disturbance to the paved streets and landscaping in these areas.

The area of investigation is underlain by a thick sequence of unconsolidated sediments that were deposited primarily by northward-flowing streams. The sediments consist of low-permeability clays and silts interlayered with discontinuous lenses of higher permeability sands and gravels. The aquifers are composed of sand and gravel layers that are typically less than 1 foot to about 20 feet thick.

Figure 1 is a cross section of the typical lithologies in the investigation area as interpreted from CPT data. The aquifers are labeled A-, B1-, and B2-level and these designations are based on the depths of the sand units from the ground surface. Using this approach, saturated sands occurring at depths between 5 and 25 feet are designated the A-level aquifer. Beneath this aquifer, typically at depths of 30 to 45 feet, is the B1-level aquifer. Beneath the B1-level aquifer is the B2-level aquifer, which usually occurs at depths between 50 and 65 feet.

These aquifers are the preferred pathway for the migration of VOCs away from the underground storage tanks at the semiconductor facility. As shown in Figure 1, these aquifers are not present at every location within the designated depths.

The monitoring wells installed as part of this six-year investigation are completed in permeable sand and gravel layers. Borings that did not encounter a minimum thickness of sand or gravel at the appropriate depths were not converted to monitoring wells. In such cases, additional soil borings had to be drilled and sampled

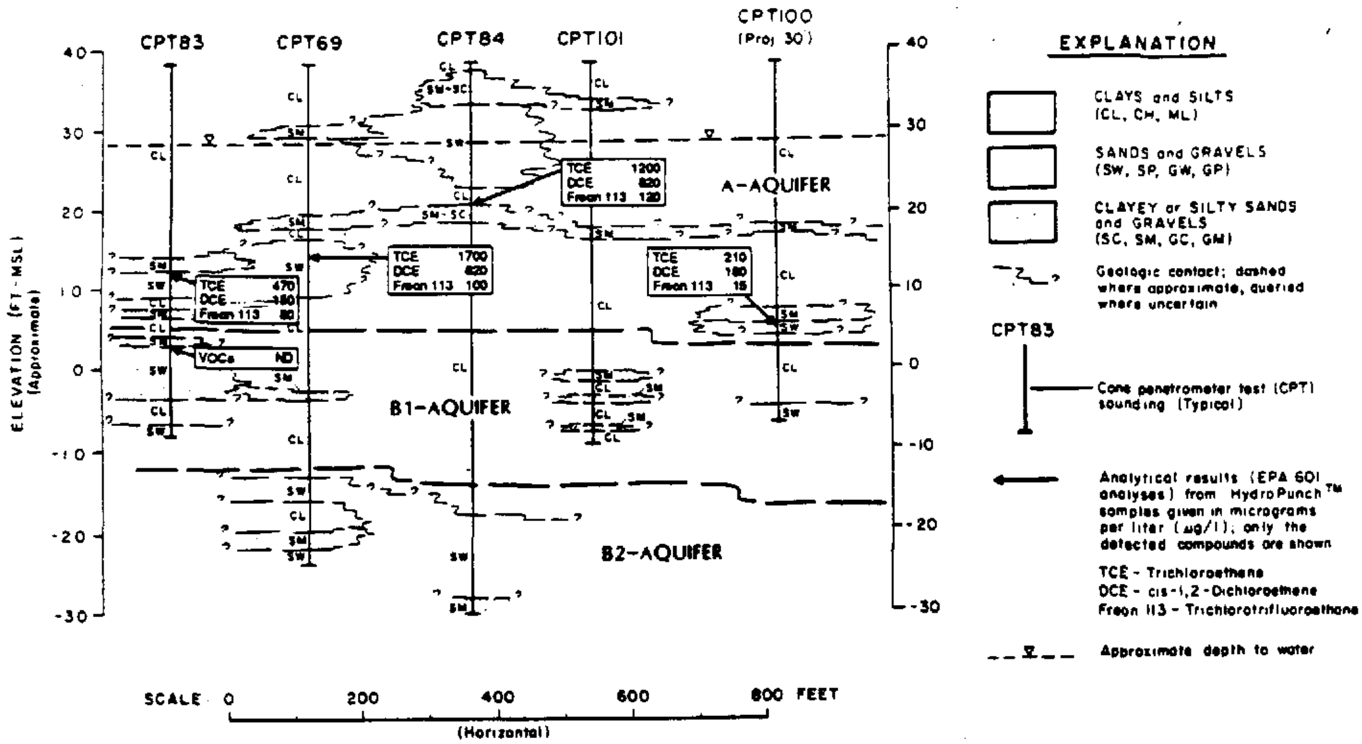

Figure 1. Typical cross section showing soil lithologies as interpreted from cone penetrometer testing.

near the initial borings to locate a thicker section of the appropriate aquifer. The California Regional Water Quality Control Board, which oversees most ground water investigations in the area, required that at least 3 feet of sand or gravel be encountered to complete each monitoring well during this investigation. Wells completed in deeper aquifers also required conductor casing to prevent VOCs in the shallower aquifers from migrating downward. Because of these requirements, the cost of the well installations escalated as the investigation progressed into the deeper aquifers. This increase in costs led to the evaluation of alternative technologies for collecting ground water samples.

Cone Penetrometer Tests

CPTs were used to define the occurrence of aquifer and aquitard materials at each tentative sampling location. Lithologic definition was required to determine whether an adequate thickness of sand and gravel existed at the appropriate depths.

CPTs are useful for determining soil characteristics and stratigraphy at sites underlain by soils or soft rock. The CPT probe is a 1.5-inch-diameter rod with a conical point that is pushed into the ground at a constant rate. Electronic sensors at the tip and sides of the probe measure penetration resistance and side friction of the soils, respectively. These two parameters are typically different for granular soils and clayey soils, making the CPT a particularly useful tool for defining the occurrence of sands and gravels vs. clays and silts.

CPTs are generally performed using a special test rig and a computer-automated data collection, analysis, and display system. Figure 2 shows a typical CPT rig pushing a probe into the ground. Best results are obtained by calibrating the CPT data with data from a continuously sampled soil boring drilled using standard

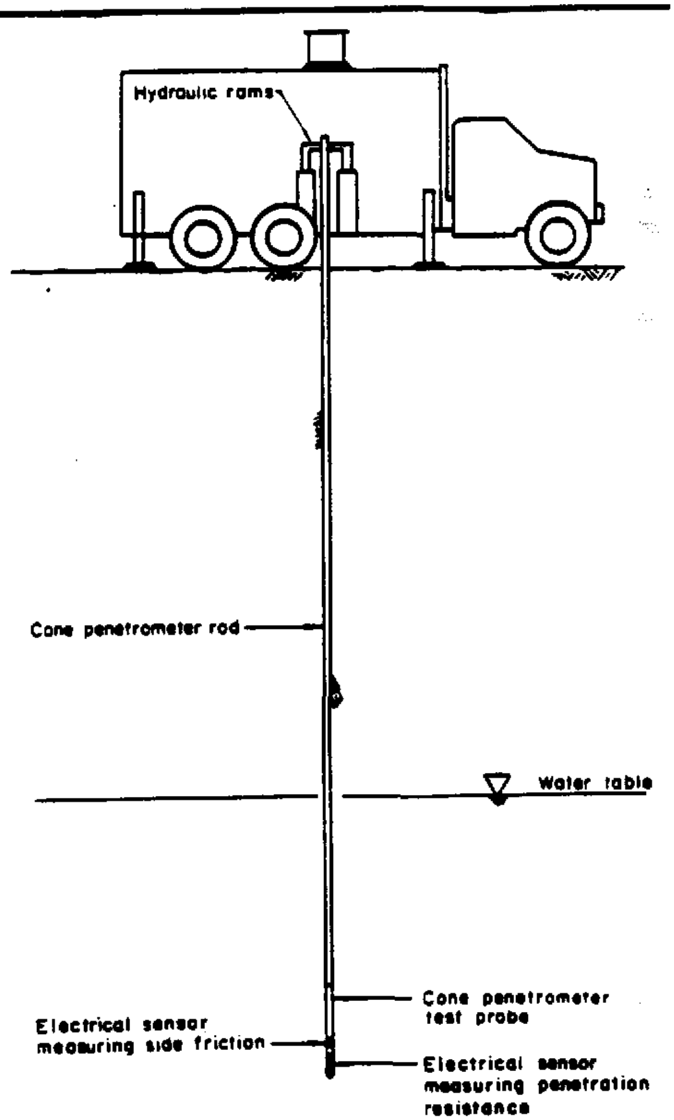

Figure 2. Typical cone penetrometer test rig.

methods. Figure 3 compares a CPT log with a standard boring log from a borehole adjacent to the CPT hole. These data are from the study area. The CPT log shows side friction and penetration resistance in soil. Values for both of these parameters typically are low as the probe is pushed through clays and silts and relatively high as the probe is pushed through sands and gravels. Figure 3 shows that the CPT log compares favorably with the lithologic information obtained from the adjacent conventionally drilled and sampled soil boring. The reader is referred to Robertson and Campanella (1986) for additional information on the use and interpretation of CPTs.

After the CPT rods were pushed to the total depth of the hole, they were removed from the ground and the hole was backfilled with bentonite-cement grout. This was accomplished using one of two methods. If the holes remained open, a 1-inch-diameter flush-threaded polyvinyl chloride (PVC) pipe was inserted to the bottom of the CPT hole and the grout was pumped into the hole. If the hole collapsed and the PVC pipe could not be pushed to the bottom of the hole, hollow CPT rods were used instead. The hollow CPT rods, equipped with a sacrificial tip, were pushed to the total depth and grout was pumped to the base of the hole.

HydroPunch Sampling

The HydroPunch, manufactured by QED Environmental Systems Inc. (Ann Arbor, Michigan), is a sampling tool that allows the rapid collection of ground water samples without installing a monitoring well. Figure 4 is a diagram showing the opened and closed positions of the HydroPunch sampler. Approximately 5 feet long and 1.5 inches in diameter, the HydroPunch is capable of collecting a 500-milliliter ground water sample. Conventional drill rods or CPT rods can be used to push the tool to the desired sampling depth. Samples can be collected from shallow or deep aquifers in areas where multiple aquifers exist because the sampling port is shielded in a watertight housing that prevents ground water from entering the tool until the desired depth is reached. In this investigation, samples were collected as deep as 69 feet.

Once the HydroPunch is pushed to the desired depth, the rods are pulled up 12 to 18 inches, exposing the sampling port to the water-bearing zone. A disposable, polypropylene screen covers the sampling ports and filters out sand particles. The probe fills with water under in situ hydrostatic pressure with no aeration. A check valve at the base of the sample reservoir then closes, preventing the sample from draining as the probe is removed from the ground. When the HydroPunch is removed from the hole, the water sample is carefully poured into a 40-milliliter volatile organic analysis (VOA) bottle with no headspace. After the HydroPunch is removed from the hole, the hole is sealed with grout as described previously for the CPT holes.

Method Validation

To evaluate the HydroPunch sampling method, a

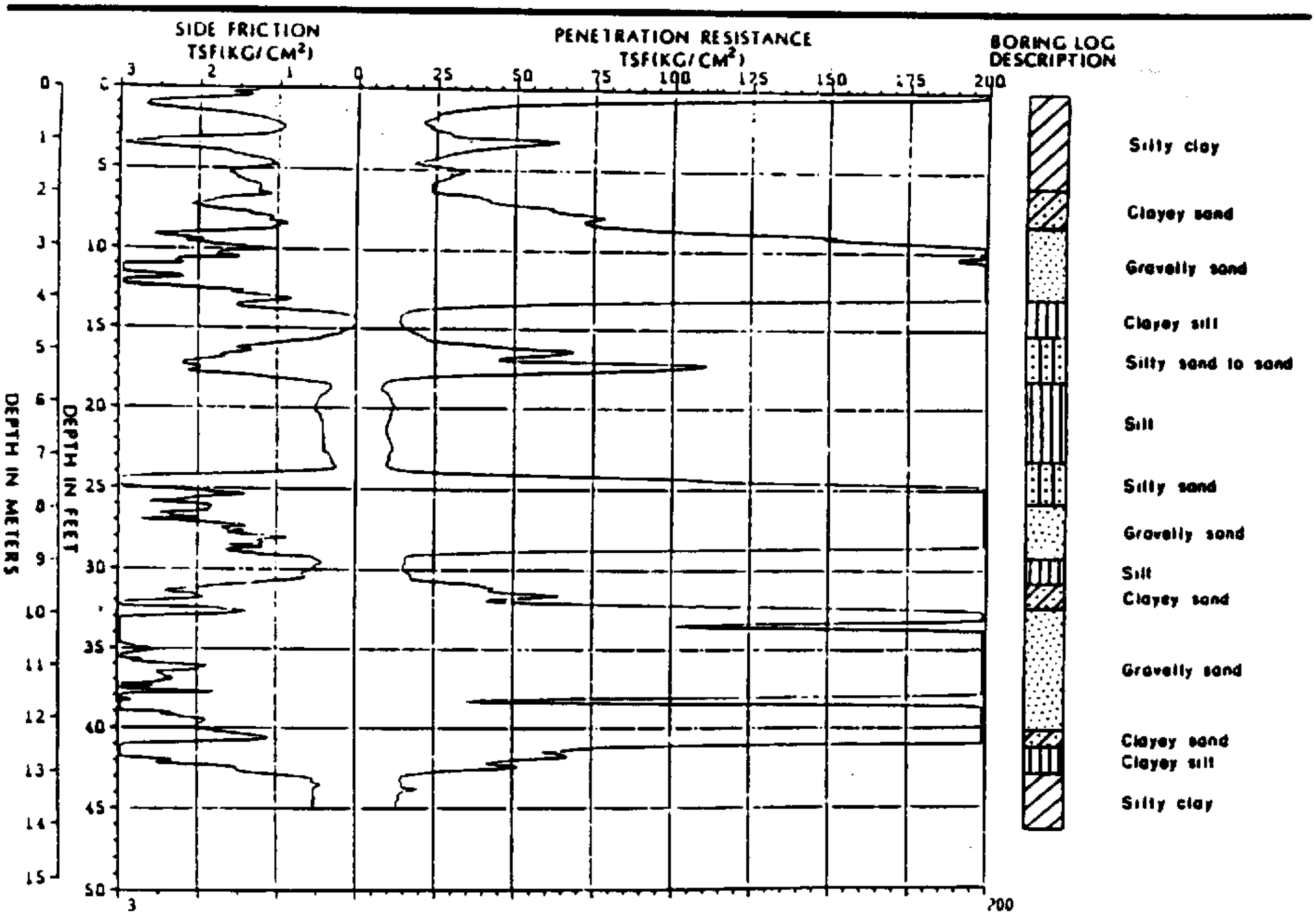

Figure 3. Cone penetrometer test log and adjacent boring log.

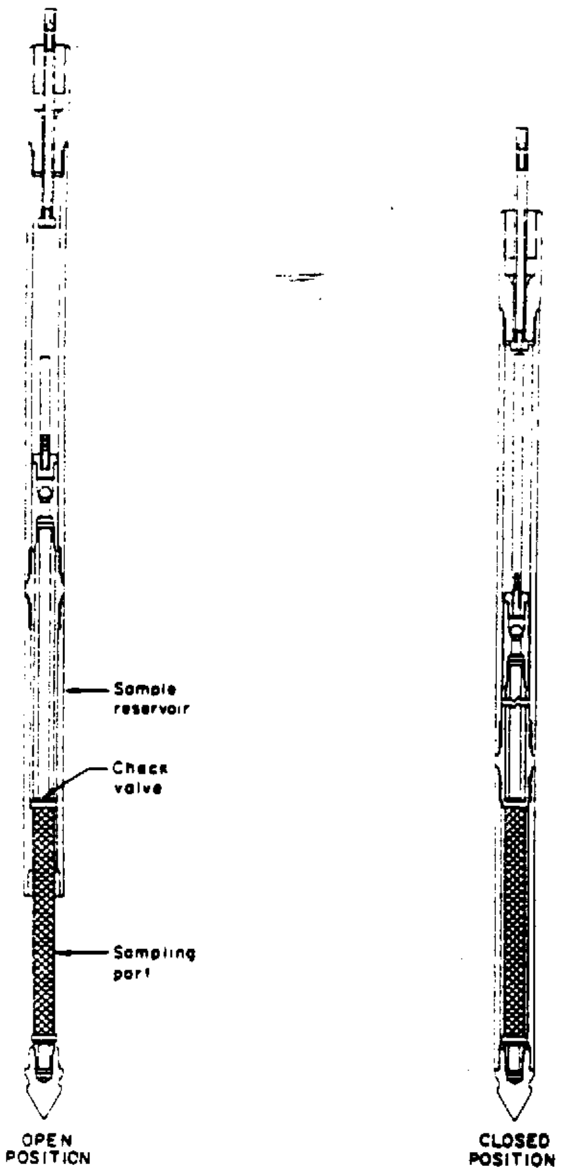

Figure 4. HydroPunch schematic.

HydroPunch sample (CPT10) was collected adjacent to an existing well (96B1) that contained elevated levels of VOCs. Table 1 summarizes the analytical results of tests conducted on those samples. The results show that the HydroPunch sample generally contained equivalent or slightly higher concentrations of VOCs compared with the sample from the adjacent well. Note that the analysis of both samples showed the same compounds at similar concentrations.

Table 1 also contains the analytical results from five additional monitoring wells and adjacent HydroPunch samples. These wells (73B2, 97B1, 119B1, 120B1, and 121B1) were installed after the downgradient edge of the plume had been defined by HydroPunch sampling.

The analytical results for HydroPunch samples and samples collected from adjacent monitoring wells compare favorably, except for those from CPT73 and well 73B2. The difference in VOC concentrations between these two samples may have occurred because the HydroPunch sampled a much narrower interval (1.5 feet) than is screened in well 73B (15 feet): dilution effects in the well may therefore have resulted in lower VOC concentrations.

Where samples were required from a deeper aquifer, the HydroPunch was pushed through a shallow aquifer where contamination may have existed. The watertight housing prevented ground water from entering the tool until the desired depth was reached. As shown in Figure 1, at location CPT83, the shallow sample contained 700 micrograms per liter (μg/L) total VOCs while the deeper sample contained no detectable VOCs.

During this investigation, the HydroPunch was disassembled and steam-cleaned before each sample was collected. To determine whether steam-cleaning was removing all VOCs, analytical results from successive samples were evaluated instead of collecting and evaluating equipment blank samples. Table 2 shows the analytical results for four HydroPunch samples. Samples CPT18 and CPT5 were collected immediately after samples CPT93 and CPT10, respectively, following steam-cleaning of the HydroPunch.

The results presented in Table 2 indicate that steam-cleaning is effective in removing the VOCs from the HydroPunch between sampling events. The presence of low concentrations of VOCs in well 121B1 (Table 1) indicates that the low levels of VOCs detected in CPT5 are real, not caused by cross contamination from the previous sample, CPT10.

In subsequent investigations using the HydroPunch, equipment blanks were collected after the HydroPunch was steam-cleaned. The blanks were collected after each steam-cleaning by pouring organic-free water through the screen, into the sample chamber, and into a 40-milliliter VOA bottle with no headspace. The blanks were analyzed for VOCs by U.S. Environmental Protection Agency (EPA) Method 601 and no VOCs were detected in these blanks.

Limitations

Several limitations of the HydroPunch sampling system became apparent during this investigation:

- 5 feet of hydrostatic head above the sampling port is required to fill the probe.
- The probe cannot be pushed through cobbles or thick sequences of coarse, gravelly material.
- The probe does not always open or fill, and the check valve does not always close properly, preventing sample collection. A 70 percent sample collection success rate was achieved with the HydroPunch. In subsequent investigations using the HydroPunch, the sample collection success increased to 85 percent.
- A limited volume (500 milliters) of ground water can be collected. Although this is sufficient for VOC analyses, a larger sample volume would be required for analysis of other parameters (such as metals or biological oxygen demand).
- This technique does not provide a permanent monitoring point (such as a well) for repeated sampling.
- Soil samples cannot be collected for logging or chemical characterization.

TABLE 1
Comparison of HydroPunch Samples to Adjacent Well Samples

HydroPunch Sample	Adjacent Well	Chemical Compounds TCE	TCA	1,2-DCE	Freon 113	VC
CPT10	—	1500	<50	2400	350	50
—	Well 96B1	530	<50	1800	240	60
CPT5	—	<0.5	0.6	<0.5	8.3	3.9
—	Well 121B1	<5	<5	<5	7	<10
CPT47	—	<0.5	<0.5	<0.5	<0.5	<0.5
—	Well 120B1	<5	<5	<5	<5	<10
CPT61	—	<0.5	<0.5	4.3	6.4	<0.5
—	Well 119B1	<5	<5	10	10	<10
CPT73	—	4.4	1.4	14	9.1	<0.5
—	Well 73B2	<5	<5	<5	<5	<10
CPT97	—	<0.5	<0.5	<0.5	<0.5	<0.5
—	Well 97B1	<5	<5	<5	<5	<10

Notes:
1. Ground water from well 96B1 and all HydroPunch samples was analyzed for VOCs by EPA Method 601. Ground water from the remaining wells was analyzed by EPA Method 624.
2. All results presented are in micrograms per liter.
3. TCE = trichloroethene
   TCA = trichloroethane
   1,2-DCE = *cis*- and *trans*- 1,2-dichloroethene (total)
   Freon 113 = 1,1,2-trichloro-1,2,2-trifluoroethane
   VC = vinyl chloride.

TABLE 2
Comparison of Successive HydroPunch Samples

HydroPunch Sample	Chemical Compounds TCE	TCA	1,2-DCE	Freon 113	VC
CPT93	<5	<5	200	18	11
CPT18	<0.5	<0.5	<0.5	<0.5	<0.5
CPT10C	1500	<50	2400	350	50
CPT5	<0.5	0.6	<0.5	8.3	3.9

Note: All results are presented in micrograms per liter.

Conclusions

The combination of cone penetrometer testing and HydroPunch sampling was a rapid and cost-effective technique for obtaining ground water samples for preliminary plume definition.

During this investigation, 77 CPTs were conducted to identify aquifers at the target depths and 40 HydroPunch samples were collected in 29 days. The CPTs averaged 48 feet in depth, and the HydroPunch samples were collected at depths between 18 and 69 feet: the average depth of collection was 35 feet. Data from six CPTs or three HydroPunch samples were collected daily.

The advantages of using this technique rather than installing monitoring wells to collect ground water samples include the following:

- Work can be completed in 25 to 35 percent of the time needed to install monitoring wells.
- The technique is less intrusive than conventional drilling methods. This is particularly helpful when conducting work in residential and commercial areas.
- No soil cuttings are generated.
- A few monitoring wells can be more strategically located based on the large amount of data that can be collected quickly and at lower cost using a CPT and HydroPunch.
- Samples can be easily collected from deeper aquifers that may require more sophisticated and expensive drilling techniques to install wells.
- Ground water samples can be collected at 20 to 50 percent of the cost of installing monitoring wells.

References

Robertson, P.K., and R.G. Campanella. November 1986. *Guidelines for Use, & Interpretation of the Electronic*

Cone Penetration Test. The University of British Columbia. Third edition.

Biographical Sketches

Mark Smolley is a project supervisor with EMCON Associates (1921 Ringwood Ave., San Jose, CA 95132). He has a bachelor's degree in geology from Pennsylvania State University. For the past five years, he has coordinated and supervised ground water investigations associated with large industrial facilities and sanitary landfills.

Janet C. Kappmeyer previously worked for EMCON Associates and is director of operations at On-Site Technologies Inc. (1715 South Bascom Ave., Campbell, CA 95008). She has a master's degree in geology from the University of Michigan. In the past seven years, Kappmeyer has focused primarily on remedial investigations of industrial and hazardous waste sites impacted by chlorinated solvents.