CytoCulture
ENVIRONMENTAL
BIOTECHNOLOGY
A DIVISION OF CYTOCULTURE INTERNATIONAL INC

July 20, 1992

Mr. George Sellman
ETNA Real Estate Investment Group
242 Trumbull Street
Hartford, CN 06156

RE: Site Remediation for Powell Street Plaza Shopping Center
Emeryville, CA (former P.I.E. Nationwide truck terminal)

Summary of Prior Remediation Work and Status of Site

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1. Introduction

CytoCulture is an environmental biotechnology firm based in Point Richmond (near Emeryville) which had designed, constructed and operated an in situ groundwater bioremediation system for the former owners of the shopping center site, P.I.E. Nationwide, Inc. (Jacksonville, FL) from March 1989 through May 1990. The bioremediation program consisted of a pair of bioreactor treatment systems to process contaminated groundwater pumped from two extraction trenches which intercepted the migrating plume of hydrocarbon product in the southwest corner of the property (along the freeway and along the former access road for the Judson Steel Corp. to the south).

The system was turned off after 15 months of continuous operation by a stop-work action instigated by P.I.E.'s lack of payment for overdue CytoCulture invoices. In September, the engineering consultant overseeing the project, Blymyer & Sons Engineers, abandoned the project, leaving CytoCulture to negotiate directly with P.I.E.. The trucking firm declared bankruptcy in October of 1990 forcing CytoCulture to recover its equipment and take an $18,500 loss in revenues for unpaid invoices. CytoCulture subsequently paid all of its subcontractors, including Curtis and Tompkins, Ltd. analytical laboratories, for outstanding invoices incurred during treatment from January through May 1990.

CytoCulture has been contracted by ETNA Realty Investments, Inc. to write up a review of these past remediation activities in consideration of restarting the bioremediation of the contaminated groundwater and soil yet remaining on site. This report is a preliminary assessment of the current status of the site and does <u>not</u> include any updated information from or communication with the regulatory agencies involved with the inactive remediation project. Cost estimates will be forthcoming in the next phase of the work and would be preliminary, pending a thorough site evaluation analysis of the existing monitoring wells and recommendations/requirements from the regulatory agencies.

The Powell Street Plaza Shopping Center was built in 1987-1988 on the site of a former truck terminal owned and operated by P.I.E. Nationwide, Inc. Truck maintenance activities and leaking underground contaminated the site with a variety of petroleum hydrocarbons over a span of at least 30 years. Contaminants range from gasoline/BTXE to diesel to waste oil and lubricants. Blymyer & Sons Engineers, Inc. presumably supervised the demolition of the terminal structures and the removal of the underground fuel storage tanks prior to 1987. Groundwater Technology Inc. was then contracted to scrape up several feet of

surface soil contamination (about 7,000 cubic yards) for treatment by a force air ventilation heap bioremediation process. The treatment apparently resulted in the reduction of petroleum hydrocarbons to less than 200 mg/kg in the soil, allowing the treated fill to be hauled to a Class III landfill under a variance from the Regional Water Quality Control Board.

During the initial construction of the shopping center, an RFP was issued by Blymyer (June 1987) soliciting bids for the clean-up of the contaminated groundwater and remaining contaminated soil on the site. CytoCulture bid against 5 other contractors at the time (see enclosed proposal of July 29, 1987) and was awarded the bioremediation contract in October of that year (the other bidding contractors included Groundwater Technology, ECOVA, Converse and two other local firms).

The CytoCulture remediation program began with additional site investigations and the installation of monitoring wells on the property (all of the former monitoring wells had been destroyed during the remediation of the surface soil and by construction activities). Construction of the groundwater bioremediation system began in mid-1988 and was completed after stop-work interruptions (payment delays) by the end of the year. Treatment was initiated in March of 1989 and went on for 15 months. This report chronicles the operations conducted by CytoCulture and its subcontractors from October 1987 through October 1990.

2. Brief Review of Site Characterization in 1987-1988

CytoCulture's first task in commencing remediation work on the P.I.E. site was to work with the county and the SF Bay Regional Water Quality Control Board to obtain a responsible oversight agency for the project. The Board was unable to provide a qualified engineer or hydrogeologist to evaluate and monitor our bioremediation proposal, and was therefore unwilling to let us proceed without a substitute oversight agency (the county was also unable to help). The DHS in Berkeley declined, as did the Water Resources Board and other agencies we contacted. Finally, because of their interest in innovative remediation technologies, the Office of Alternative Technology of the DHS agreed to work with our team in evaluating the in situ bioremediation project (see regulatory issues below). Their first request was, of course, to better establish the plume of contamination and to define the groundwater gradient, influence of tides and other hydrogeological parameters. At that time, they determined that the biotreatment project would proceed in two phases: An initial pump-and-treat phase over a year, followed by actual in situ treatment with reinfiltration of the treated groundwater into trenches up-gradient of the contaminated zones.

Alton Geoscience was subcontracted by CytoCulture in October of 1987 to review prior site investigations and to perform additional site characterizations as requested by the Alternative Technology Office of the former Department of Health Services (now Cal-EPA). Alton Geoscience reviewed the earlier investigation reports and developed a plan for additional characterizations. The results of their initial investigations and their plans for additional characterization are summarized in the "Site Characterization Report for P.I.E. Nationwide Property" of November 3, 1987 (enclosed).

The Alton Geoscience recommendations were approved and expanded by the Alternative Technology Office in late 1987 to drill eighteen soil borings and eighteen monitoring wells. The results of this site characterization work are summarized in the enclosed "Report on Additional Site Characterization Studies at P.I.E. Nationwide Property" of April 28, 1988. (Log borings and analytical data sheets not enclosed).

The 1987-1988 site characterization report includes background information on the site geology and hydrogeology, results of the soil borings and monitoring well installations, gradient data, assessment of hydrocarbon contaminations, site plans, cross sectional views of the subsurface stratigraphy and concentration contour lines for the anticipated hydrocarbon plumes. Copies of the original boring logs and analytical data sheets are available, but not enclosed.

Site Geology/Hydrogeology

The Alton Geoscience Report includes site plans and cross sectional stratigraphy drawings which emphasize the complex nature of the site and its contamination. The site is basically a former marsh area filled in with mixed rubbish and fill in the 1930s. After the contaminated surface soil was scraped off and treated in 1987, new engineered fill was brought in to raise and level the site. In constructing the extraction trenches, we encountered railroad ties, steel, bricks, slag from the steel mill, along with mixed fill and clay. Bay mud was reached near mean water level (about 10 feet for the trench along the west side, and at about 7 feet for the trench along the south side).

The fill and native soils on this site are generally of low porosity and therefore not ideal for an infiltration program. However, flow rates of 1-2 gpm per trench have been obtained and should be improved by constructing deeper trenches for intercepting the migrating plume of dissolved phase hydrocarbons.

The split path of plume migration (west and south) further complicates remediation as does the fact that the groundwater is tidally influenced. Groundwater from the west trench appeared to be brackish or saline, with fresh water in the south trench.

Contamination Plume

Briefly, the Alton Geoscience report describes a broad plume of hydrocarbon contamination extending south and west from the locations of the original underground storage tanks (now under building D). The westward migration towards MW-7 is consistent with tidally influenced water moving down-gradient to the Bay. Free product in MW-7 was measured at 1.32 feet on March 10, 1988. This plume of free product oil and fuel was encountered, as expected, during the installation of the groundwater extraction trench along the western property line in June of 1988.

The hydrocarbon plume was also shown to be migrating south across the southern property line, presumably influenced by the creek which runs westward (parallel to the P.I.E. property line) about 300 feet to the south (through the current Martin Group property that was going to be developed for Marriott Hotels - see CytoCulture's site plan for September 1990). Soil boring analyses showed high levels of hydrocarbon contaminations (17,000 ppm in B7) although the nearest monitoring well MW-3 and MW-4 had little dissolved phase hydrocarbon. Subsequent installation of the groundwater extraction trench along the south boundary struck free product again, confirming free product migration southward.

Concentration contour maps summarize the findings reported by Alton Geoscience on April 28, 1988. At that time, the floating free product appeared confined to MW-7 (shown as a dashed elliptical curve representing an imagined plume migrating west). During the construction of the extraction trenches, however, it was obvious that free product contamination was migrating across both the west trench (towards the bay) and the south trench (onto the Martin property to the south). As will be discussed below, the CytoCulture remediation system recovered 800 gallons of free product (weathered diesel/oil) in the 15 months of pumping groundwater from these trenches.

The plume of dissolved phase hydrocarbon is much more extensive as indicated by the concentration contours in the Alton Geoscience site plans. Much of the southern and western edges of the property are contaminated from a plume which extends out from under the buildings D, C and B. Contaminated soil in the saturated zone (e.g., 17,000 ppm at MW-3) undoubtedly will contribute to a perpetual presence of dissolved phase hydrocarbon for years to come unless the soil can be treated directly.

3. Remediation Work Prior to CytoCulture (before mid-1987)

Several underground fuel and waste oil tanks were excavated and removed prior to 1987 under the supervision of Blymyer & Sons Engineers (no contact made, no information obtained). At that time we understood several tanks were leaking and that free product had been bulldozed back into the excavation pit and filled in with soil. Presumably records of the excavations and tank removals could be obtained from the county or from Blymyer & Sons Engineers. During the construction phase of the shopping center, fumes from the contaminated soil were strong enough to cause an equipment operator to be taken to the hospital, resulting in DHS/county involvement in site investigations and clean-up. At the time the storm sewer was being constructed along the south property, CytoCulture was on site to witness the excavation (and reburial) of oil-saturated soils from the bottom of the trenches (not far from our present excavation trench).

Site investigations by several environmental consultant groups (see Alton Geoscience Report of November 3, 1987) led to the conclusion that treatment of the upper 3-5 feet of surface soil would greatly reduce contamination on this site. Accordingly, Groundwater Technology Inc. implemented an above-ground soil bioremediation program to treat about 7,000 cubic yards of hydrocarbon-contaminated soil in late 1986/early 1987. The biotreatment reduced soil contamination levels to less than 200 ppm TPH. The soil was hauled to a class III landfill for disposal under a variance from the RWQCB (at that time, 100 ppm was the normal clean-up level for diesel TPH in soil).

Treatment of the groundwater and additional contaminated soil on site was originally bid by Groundwater Technology, but was later put out for open bidding on account of the very high prices presented by GTI. As mentioned, CytoCulture bid against 5 other contractors in July 1987 and was later awarded the contract. Aside from the GTI soil treatment, to our knowledge, there was no other treatment of soil or groundwater prior to CytoCulture's arrival on site in October 1987.

4. Groundwater Bioremediation by CytoCulture (1988-1990)

As described in general terms in the Proposal, and more specifically in the Operational Plan of December 1987, CytoCulture constructed two groundwater extraction trenches and two corresponding bioreactor treatment systems to degrade hydrocarbon contamination in groundwater. The system was installed in late 1988 and began treating water continuously in March 1989, proceeding with little interruption for 15 months.

After recovery of "free product" floating hydrocarbons in an oil/water separator, the contaminated groundwater flowed directly into the first of two bioreactor units in series. The recovered oil and fuel was collected for processing by a local oil recycling facility (Evergreen Oil Recyclers).

For a 3-4 gpm gallon per minute flow rate, these bioreactors had a working volume of approximately 1,000 gallons and a corresponding hydraulic residence time of about 4 hours each. The bioreactors in series therefore had a combined hydraulic residence time of about 8 hours, with an additional 8 hours provided by an aerated holding tank (in this case with a 2,000 gallon capacity).

The influent groundwater pumped from the extraction trenches usually had dissolved phase hydrocarbons ranging from 50 to 400 mg/L.

Over 1.3 million gallons of groundwater were treated to non-detectable levels of hydrocarbons (less than 0.5 ppm TPH, less than 1 ppb BTXE; see Table below). The treated groundwater met drinking water quality standards and was discharged under permit to the East Bay Municipal Utilities District (EBMUD) sanitary sewer (a main line of the sewer system runs directly under the concrete pads of the bioreactor basins on the site).

This initial "pump and treat" phase of remediation generated a constant flow of treated, clean water laden with nutrients (ammonium, phosphate and minimal salts) and excess hydrocarbon-degrading bacteria. From several years of experience with similar contamination sites in California, there was high certainty that this treated effluent would meet all requirements for discharge to the sanitary sewer or later, to the land for <u>in situ</u> treatment of the contaminated aquifer. Generally, the bioreactor effluent levels of benzene, toluene and xylene fall below the regulated limit of 0.5 microgram per liter (ppb) and the levels of total extractable hydrocarbons are consistently below 0.5 milligram per liter (see data tables below).

The results of groundwater treatment over 15 months are summarized on the next page.

Continuous Operation from March 1988 through May 1990
Flow Rates: 0.5 gpm start-up, 5 gpm maximum, 2-3 gpm average
Total Treatment: over 1.5 million gallons of groundwater
Treated Effluent Discharge: Sanitary sewer system

FIRST 100 REPRESENTATIVE INFLUENT/EFFLUENT SAMPLINGS

"INF" = raw influent "EFF" = treated effluent

No.	Date	Benzene ug/L	Toluene ug/L	Xylenes ug/L	Total Petr. Hydrocarbons mg/L
INFLUENT	1/09	290	10	9	4.2
Inoculum	3/02	17	6	6	7,400
Treated	3/03	6	16	7	3.4
EFF-6	3/08	ND	ND	ND	15
EFF-7	3/09	ND	ND	ND	2
EFF-9	3/10	ND	ND	ND	0.8
EFF-10	3/13	ND	ND	ND	1.5
EFF-11	3/14	ND	ND	ND	trace
EFF-12	3/17	ND	ND	ND	0.6
INFLUENT	3/21	450	13	4	2.9
EFF-14	3/21	ND	ND	ND	ND
EFF-16	3/28	ND	ND	ND	ND
EFF-18	3/31	ND	ND	ND	ND
INFLUENT	4/12	630	16	12	2.2
EFF-22	4/12	ND	ND	ND	ND
EFF-26	4/22	ND	ND	ND	ND
EFF-30	4/26	ND	ND	ND	ND
EFF-34	5/01	ND	ND	ND	ND
INFLUENT	5/15	ND	ND	ND	free product **1,400**
EFF-43	5/17	ND	ND	ND	32
EFF-44	5/22	ND	ND	ND	6
EFF-47	5/25	ND	ND	ND	ND
INFLUENT	5/26	ND	ND	800	ND
EFF-50	5/27	ND	ND	ND	ND
INFLUENT	5/30	ND	320	ND	ND
EFF-53	5/30	ND	ND	ND	ND
INFLUENT	6/09	100	13	20	210
EFF-59	6/09	ND	ND	ND	ND
EFF-62	6/16	ND	ND	ND	ND
EFF-65	6/30	ND	ND	ND	ND
INFLUENT	7/11	ND	ND	ND	350
EFF-70	7/11	ND	ND	ND	ND
EFF-71	7/31	ND	ND	ND	ND
INFLUENT	8/08	1	ND	11	570
EFF-72	8/08	ND	ND	ND	ND
EFF-77	8/30	ND	ND	ND	ND
INFLUENT	9/15	ND	ND	ND	4,500

No.	Date	Benzene ug/L	Toluene ug/L	Xylenes ug/L		Total Petr. Hydrocarbons mg/L
EFF-79	9/15	ND	ND	ND		ND
INFLUENT	9/29	90	ND	ND		**2,200**
EFF-82	9/29	ND	ND	ND		ND
EFF-86	10/19	ND	ND	ND		ND
INFLUENT	11/17	15	ND	100	free oil	**23,000**
EFF-91	11/17	ND	ND	ND		ND
INFLUENT	12/01	340	2	3		**4,900**
EFF-93	12/01	ND	ND	ND		ND
EFF-96	12/28	ND	ND	6		ND
EFF-100	01/29	ND	ND	ND		ND

Over a period of 15 months of continuous operation, the treated effluent discharges were documented as "non-detectable" for total petroleum hydrocarbons and for benzene, toluene, xylenes and ethylbenzene, with two exceptions. Effluent treated water almost invariably contained a health bacterial floc, in spite of wide variations of influent contaminants. The flow settled out in 15-30 minutes leaving a transparent (see photos) and odorless supernatant ready for reinfiltration or discharge to the sewer.

Plans for in situ treatment of the contaminated soil called for the reinfiltration of the treated discharge water with enriched cultures of bacteria and nutrients. A reinfiltration gallery of leachfield pipes was designed to maximize the distribution of bacteria through the unsaturated zones of fill above the contaminated areas of soil and groundwater. The continual extraction of groundwater down-field coupled with the reinfiltration of treated water up-field could establish a gradient of bacteria over the contaminated areas. Extensive sampling of 16 surrounding monitoring wells could allow for an evaluation of the bacterial migration and biodegradation.

5. Interruption/Termination of Bioremediation in May 1990

After several months of no payment on past due invoices for treatment services, CytoCulture was forced to stop pumping operations in early June of 1990. A letter was sent to P.I.E. indicating that CytoCulture would have to notify the sanitary sewer district and regulatory agencies of any prolonged interruption of services. No reply came and we notified EBMUD. The units were maintained with aeration for several weeks and then used to treat the remaining dissolved phase hydrocarbons in the clarifiers. Final samples of discharge water were tested to confirm compliance with our permit. The recovered free product was recycled by Evergreen. Electricity was turned off in July.

Only a few payments were ever received for the invoices submitted to P.I.E. in 1990. CytoCulture was forced to pay for all subcontractors including the analytical laboratory and oil recyclers. The last check received from P.I.E. bounced (bank notice enclosed), but later was deposited.

In September, a letter was received from Blymyer & Sons Engineers indicating they were severing their ties with our project and leaving us in direct communication with P.I.E. (enclosed). CytoCulture sent several letters to P.I.E. and received no response; telephone calls to management level personnel gave no results either.

In October, CytoCulture was informed that P.I.E. Nationwide had filed under Chapter 11 bankruptcy laws. CytoCulture was preparing to attend the creditors meeting in Jacksonville, FL when we were informed that P.I.E. had refiled under Chapter 7 laws leaving us no chance of recovering payment past due invoices. In 1991, CytoCulture received a letter from the attorneys settling the P.I.E. estate indicating their wish for us to return any payments made for our services in the year of 1990 on grounds that we were "privileged" in receiving payments within 3 months of their bankruptcy. CytoCulture declined their request on grounds that we were still owed over $18,000 for services rendered at that site.

CytoCulture recovered all of its equipment and possessions from the site in October, leaving the empty work basins and electrical panels. These panels have since been vandalized.

When the Martin Group expressed interest in trying to remediate contamination on their property to the south, CytoCulture drafted a proposal to expand the original biotreatment system to process extracted groundwater from both properties at a great savings relative to building a new treatment system. The Martin Group did not proceed with any further studies or remediation activities on their property other than to confirm the migration of hydrocarbons from the former P.I.E. property onto the former Judson Steel property to the south. Their most recent environmental consultant for site investigation on the former Judson Steel property was PES Environmental Services of Novato.

To our knowledge, no further work or investigations have been discussed for either property. Until we were contacted by the County this spring, CytoCulture had not discussed the remediation of this site with any consultant, owner or regulatory agency.

6. Regulatory Issues

The former P.I.E. site is probably deemed an ecologically sensitive site and therefore subject to regulatory pressure. The San Francisco Bay lies about 100 yards to the west of the western boundary of the property where free product migration has been evident. The creek to the south feeds directly into the marsh land of the Bay, although much of it is lined with concrete. Off site migration currently contributes to the contamination of Cal Trans property (Interstate 80) and Federal wetlands to the west, and to contamination of the Martin Group (current owner?) property (former Judson Steel) to the south. No investigations have been carried out for the Interstate or wetlands area, but substantial investigations have been performed and reported by geotechnical consultants for the Martin Group property since mid-1990 (we were in communication with two of these consultants groups in 1990).

Since we have been asked not to contact any regulatory agencies regarding this site, CytoCulture can only speculate as to what could be mandated and when it would be enforced. Based on our current projects and recent experience with the SF Bay Regional Water Quality Control Board (RWQCB) and the North Coast RWQCB (our Santa Rosa in situ groundwater project), we have the following general expectations:

1. Whoever currently owns the property **now** is defined under Federal RCRA and RWQCB regulations as the "Responsible Party". Although P.I.E. Nationwide may have caused the contamination and technically be liable, the responsibility for clean up starts with the current owner as the "RP". We presume ETNA now owns the property, so ETNA has become the RP for this contaminated site. The enclosed "Notice of Requirement to Reimburse" which we received by registered mail in March confirms that ETNA is an RP for this site (the other being The Martin Group).

2. By Tri-Regional Board regulations and policy for leaking underground storage tanks, and by state Leaking Underground Fuel Tank (LUFT) regulations, and by corresponding Federal laws, the RP of a contaminated site must act to mitigate the problem. In the Bay Area, the enforcement and general (not necessarily technical) oversight for cleaning up contaminated sites is deferred to the Counties. Their competence and sense of urgency will vary from county to county. Apparently Alameda county is just coming around to noticing that the 1988-1990 remediation program stopped at this property. According to the enclosed Notice, this project is considered a "new case", even though the county was involved in and informed of the original remedial actions.

3. The County will require action, probably in the form of a revised "Remedial Action Plan" or updated "Work Plan" indicating how the RPs will mitigate the very apparent threat to the quality of groundwater on this site. Sooner or later, they will enforce this requirement; failure to comply usually brings on fines and penalties along with a court mandated clean-up. We have no records of past clean-up orders or mandates since CytoCulture was not the project manager/consultant, but rather the contracted remediation team for clean-up. The only correspondence we saw is the RWQCB letter of 1986 indicating an NPDES permit would be required for any discharge to the storm sewer. The laws have changed considerably (for the better in most cases) for getting the permits to discharge to the land or the contaminated aquifer.

4. The requirement for an RAP or Work Plan would then be followed by a requirement to take action in mitigating the pollution. This site is a likely high priority site because:

a. Free product has been recovered (800 gals) in the recent past; free product (oil) is probably still present

b. The proximity of the SF Bay makes this ecologically sensitive

c. The project appears to have been "abandoned" with no follow-up work or additional treatment

d. Quarterly monitoring of the monitoring wells has not been performed (now a law for contaminated sites)

e. Counties are now taking a more pro-active role in getting sites cleaned up; Alameda County is no exception. The counties also have better expertise than before.

f. The Office of Alternative Technology (now in Cal-EPA) is unlikely to take the time and interest to monitor this project as well or at all; the counties are more capable of monitoring site clean-ups than they were 3 years ago

g. Bioremediation and in situ treatment are more widely accepted now; this site is still a tough one for trying to reinfiltrate treated water, but the county will be pressing for definitive action in cleaning the aquifer.

7. Requirements to Reinstall Treatment System
(Forthcoming in the next phase of work)

8. Cost Estimates for Reinstallation/Operation of System
(Forthcoming in the next phase of work)

CytoCulture
INTERNATIONAL INC.
Biotechnology Research, Scale-Up and Marketing

Abbreviated

Proposal for

IN SITU SITE REMEDIATION OF SOIL AND GROUNDWATER HYDROCARBON CONTAMINATION BY AUGMENTED BIORECLAMATION USING LABORATORY SELECTED BACTERIAL CULTURES

submitted to

P.I.E. Nationwide, Inc. and Blymyer & Sons Engineers, Inc.

by

CytoCulture International, Inc.

as a Joint Venture with

Sybron Chemicals, Inc.

in Collaboration with

Alton Geoscience, Inc.

July 29, 1987
(Revised October 1, 1987)

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EXECUTIVE SUMMARY

CytoCulture International, Inc., a local environmental biotechnology company, and Sybron Chemicals, Inc. have formed a joint venture to develop an in situ site remediation program for soil and groundwater contaminated with diesel fuel hydrocarbons at the former P.I.E. Nationwide trucking facility in Emeryville, CA. The remediation program is based on the use of individually selected strains of aerobic bacteria which biodegrade specific classes of hydrocarbons at much higher rates than naturally occuring microbes. A blend of seven pseudomonas strains has been formulated at Sybron Chemicals, Inc. to optimize the "Augmented Bioreclamation" of diesel and gasoline contaminated groundwater. The bacterial cultures will be used to treat contaminated brackish water which will be continuously drawn up from french drains placed in the tidal groundwater downstream of the contaminated areas. The water will be retained in a series of stainless steel chemostat bioreactor vessels above ground until the biodegradation has lowered the concentration of contaminants to an acceptable level. The treated water will then be aerated and mixed with fresh cultures of bacteria before being injected back into the ground upstream of the contamination areas. This continuous addition of high concentrations of enriched bacterial cultures should allow for extensive biodegradation of the hydrocarbon product remaining in the soil and at the moving soil/tide water interface. At least two, and possibly three, separate bacterial bioreactor treatment and delivery systems of this type are planned for the site.

In collaboration with Alton Geoscience, Inc., CytoCulture International will conduct further soils and groundwater investigations to maximize the effectiveness of the planned bioreclamation systems behind Buildings A and B and to determine whether a separate system will be needed in the Pad K area. Eleven monitoring wells will be drilled by Alton Geosceinces in consultation with Blymyer & Sons Engineers; several of these wells will later be integrated with the bioreactor systems to continuously monitor the impact of the remediation program. CytoCulture International, Alton Geoscience and Sybron will be responsible for the design and operation of the bacterial bioreactor treatment and delivery systems. The bioreactor systems will be equipped with automated process controls for continuous delivery of bacteria to designated groundwater injection sites and occasional batch delivery to the subsurface PVC perforated pipe system beneath Buildings A, B and C. Although the Augmented Bioreclamation program is designed for nearly a year of site remediation, prior success and early closures at two similar hydrocarbon groundwater decontamination projects in California strongly suggest this site could be closed much earlier.

PROPOSED BUDGET

Task #	Task Description	Allocation
1.	Start up studies, assessment of prior data site visits by hydrogeologists and reports	
2.	Applications for required permits; presentations to local regulatory agencies	
3.	Installation of eleven groundwater monitoring wells in keeping with scope of work	
4.	Additional soil and water investigations of Pad K area, and areas east of Buildings A & B (assume 6 borings) with tests and reports	
5.	Construction of concrete pads with enclosed fence for each of three bioreactor systems	
6.	Excavation, placement and gravel bedding of french drains (assume 3) with plumbing to groundwater pumps	
	Excavation, plumbing and gravel bedding of piping for 3 infiltration trenches and manifolds for connecting to existing subsurface PVC perforated pipe (Bldgs A-C)	
7.	Design, construction and installation of steel tankage, pipes, pumps, monitors, and controls for three complete bioreactor systems	
	Installation of pumps and start up of bioreactors	
8.	Start up costs for bacteria, materials and labor, including preliminary testing for RWQC Board	
9.	Monthly operational costs over 10 months including bacteria, supplements, labor, equipment parts & service, water testing services and reports	
10.	Sample analyses: Total Hydrocarbon, phenol and polyaromatic hydrocarbons as required by RWQC Board	
11.	Final report, presentation of results to regulatory agencies, evaluations, and technical recommendations	

PROPOSED WORK SCHEDULE

TASK	FIRMS *	MONTH											
		1	2	3	4	5	6	7	8	9	10	11	12
1	ALT	X											
2	ALT	X											
3	ALT	X											
4	ALT	X											
5	ARC		X										
6	HAT		X										
7	ALT SYB	X	X										
8	SYB		X										
9	SYB ALT			X	X	X	X	X	X	X	X	X	X
10	SYB												X

* Participating subcontracting firms:

SYB = Sybron Chemicals
ALT = Alton Geoscience
ARC = Arrow Construction Co.
HAT = Hatton Construction Co.

PURPOSE AND OBJECTIVES

The purpose of the proposed site remediation project is to render the P.I.E. trucking site to levels of contamination acceptable to the State of California Department of Health Services, the San Francisco Bay Regional Water Quality Control Board, and Alameda County Department of Health. The contamination on site consists of petroleum hydrocarbons, primarily diesel fuel, from leaking underground storage tanks, above-ground storage tanks, and product delivery lines. The leaking equipment has since been removed from the site prior to the commencement of the current construction of a new shopping center.

Contamination exists as free-product on the groundwater and is adsorbed in the soil. The soil in the most heavily contaminated areas has been scraped down to six feet below the surface and is currently being treated on site by another contractor with enhanced bioreclamation techniques (spraying nutrients to enhance the growth of indigenous bacteria in the soil). The scraped soil has been replaced with engineered fill but the mud beneath the fill is still heavily contaminated in several areas. Saturation of the soil with diesel fuel at the level of the groundwater has been observed.

The primary objective of the proposed site remediation project is to design, construct and operate an Augmented Bioreclamation system using Sybron bacterial cultures to biodegrade the diesel fuel contaminating both the soil and the groundwater so as to bring the site into compliance with current regional water quality regulations. Treatment will involve both above ground bacterial bioreclamation of water extracted from the contaminated water table and subterranean bioreclamation of the contaminated soil with aerated bacterial cultures injected back into the ground with the treated water.

A second, and equally important, objective is to achieve compliance with regional water quality regulations in as short a time and as cost-effectively as possible. Therefore the project has been designed to optimize the application of bacterial Augmented Bioreclamation technology to this particular site by employing three individual bioreactor systems at the three most heavily contaminated areas on the site. If reasonably high flow rates (> 3 gal/min) of contaminated water through the system can be maintained, the site could potentially reach compliance levels of contamination in less than one year. Sybron Chemicals and Alton Geoscience are already setting precedents in California by applying to state regulatory agencies for early closures at two similar Augmented Bioreclamation sites involving polyaromatic hydrocarbon contamination of soil and groundwater.

CYTOCULTURE PROJECT LEADERSHIP

Project Director: Randall J. von Wedel, Ph.D.

Dr. von Wedel is President and Director of Research for CytoCulture International, Inc., San Francisco, CA. He is a biochemist with extensive experience in project management ranging from biomedical research programs in both industrial and university laboratories to environmental biotechnology projects in the field. Besides establishing CytoCulture as a R & D and consulting firm in biotechnology, he has also set up a consulting firm, AmbienTech, in San Juan, Puerto Rico to deal directly with the application of bioaugmentation technologies to local municipal and industrial wastewater or groundwater contamination needs. Dr. von Wedel will oversee the construction, testing and operation of the bioreactor treatment and delivery systems on site. He will be coordinating the various sub-contractors participating in all phases of the project from the site evaluations through the construction of the bioreactors. He will then be responsible for submitting all reports to Blymyer & Sons Engineers, P.I.E. Nationwide and the various construction and water quality control regulatory agencies.

Project Manager: Jose F. Mosquera, M.S.

Mr. Mosquera, a Research Engineer in Sanitary/Environmental Engineering at the University of California, Berkeley, will work for CytoCulture International as the Project Manager for the proposed Augmented Bioreclamation program at the P.I.E. trucking site. He will be responsible for overseeing the day to day operations of this project at the site. He will be there to monitor, adjust and maintain the three proposed bioreactor systems described in this proposal. His extensive experience in designing and maintaining bacterial bioreclamation systems will be essential for his key role in this project.

The Curricula Vitae for Dr. von Wedel and Mr. Mosquera are enclosed in Appendix 1.

Dr. von Wedel and Mr. Mosquera have also submitted a Step I (Feasibility Study) Grant Application to the California Hazardous Waste Reduction Grant Program sponsored by the Office of Alternative Technologies, Toxic Substances Division of the State Department of Health Services. The title of the grant proposal is:

Bacterial Biodegradation of Hazardous Wastewater: Phase I Study

A copy of this proposal is available for background reading.

THE JOINT VENTURE WITH SYBRON CHEMICALS

For over a year, CytoCulture International, Inc. has been the Northern California representative and contracted distributor for the Sybron Biochemical Division of Sybron Chemicals, Inc.. involved with the production of novel bacterial cultures sold for municipal and industrial wastewater treatment. Sybron Chemicals has been a world leader in this field for nearly forty years. An arrangement has been made between the companies whereby Dr. von Wedel, as Project Director and Mr. Jose Mosquera, as the CytoCulture Project Manager, will work closely with Mr. Gary Hater, Manager of soil and groundwater treatment technology for Sybron. The Joint Venture will become a formal, binding agreement when CytoCulture is awarded the contract for this project. See the Letter of Collaboration from Mr. Hater, the C.V.'s for Mr. Hater and Dr. Goldsmith and additional technical literature from Sybron in Appendix 2.

THE COLLABORATION WITH ALTON GEOSCIENCE

Alton Geoscience, Inc. has been working on two similar Augmented Bioreclamation projects with Sybron Chemicals as their contracted representative for soil and groundwater applications in southern California. Alton Geoscience is a recognized leader and pioneer in the development of alternative remediation technologies for contaminated soil and groundwater, including air stripping of hydrocarbons, high efficiency incineration and Augmented Bioreclamation (in collaboration with Sybron). Alton, Sybron and CytoCulture are working to establish a closer business relationship for future Augmented Bioreclamation projects in Northern California. Please refer to the Letter of Collaboration from Mr. Jeff Wiegand and technical literature from Alton Geoscience in Appendix 3.

PROJECT DESCRIPTION BY TASKS

The following Task Descriptions summarize the scope of work, estimated costs and projected schedule for the implementation for the proposed Augmented Bioreclemation project at the P.I.E. trucking site in Emeryville. The proposed costs and scheduling have been summarized on pages 4 and 5 respectively.

1. Start Up Studies, Evaluations and Assessment of Prior Data

CytoCulture and Alton Geoscience will review data from previous consultants regarding prior site investigations and activities. This will involve inspections on site, assessment of the data and an evaluation of the validity if the conclusions of the previous reports. A brief report will be filed. Work would begin within 1 month of receiving a contract from P.I.E..

2. Applications for Required Permits

CytoCulture and Alton Geoscience will be submitting applications for permits pertaining to drilling, construction and treatment operations on the site. These permit applications will be filed within the first month of the contract period.

3. Installation of Eleven Groundwater Monitoring Wells

Alton Geoscience will be subcontracted to perform the drilling, installation, testing and operation of the eleven monitoring wells specified in the original scope of work. The sites for these wells will be selected in consultation with CytoCulture, Sybron and Blymyer & Sons Engineers with the intention of making as much use of these wells as possible in the normal operation of the bioreactor treatment and delivery systems. The drilling would begin within 10 days of receiving approval from the regulatory agencies and would be completed within 2 weeks.

4. Additional Soil and Groundwater Investigations

Alton Geoscience will be subcontracted to carry out additional site borings (at least six) to characterize the soil and groundwater contamination in the Pad K area and along the access road to the east of buildings A and B. This phase of the project has been advanced to first priority to accomodate construction plans on site.

5. Construction of Concrete Pads and Fencing for Bioreactors

Arrow Construction Company (Novato, CA; California General Building Contractor License Number 420628) will be sub-contracted to design and build the concrete pads (10 ft x 16 ft) which will support the bioreactor systems. Each 5 inch slab will be reinforced with # 4 reinforcing rods spaced 1 ft on centers.

Chain link fencing (6 ft) with redwood slats will be built around each pad and equipped with a 10 ft swinging gate at one end to allow complete access to the pad for installing or maintaining the equipment. Construction would begin by the end of the first month of the contract period.

6. Excavation and Installation of French Drains and Injection Trenches

Hatton Construction Company (San Bruno, CA; California Excavation Contractor's License # 319158) is one probable backhoe service which would be sub-contracted to dig trenches for the installation of the french drains, injection pipes and the subsurface PVC pipe manifolds (Buildings A, B and C).

Three french drains are planned at this time, to be located, for example, between buildings B and C, west of building A and west of the Pad K area. These locations are fairly speculative and would be determined for certain after consultations with Blymyer & Sons Engineers and Alton Geoscience, following their borings, monitoring well installations and site characterization. The french drains, from which contaminated water would be drawn for treatment in the bioreactor systems, will be bedded in pea gravel at about 12 feet below the surface, well below the high mark for the rising tidal groundwater. The piping will consist of 6 inch well casing pipe with 0.2 inch cuts. Connections to the bioreactor will be made at both ends or in the center. The trenches will be on the order of 50 feet in length, oriented parallel to the nearest building wall.

The injection trenches will be designed to maximize the surface area for returning treated water to the soil with fresh cultures of bacteria. One likely possibility, to save cost and effort, would be to dig a six foot trench parallel to the south sides of buildings B and C, and the east sides of buildings A and B, just beyond the ends of the subsurface PVC pipes protruding from the buildings (3 ft below the surface). In this way, the manifold can be connected to each pipe in the same trench where a perforated PVC pipe can be installed six feet from the surface. This greatly cuts the cost of labor and materials (pea gravel) and minimizes the disturbance to the existing site. The injection piping could be on the order of 50

to 75 feet in length, providing a large surface area for infusing fresh bacteria. The entire trench would be filled with gravel to maximize diffusion.

The PVC manifold for the subsurface PVC piping would be equipped with a manual valve to allow periodic (e.g., once a month) batch infusion of bacterial cultures under the buildings. The continuous infusion of bacteria into the soil will otherwise only occur by way of the injection trenches, the exact location and specifications for which will be determined jointly with Alton Geoscience, Sybron and Blymyer & Sons Engineers.

7. Design, Construction and Installation of Bioreactor Systems

Alton Geoscience has also been selected to contract with CytoCulture in the design, fabrication and installation of the bioreactor systems, complete with microcircuitry logic controls, groundwater pumps and process controls. As indicated before, Alton has worked closely with Sybron on similar Augmented Bioreclamation projects in California for which they also supplied the bioreactor hardware. CytoCulture will assist in the design and operation phases of the bioreactor development.

8. Start Up for Initiating Treatment

Sybron and CytoCulture would work together to test the bioreactor systems and initiate the Augmented Bioreclamation project with Sybron bacteria. This would involve at least two people from Sybron (see Appendix 2 for details) and two people from CytoCulture over a period of nearly a week. Sybron will provide bacteria, supplements, testing equipment and labor for this phase of the work. This work would begin in the second month of the contract period if there are no major delays in the installation of the drains, pumps, plumbing and bioreactors.

9. Monthly Operation of Bioreactors

CytoCulture would assume the primary responsibility for the day to day monitoring and maintenance of the three bioreactor systems once the systems were up and running. At this time, we are projecting a running period of 10 months, with an overall contract period of just one year. Sybron will make a monthly visit for mechanical and biological maintenance (see Letter from Mr. Hater in Appendix 2).

Alton Geoscience will also provide monthly mechanical maintenance. The CytoCulture Project Manager will be on site almost daily and will perform weekly chemistry tests on the cultures as well as to take weekly samples for total hydrocarbon and polyaromatic hydrocarbon analyses.

10. Routine Analysis for Monitoring Hydrocarbon Levels

CytoCulture will collect samples of treated and untreated ground water at the site for routine analysis (probably at Technical Analytical Laboratory, Hayward) according to the guidelines specified by the Regional Water Quality Control Board in authorization #2198.11 (see Blymyer's call for proposals).

11. Final Report and Presentation of Results

At the conclusion of the 10 month treatment period, a report will be submitted to P.I.E./Blymyer & Sons Engineers detailing the progress of the Augmented Bioreclamation project. The report will emphasize the communication which will be maintained with the state and regional water quality control boards as a demonstration of our "best efforts" policy to maximize the efficiency of the bioreclamation project. This report will include our evaluation of the various phases of the project and our technical recommendations how to proceed with or close down the bioreclamation project at that time. Out of that report will come a formal report to be submitted to the state and regional water qualtiy control boards and Departments of Health.

Several factors could reduce the budget total substantially, such as the decision to only install two bioreactor systems (e.g., delete the Pad K area) or reduce the projected length of the project or simplify the construction scheme presented in this proposal. These are issues which will be discussed at upcoming meetings with Blymyer & Sons Engineers.

CytoCulture

October 5, 1987

Chris Falbo
BLYMYER & SONS ENGINEERS, INC.
1829 Clement Avenue
Alameda, CA 94501-1396

Dear Chris:

Thank you for your letter of intent of September 18, 1987 authorizing CytoCulture International, Inc. to proceed with Tasks 1, 2 and 4. As we have discussed, we are pushing up the time table on Task 4 to take boring samples from the Pad K area of the site as early as possible. Accordingly we have notified our collabortor and sub-contractor for the hydrogeology aspects of the project, Alton Geoscience Inc. They have agreed to send up a hydrogeologist to supervise the drilling and sampling of the borings now scheduled for this Wednesday, October 7. We are therefore issuing a confirming Purchase Order to Alton for this task only and will continue to submit additional purchase orders for Tasks 1 and 2 as we complete our negotiations on the final contract between Blymyer/P.I.E. and the CytoCulture/Sybron joint venture. CytoCulture has already inquired on permits and permission needed for drilling and sampling borings on the site.

In finalizing the contract for this joint venture, we have already discussed our request for a clause which specifies that the funds received by CytoCulture as payments for this project could be assigned to our bank. We would also request a clause in the contract which states that the cost of defending against any investigatory or enforcement actions by any official environmental or regulatory agency shall be borne by Blymyer & Sons Engineers and/or P.I.E. Nationwide. Of course, CytoCulture and Sybron will be available and willing to assist in responding to any official inquiries or enforcement actions.

The Statement of Insurance from Sybron Chemicals Inc. is enclosed. We await copies of the Certificates of Insurance from both Sybron Chemicals and Alton Geoscience; other Statements of Insurance for our other subcontactors will be available soon.

A draft Schedule of Payments is enclosed for your review and inclusion in the contract. Please let me know if there is any other information I can provide you to facilitate the completion of the draft contract.

Sincerely,

Randall J. von Wedel, Ph.D.

BLYMYER & SONS engineers, inc.

July 8, 1987
BSE Job No. 8648

CYTOCULTURE
1208 Fourth Avenue
San Francisco, CA. 94122

Attn: Dr. Randall von Wedel

SUBJECT: REQUEST FOR PROPOSALS
IN-SITU SITE REMEDIATION
5500 EASTSHORE HIGHWAY
EMERYVILLE, CALIFORNIA

Dear Dr. von Wedel:

This letter constitutes a formal request for proposal for the subject work. The purpose of the site remediation is to render the site to levels of contamination acceptable to State of California Department of Health Services, San Francisco Bay Regional Water Quality Control Board, and Alameda County Department of Health. The contamination on site consists of petroleum hydrocarbons, primarily diesel fuel, from leaking underground storage tanks, above-ground storage tanks, and product delivery lines. Contamination exists as free-product on the groundwater and is adsorbed in the soil. Both phases of contamination require treatment.

The scope of work is as follows:

1. Conduct any necessary feasibility treatability, or start-up studies as required by the proposed treatment system or systems;

2. Conduct further soils and water investigation to determine the extent of contamination on the east side of the property, most specifically in the area of Pad K on the enclosed drawing;

3. Install no less than eleven (11) groundwater monitoring wells on site to monitor groundwater quality; locations for wells shall be chosen in consultation with Blymyer & Sons Engineers and should have a minimum depth of 20 feet, or as required by the proposed treatment system;

4. Design a remediation system, based upon the above work and work done previously at the site, to remove the hydrocarbon contamination both in the soil and on the groundwater.

5. Purchase all necessary equipment for full implementation of the designed system, including any necessary tanks, pumps, piping, bacteria, nutrients, and any accessories.

6. Obtain all necessary permits from and make any required demonstrations to San Francisco Bay Regional Water Quality Control Board or any other agencies required by Federal, state or local regulation;

7. Install the remediation system as approved by San Francisco Bay Regional Water Quality Control Board, any other requisite Federal, state, or local agency, and P.I.E. Nationwide, including all necessary components, lines, and discharges; included in this phase is all drilling, excavation, trenching and resurfacing necessary for installing the system.

8. Start-up and test the system to insure proper operation and compliance with San Francisco Bay Regional Water Quality Control Board authorization #2198.11 (enclosed).

9. Maintain and monitor the system on a monthly basis to insure proper operation and compliance, including all necessary foreseeable servicing of equipment and reports to the RWQCB.

Based upon the above scope of work please provide a cost and schedule for each work step. The scope of work may be reorganized or phased for bid purposes, as long as each work step is clearly indicated in the bid. Any work conditional on a previous work step should be indicated in the proposal with possible contingencies. If precise costs cannot be specified because of a lack of data for any work step, ranges of costs should be given with applicable assumptions stated.

All bidders should have previously received copies of the following documents for use in making bids:

1) Groundwater Technology Assessment dated September 5, 1986.
2) Peter Kaldveer and Associates Assessment dated August 15, 1986.
3) Geotechnical bore logs from Geomatrix Consultants, dated October 9, 1986.
4) Laboratory analyses of soil samples analyzed for hydrocarbons, dated April 23, 1987.
5) Laboratory analyses of soil samples, analyzed for pesticides, PCB's, and metals, dated January 13, 1987.
6) Laboratory analyses of soil samples, analyzed for total petroleum hydrocarbons as diesel, dated April 27, 1987.
7) Bore logs for Wells GT-9 through GT-13, dated October 1, 1986 through December 15, 1986.
8) Laboratory analyses of soil samples, analyzed for priority pollutants, dated October 15, 1986.

July 8, 1987

In addition, the following documents are included with this request for proposal:

1) Site plans for the development currently taking place on site, including the location of PVC perforated pipe buried under buildings A, B, and part of C, for use in any soil venting or nutrient introduction system.

2) Geotechnical soils bores done in the area of Pad K, in which hydrocarbon odors were noted, by Laver R. Loper and Associates.

P.I.E. Nationwide has purchased some equipment for groundwater remediation. To save costs, this equipment may be incorporated into any designed treatment system. However, using the equipment is not mandatory for the treatment system to be considered. The purchased equipment includes one probe scavenger, one water table depression pump, and the accessories for each.

Please send a proposal by July 29, 1987, covering all above-referenced points, addressed in the following manner:

P.I.E. NATIONWIDE
C/O BLYMYER & SONS ENGINEERS, INC.
1829 CLEMENT AVENUE
ALAMEDA, CALIFORNIA 94501

If there are any questions, please call my office at: (415) 521-3773. Also, if CYTOCULTURE declines to bid on the project, please inform Blymyer & Sons of that fact as soon as possible.

Cordially yours,

BLYMYER & SONS ENGINEERS, INC.

Chris Falbo

CF/ds

Attachments

cc: Mr. John Ster-P.I.E. NATIONWIDE, JACKSONVILLE, FL.

STATE OF CALIFORNIA
GEORGE DEUKMEJIAN, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
1111 JACKSON STREET, ROOM 6040
OAKLAND 94607

Phone: Area Code 415
464-1255

November 25, 1986
File No. 2198.11

Mr. Jim Skelton
P.I.E. Nationwide
P.O. Box 2408
Jacksonville, Florida 32203

Subject: NPDES Permit for Diesel Leak Cleanup, P.I.E. Nationwide, 5500 Eastshore Highway, Emeryville

Dear Mr. Skelton,

Under State and Federal law, discharges of polluted water to surface waters require an NPDES permit. We acknowledge receipt of the EPA forms 1 and 2C NPDES applications and the application fee. I cannot at this time provide you with an estimated date for the Regional Board to consider your NPDES permit application at the required public hearing. However, I believe it is in the public interest to have the discharge of hydrocarbon contaminated groundwater proceed in this specific instance, without my recommendation to the Regional Board for enforcement action, provided the following requirements are met:

1. At no time shall the total dissolved hydrocarbon content of the discharge exceed 100 ug/l. Total phenol shall be analyzed specifically and will contribute to the hydrocarbon total. At no time shall poly-aromatic hydrocarbons detected by EPA method 610 exceed 15 ug/l. If these limits are exceeded, the discharge will cease immediately and the Regional Board shall be notified at the earliest opportunity at 415-464-1255.

2. Discharge shall not occur until at least a 24 hour pilot operation of the treatment system meets the standards listed in item 1..

3. Sampling shall occur daily for the first three days of discharge. These samples shall be analyzed on the most rapid basis practically available.

4. Following this start-up phase, sampling shall occur weekly, and analysis can occur on a more normal basis.

5. Reports shall be submitted on a weekly basis for the first three weeks of operation, and on a monthly basis thereafter, detailing the results of effluent analysis, flow rate of effluent, and general description of the operation and maintenance of the recovery system.

6. After this four week start up phase, general reports shall be submitted quarterly, describing the overall status of the investigation and recovery operation, including precise water and product levels in

groundwater monitor wells.

A detailed technical review of the investigation and remedial action proposed for this site has not been undertaken by our staff, and due to the large number of cases of this type and limited staff availability, a review of this type is not anticipated in the near future.

We appreciate your cleanup activities. Any questions on this matter should be directed to Dale Bowyer at 415-464-0846.

Sincerely,

Roger B. James
Executive Officer

cc: Mr. Chris Falbo
Blymyer and Sons
1829 Clement Ave.
Alameda, CA 94501

Mr. T. M. Gerow
Alameda County Div. of Environmental Health
470 27th St., Rm. 324
Oakland, CA 94612

Site Characterization Report for P.I.E. International Property, 5500 Eastshore Freeway, Emeryville, California.

Prepared for:

Cyto Culture International, Inc.
1208 Fourth Avenue,
San Francisco, California
94122

November 3, 1987

by:

Alton Geoscience
16510 Aston Street
Irvine, California
92714

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4. Results of Laboratory Analyses of the Sample From Boring B-4 at 5 Feet Using EPA Method 8270.

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A. Boring Logs
B. Laboratory Reports and Chain of Custody Records.
C. Boring Logs, Laboratory Report for Soil Samples, Well Construction Details, Laboratory Report for Water Samples.

Introduction

Overview of Program

This report presents the results of a limited background review and a partial site characterization of the P.I.E. property, 5500 Eastshore Freeway, Emeryville, California. The objectives of this study are to:

1. Determine the geologic and hydrogeologic conditions at the site through review of previous work performed and background research.

2. Determine if hydrocarbon-affected soil and ground water are present, and if so, define their extent and degree.

3. Determine the potential impact of hydrocarbons on utilized ground water and any receiving surface waters, if any.

Site Description

This former trucking facility is located between the Eastshore Freeway and Shellmound Street in Emeryville, California (Please refer to Figure 1, Index Map, and Figure 2, Site Plan). Light and heavy industrial businesses are located north, east, and south of the site. The Eastshore Freeway is located to the west.

The site is presently undergoing construction of a retail shopping mall.

Background Review

Geographic Setting

The site is located along the eastern edge of San Francisco Bay at an elevation of approximately 6 feet above sea level (N.G.V.D.-1929). San Pablo Ridge is located to the east and northeast. The San Leandro Hills are present to the east and southeast.

The topography is relatively flat near the site, with low rolling hills dominating the surrounding landscape to the east. The topography at the site slopes gently down toward the west.

The San Francisco Bay is located approximately one tenth of a mile west of the site.

Regional Geology

The site is underlain by unconsolidated alluvium consisting of artificial fill, bay mud, salt marsh deposits, and alluvial fan deposits of the Temescal formation.

The Hayward Fault is located approximately 5 miles east of the site.

Regional Hydrogeology

First ground water occurs at a depth of approximately 5 feet. According to the Regional Water Quality Control Board, San Francisco Bay Region, ground water flow in the region is generally toward San Francisco Bay.

It has been reported that tidally-induced fluctuations of 2 to 3 feet in ground water levels had been observed in former monitoring wells at the site.

Ground Water Quality

The Alameda County Department of Public Works stated during a telephone conversation that intrusion of high salinity water occurs at a depth of 70 feet in the City of Alameda, approximately 5 miles south of the site.

The California Department of Water Resources (1975) reported that sea-water intrusion in Alameda and Santa Clara Counties is being managed by recharge programs.

Ground Water Usage

No ground water usage takes place from beneath the site, due to the brackish condition of the water. According to the Alameda County Department of Public Works, three monitoring wells are located within one mile of the site. One monitoring well is located approximately 0.6 miles southeast of the site and has a total depth of 19 feet. Another monitoring well is located approximately six tenths of a mile east of the site and has a total depth of 22 feet. No information regarding the perforated intervals was available for these wells. The third monitoring well is situated approximately 0.3 miles east of the site. This well has a total depth of 32 feet and a perforated interval from 9 to 28 feet depth. No information regarding sanitary seals was available for any of these wells.

Geotechnical Study

On April 24, 1986, Geomatrix Consultants drilled three borings, A1, A2, and A3, at the site as a preliminary geotechnical investigation. On October 8, 9, and 10, 1986, nine additional exploratory borings, 2 through 10, were drilled by Geomatrix Consultants as part of an additional geotechnical investigation (Please refer to Figure 2, Site Plan for the location of the borings). The borings were drilled to depths ranging from 20 to 48 feet using 6-inch diameter, continuous-flight augers.

The Boring Logs for Borings A1 through A3 and Borings 2 through 10 are included in Appendix C. The soils sampled were described in accordance with the Unified Soils Classification System.

According to Geomatrix Consultants, the exploratory borings encountered between 8 and 18 feet of mixed clayey and sandy fill which contained some construction debris. In most borings, the fill was generally 10 to 11 feet thick. The fill is underlain by bay sediments consisting of loose to medium-dense silty sand with shells and soft to medium-stiff silty clay. The bay sediments are dark gray to blue gray and range from 3 to 32 feet thick. The thickness of the fill decreases toward the southwest corner of the property. Petroleum odors were detected in Borings A2, A3, 3, 4, 5, 6, and 9.

As a result of the detection of hydrocarbon odors in samples collected during the geotechnical investigation, Groundwater Technology and Peter Kaldveer and Associates, Inc. were retained to perform assessments of the degree of fuel hydrocarbons in the subsurface.

Investigation by Groundwater Technology

On August 4, 1986, Groundwater Technology supervised the excavation of eight monitoring wells, GT-1 through GT-8, at the site. Monitoring Wells GT-4, GT-5, GT-6, and GT-7 were excavated to a depth of 16.5 feet. Monitoring Wells GT-1, GT-2, GT-3, and GT-8 were drilled to depths of 10.5, 19.0, 11.5, and 10.0 feet, respectively. The monitoring wells were drilled using eight-inch diameter, hollow stem augers. Samples were collected using a split spoon sampler. The Boring Logs for Monitoring Wells GT-1 through GT-8 are included in Appendix C. The soils sampled were described in the field in accordance with the Unified Soils Classification

System.

Groundwater Technology reported that in general, light brown gravel and sand fill is present from the surface to depths between 3 and 5 feet. The subsurface soils from 5 feet to 19 feet consist of black and green sands, gravelly sands, clayey sands, and clays. Hydrocarbon odors were detected in each of the borings.

Samples collected from the monitoring wells drilled by others were analyzed for diesel fuel- and motor oil-range total petroleum hydrocarbons using modified EPA Method 8015. The results of the laboratory analyses are summarized in Table 1. The Official Laboratory Report is included in Appendix C.

On August 7, 1986, Groundwater Technology supervised the installation of three-inch ID PVC casing in the eight ground water monitoring wells at the site. Please refer to the Well Construction Details included in Appendix C. It was reported that free product was observed in three of the monitoring wells (GT-1, GT-3, and GT-5). All the wells were reportedly destroyed during the construction of the shopping mall.

TABLE 1. Results of Laboratory Analyses of Soil Samples Collected by Groundwater Technology from Monitoring Wells GT-1 Through GT-8.

Boring	Depth (Feet)	Waste Oil TPHC (ppm)	Diesel TPHC (ppm)
GT-1	5.5-6.0	11,000	---
GT-1	10.0-10.5	2,500	---
GT-2	5.5-6.0	26	---
GT-2	10.5-11.0	16,000	---
GT-2	18.0-18.5	30	---
GT-3	5.5-6.0	930	---
GT-4	5.5-6.0	---	ND<100
GT-4	10.5-11.0	---	680
GT-4	15.5-16.0	---	ND<100
GT-5	5.5-6.0	---	110
GT-5	10.5-11.0	---	ND<100
GT-6	5.5-6.0	---	6,800
GT-6	10.5-11.0	---	ND<100
GT-6	15.5-16.0	---	ND<100
GT-7	5.5-6.0	---	110
GT-7	10.5-11.0	---	1,400
GT-7	15.5-16.0	---	ND<100
GT-8	7.5-8.0	---	3,800

Notes: TPHC=Total Petroleum Hydrocarbons , ND=Not Detected, ---=Not Analyzed

Ground water samples were collected by Groundwater Technology from the monitoring wells on August 4, 1986, prior to the installation of the casing. These samples were analyzed for total petroleum hydrocarbons in accordance with modified EPA Method 8015. It was reported by Groundwater Technology that these samples were also analyzed for benzene, toluene, xylenes, and ethylbenzene. Water samples were also collected from Pit TR 1 and Pit TR 3 and analyzed for total petroleum hydrocarbons. No information was presented indicating where

these pits were located, their depth, or how the samples were collected. Table 2 presents the reported results of the laboratory analyses. The Official Laboratory Report for the total petroleum hydrocarbon analyses is included in Appendix A. However, no Official Laboratory Report stating the results of the BTX analyses or Chain of Custody Record was present in the copy of the Groundwater Technology report dated September 5, 1986, as received by Alton Geoscience.

TABLE 2. Results of Laboratory Analyses of Ground Water Samples Collected by Groundwater Technology from Monitoring Wells GT-1 Through GT-8.

	Constituent (ppm)			
Well No.	TPHC (ppm)	B (ppm)	T (ppm)	X (ppm)
GT-1	3.2	2.5	0.044	0.49
GT-2	16	0.26	ND<0.002	0.008
GT-3	20	0.87	0.004	0.034
GT-4	4	ND<0.002	0.007	ND<0.002
GT-5	ND<1	0.042	ND<0.002	ND<0.002
GT-6	ND<1	ND<0.002	ND<0.002	0.005
GT-7	13	0.48	0.04	0.33
GT-8	600	77	0.056	0.4
Pit TR 1	2,000	0.32	ND<0.002	0.02
Pit TR 3	ND<1	0.033	ND<0.002	0.2

Notes: TPHC=Total Petroleum Hydrocarbons, B=Benzene, T=Toluene, EB=Ethylbenzene, X=Xylenes, ND=Not Detected. No Official Laboratory Report accompanied the reported values for benzene, toluene, and total xylenes.

Investigation by Kaldveer and Associates, Inc.

On August 11, 1986, Peter Kaldveer and Associates, Inc., drilled seven borings, EB-1 through EB-7, to assess the extent of hydrocarbon-affected soil and ground water (Please refer to the site plan included in Appendix C for the location of the borings). The borings were drilled to ground water or to a maximum depth of 15 feet. Eight-inch diameter, hollow stem augers were used to drill the borings.

According to the consultant, the subsurface soils to a depth of approximately 10 feet consists of fill material. The fill is comprised of silty and sandy clays, and sands with variable amounts of fines with gravel lenses and construction debris. Underlying the fill material are native sands. Please refer to the Boring Logs included in Appendix C. Ground water was encountered in all the borings at depths between 7 and 14 feet and water samples were collected from each boring.

Soil and ground water samples were analyzed for Nonhalogenated Volatile Organics using EPA Method 8015. The laboratory results were not included in their report dated August 15, 1987.

Subsurface Investigation

Soil Sampling

On October 7, 1987, Alton Geoscience supervised the excavation of Borings B-1, B-2, B-3, and B-4. Borings B-1 through B-3 were drilled inside the limits of Pad "K". Boring B-4 was drilled at the southern limit of the property. Please refer to Figure 2 for the locations of Pad "K" and the borings. Eight-inch diameter, continuous flight, hollow stem augers were used to drill the borings. Boring B-2 was drilled to a depth of 14 feet and was sampled continuously in order to provide better stratigraphic control. Boring B-1, B-3, and B-4 were drilled to a depth of 12 feet and samples were collected at 2.5-foot intervals. Sampling was performed utilizing a standard penetration sampler with stainless steel inserts. The sampler and sample tube inserts were washed with a sodium tripolyphosphate solution prior to use. Ground water was encountered at a depth of approximately 6 feet in each boring.

Soil Description

The Boring Logs for Borings B-1 through B-4 are included in Appendix A. The soils sampled were described in the field in accordance with the Unified Soils Classification System.

In general, the soils consist of dense, grayish olive green and yellowish brown, sandy gravels and sandy silts from the surface to 5 feet depth. Black, organic Bay mud, consisting of a mixture of clay and silt, is present between the depths of 5 and 11 feet. Layers of organic sands and organic silty gravels are interlayered with the bay mud. Between the depths of 11 and 13 feet, moderate yellowish brown, gravelly sands were encountered. A brown, stiff, clayey sand was encountered from 13 to 14 feet in Boring B-2.

Two east-west cross sections were constructed using boring logs from previous work and the boring logs prepared by Alton Geoscience. Please refer to Figures 3 and 4. It appears that, in general, the bay mud thins toward the east and the fill is thickest in the southwest portion of the property.

Laboratory Analyses

Soil samples collected from the borings were analyzed for total petroleum hydrocarbons (TPHC) with distinction between gasoline, diesel, and waste oil using modified EPA Method 8015. The results of this analysis are presented in Table 3. Field inspection of the sample from Boring B-4 at a depth of 5 feet indicated that this sample contained the highest total petroleum hydrocarbon concentration. Therefore, that sample was also analyzed for polynuclear aromatic hydrocarbons and phenols using EPA Method 8270. A summary of the results of this analysis is presented in Table 4. The Official Laboratory Report and Chain of Custody Record are included in Appendix B.

TABLE 3. Results of Total Petroleum Hydrocarbon Laboratory Analyses of Soil Samples.

Boring	Depth (Feet)	Total Petroleum Hydrocarbon (ppm)
B-1	7	ND<10
B-2	5	21
B-3	5	34
B-4	5	7,690

Notes: TPHC=Total Petroleum Hydrocarbons, ND=Not Detected

TABLE 4. Results of Laboratory Analyses of the Sample From Boring B-4 at 5 Feet Using EPA Method 8270.

Constituent	Concentration (ppm)
2-methyl decane	14
2,6,10-trimethyl dodecane	19
3-ethyloctane	25
2,6-dimethyl undecane	28
2,6,10,14-tetramethyl pentadecane	25

Note: All other compounds were None Detected. Please see the Official Laboratory Report.

Findings

The site is located along the eastern edge of the San Francisco Bay at an elevation of approximately 6 feet above mean sea level (NGVD-1929). The underlying soil consists of alluvial fan deposits, bay mud, and artificial fill. The bay sediments are thinner to the east and the fill is thickest in the southwest portion of the site.

Near-surface ground water is present at a depth of approximately 6 feet beneath the site. Tidally influenced fluctuations in ground water levels of 2 to 3 feet have reportedly been observed.

Low concentrations of diesel-range hydrocarbons were detected in soil samples collected from Borings B-1, B-2, and B-3 drilled at Pad "K". Elevated levels of diesel-range hydrocarbons are present in the sample obtained from Boring B-4.

Based on a review of previous work performed by others, it appears that hydrocarbon-affected soil and free product on the ground water are present in the southern third of the property. Please refer to Figure 5 for the estimated extent of the free product plume. It should be noted that the extent of the free product plume is based on information from wells and borings that were drilled in 1986.

Discussion

There are some inconsistencies in the descriptions of the subsurface soils. The bay mud observed by Alton Geoscience was black and organic. Previous reports have described this as dark gray silts and clays or silty clays without mention of organic material.

It was reported that free product was detected in Monitoring Wells GT-1, GT-3, and GT-5. However, the presence of free product is not consistent with the low concentrations of petroleum hydrocarbons detected in the ground water. There are two possibilities for this discrepancy:

1) Water samples were collected from the boring prior to the installation of the casing. It is possible that the ground water sampled was from a zone well below the hydrocarbon-affected water.

2) Water samples were collected and analyzed before free product migrated to these wells.

Ground water was reportedly encountered at depths between 7 and 14 feet in borings drilled by Kaldveer and Associates. The fourteen feet depth is not consistent with the depth to ground water observed by Alton Geoscience and that reported by others. A possible explanation for this discrepancy is that the measurement of water depth was made before the ground water level in the boring equilibrated.

Conclusions

Laboratory results indicate that the soil samples collected from the subsurface below Pad "K" do not contain significant concentrations of hydrocarbons.

It is apparent that petroleum hydrocarbons are present in the soils in the area of Boring B-4. Based on a review of previous work, the extent of the free product plume appears to be located in the southern third of the property. The extent of the hydrocarbon-affected soil and ground water have yet to be defined.

Recommendations

Alton Geoscience recommends that eleven ground water monitoring wells be installed to define the extent of hydrocarbon-affected soil and ground water, and to better define the hydrogeology of the site. These monitoring wells might also be used as extraction points for the mitigation of free product and dissolved-phase hydrocarbons in the ground water.

Bioreclamation has also been proposed for the mitigation of hydrocarbon-affected soils at the site. This proposal calls for the injection into the subsurface of an aqueous solution containing specifically cultured bacteria and a lithium-chloride tracer through leachfield piping.

Five additional offsite monitoring wells should be installed to further define the extent of the contamination. These wells will also be used to monitor the ground water to ensure that the injection of the aqueous solution is not causing mounding of the ground water which might drive the free product or ground water containing dissolved-phase hydrocarbons off site. These wells can be sampled and analyzed for the lithium-chloride tracer to determine the path of the injected solution. Ground water monitoring of the offsite wells should also be performed in order to determine the overall ground water flow direction. Fluctuations in ground water elevations might mask the net ground water flow direction and gradient.

Ground water pumped from the subsurface will be treated and discharged to the sewer system. In order to determine practical discharge criteria, soil and ground water samples from a well outside the adsorbed-phase hydrocarbon and

dissolved-phase hydrocarbon plumes should be chemically analyzed. This will help to determine the subsurface background conditions, especially the hydrocarbon and total dissolved solids (TDS) concentration existing in the organic-rich bay mud. Once determined, Alton Geoscience will propose discharge criteria appropriate to the natural background conditions.

Alton Geoscience appreciates the opportunity to provide technical services for Cyto Culture. Please call if you have any question regarding this project.

Respectfully submitted,

ALTON GEOSCIENCE

Terrence A. Fox
Project Geologist

Jeffery W. Wiegand, C.E.G. 331
Vice President

TAF/JWW

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FIGURE 1: INDEX MAP
Showing Site Location and Well Within One Mile
P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

LEGEND

● Well Location

SOURCE:

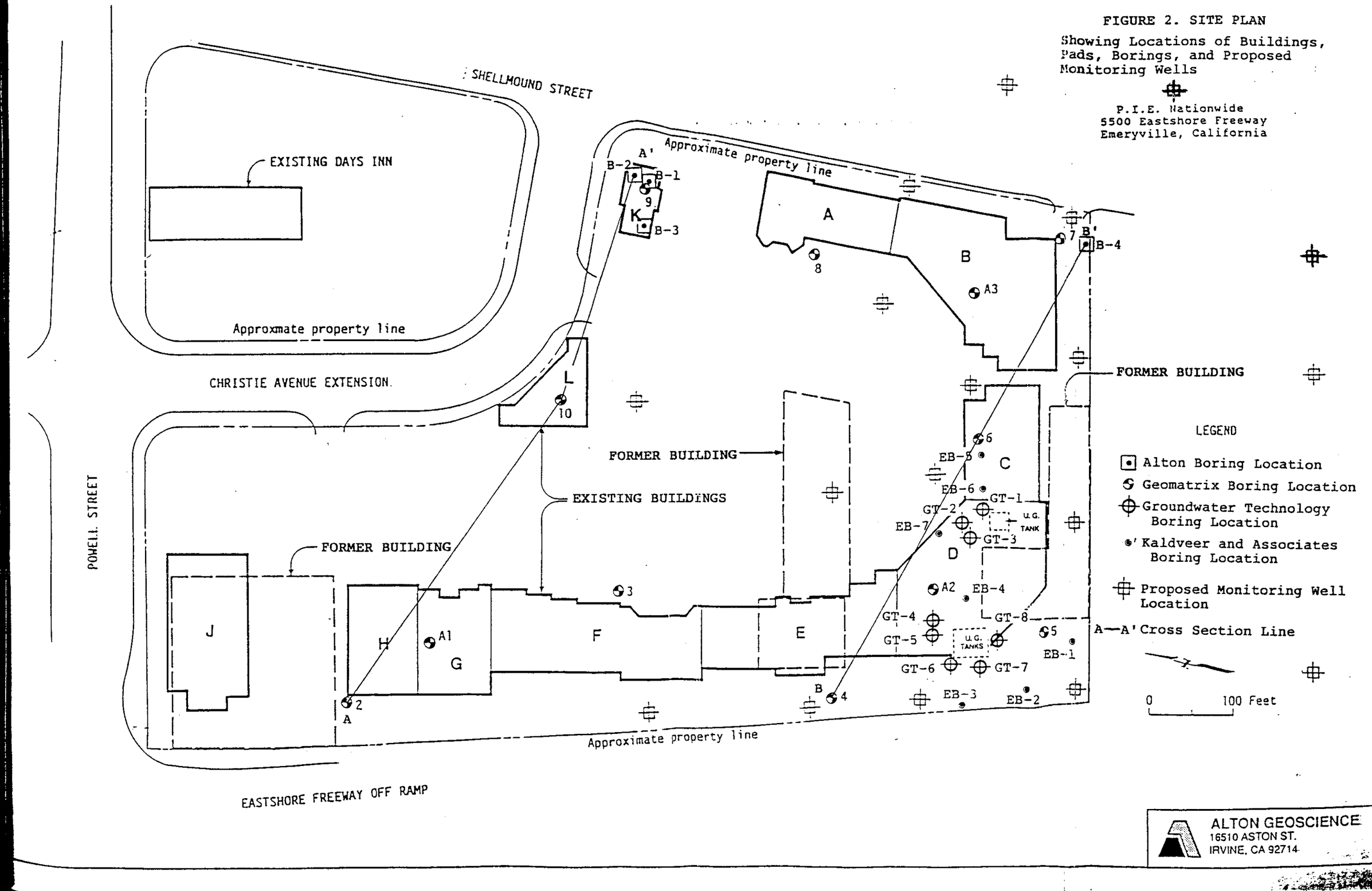
United States Geological Survey
7.5 Minute Topographic Map,
Oakland West Quadrangle

ALTON GEOSCIENCE
16510 ASTON ST
IRVINE, CA 92714

FIGURE 2. SITE PLAN

Showing Locations of Buildings, Pads, Borings, and Proposed Monitoring Wells

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California



ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

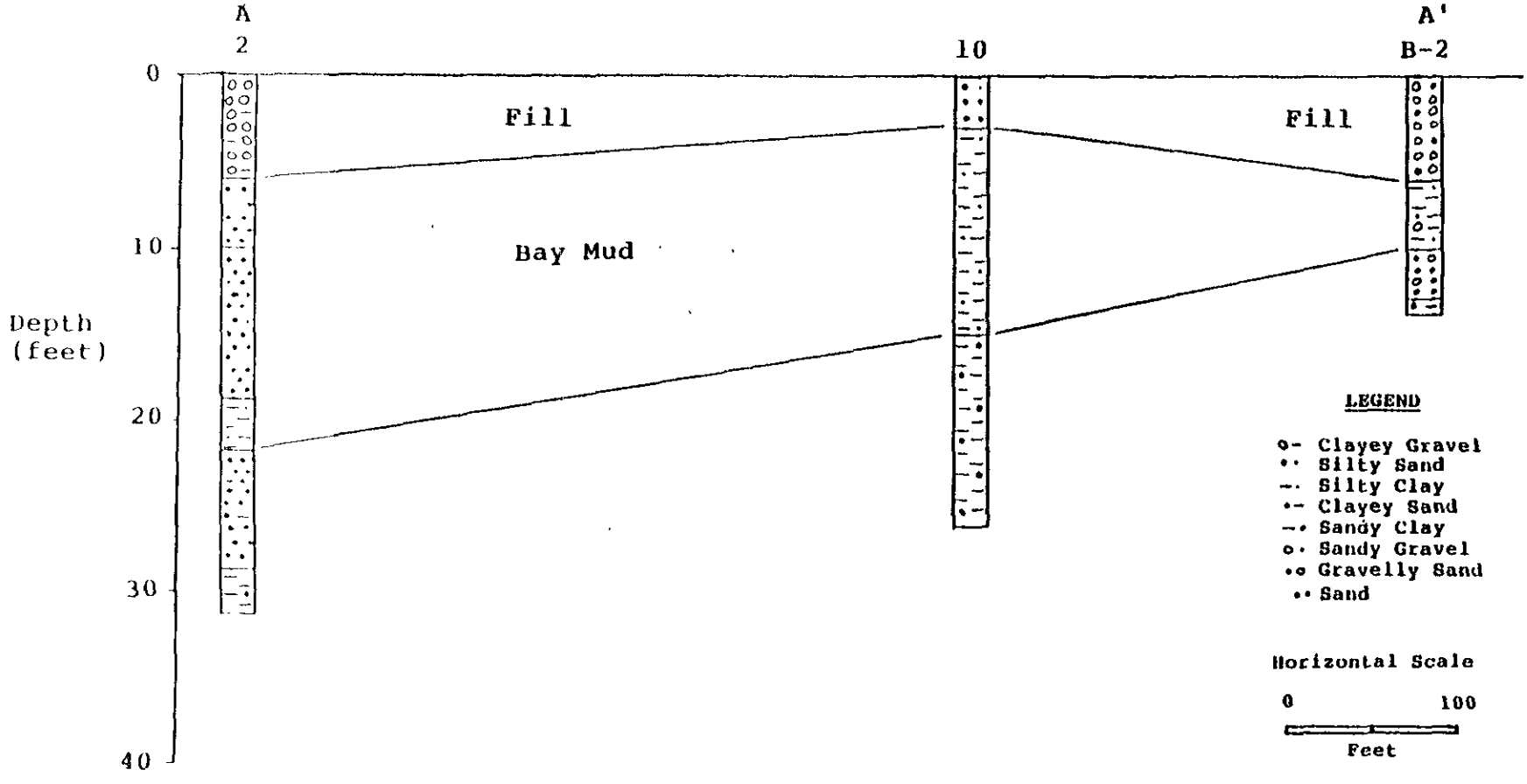


FIGURE 3. Cross Section A-A'

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

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IRVINE, CA 92714

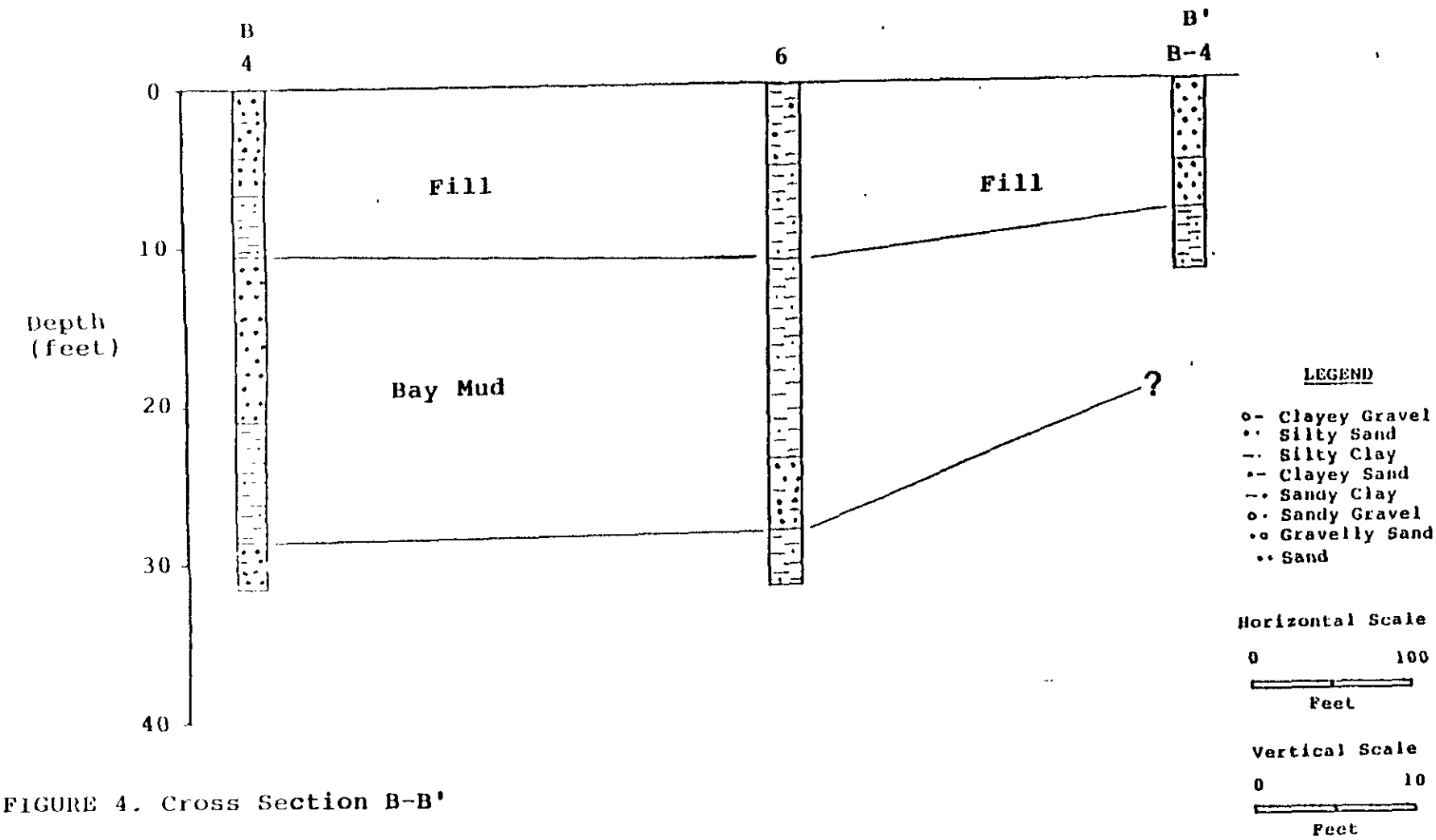

FIGURE 4. Cross Section B-B'

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

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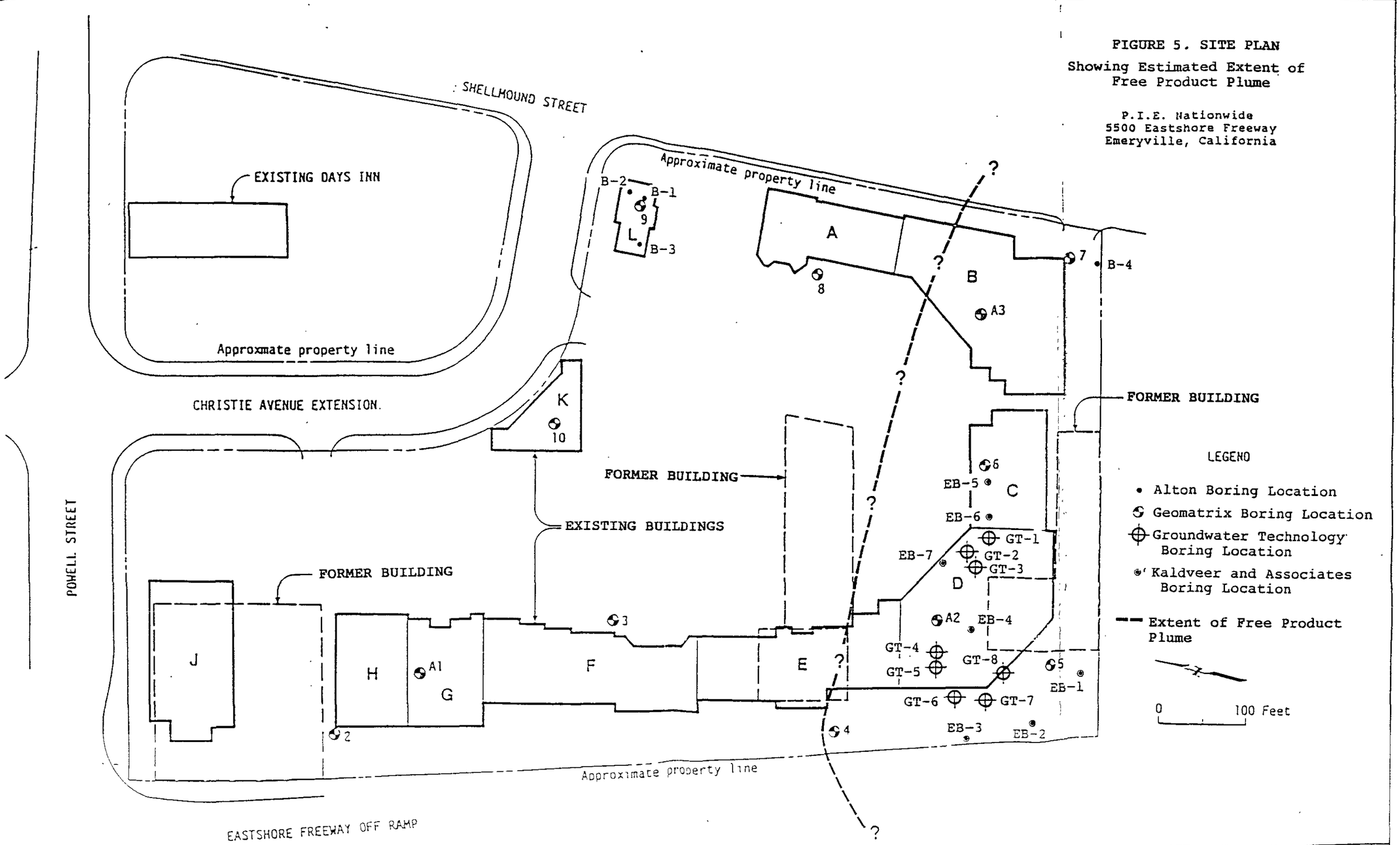
IRVINE, CA 92714

FIGURE 5. SITE PLAN

Showing Estimated Extent of Free Product Plume

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California



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CytoCulture
INTERNATIONAL INC.

Biotechnology Research, Scale-Up and Marketing

OPERATIONAL PLAN

Supplement to Proposal for

IN SITU SITE REMEDIATION OF SOIL AND GROUNDWATER HYDROCARBON CONTAMINATION BY AUGMENTED BIORECLAMATION USING LABORATORY SELECTED BACTERIAL CULTURES

[P.I.E. NATIONWIDE EMERYVILLE SITE]

submitted to

Alternative Technology and Policy Development Section
Toxic Substances Control Divsion
State of California Department of Health Services

by

CytoCulture International, Inc.

in a Joint Venture with

Sybron Chemicals, Inc.

in Collaboration with

Alton Geoscience

December 18, 1987

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Introduction

This Operational Plan describes in detail the conceptual design for the P.I.E. Nationwide Emeryville Site Bioreclamation project proposed by the joint venture of CytoCulture International and Sybron Chemicals. This Plan is intended to assist the regulatory agencies involved in permitting this project and to serve as a supplement to the original proposal (drafted July 29, 1987, updated October 1, 1987) submitted to the client.

Specific concerns about the reinfiltration of treated water and the possibility of spreading the product plume are addressed directly. On-site and off-site well studies, contaminated water extraction techniques, bioreactor system designs, monitoring plans, reinfiltration strategies, potential problems and alternative approaches will all be discussed in the context of a phased program for proceeding initially with the treatment of groundwater followed by the in situ bioreclamation of the soil. Permitting of the soil treatment by the Regional Water Quality Control Board will be dependent on the active participation of the Alternative Technology Office (DHS) in monitoring this site.

Monitoring Well Drilling

The original proposal called for drilling eleven monitoring wells to establish groundwater flow and the extent of the product plume on site. The Site Characterization Study by Alton Geoscience (November 3, 1987) then recommended adding five more monitoring wells, three of which were to be off site to the south and east (see Figure 2 of Site Characterization Report). Of the thirteen on-site wells, three along the southern property line and three along the western property line were to be drilled with 4 inch casings to permit their use for continuous extraction of water for treatment should it be necessary. The remaining eight on-site wells and three off-site wells were to be drilled with less expensive 2 inch casings for monitoring purposes only.

To improve off-site monitoring of the plume, two additional wells will be drilled: a third well off-site to the south and a second well off-site to the east, for a total of 18 wells (13 on site and 5 off site). Both additional wells will have two inch casings. The updated positions of all 18 monitoring wells are indicated on the attached Site Plan modified from the original Figure 2 of the Site Characterization Report. Positions may vary slightly to accomodate existing or anticipated structures on or off site. Drilling of these wells is scheduled for Janaury 1988. See specific sections below on the intended uses of these wells.

Groundwater Characterization and Product Plume Definition

The observed inconsistencies in soil and hydrogeological data of past geotechnical and site characterization reports underscore the need for better groundwater studies before proceeding with any bioremediation plans. It is quite apparent that petroleum hydrocarbons hot spots are showing up at considerable distances from the original leaking underground tanks. In particular, repeated observations and laboratory analyses during storm sewer installations suggested contamination and some free product in the soils below 6 feet along the southern property line. These observations have been partially substantiated by previous and recent borings; there have also been undocumented observations of apparent hydrocarbon contamination in the soils of the Judson Steel property to the south. These worrisome indications of an moving free product plume can be explained by at least three phenomena:

1. Motor oil or fuel spill/leak contamination from truck servicing activities or above ground tanks around the site over the last 30 years. Although unlikely, some of this hydrocarbon could have penetrated through the original fill (which has since been removed) into the saturated zone of the underlying soil.

2. Actual plume migration southward from the leaking tanks and/or motor oil or fuel spill contaminated areas. Migration could be influenced by underground tributaries of an old creekbed located to the south. Alternatively, tidal flow could be distorted by other subterranean features such that local groundwater flow is southward in this area.

3. Hydrocarbon contamination detected sporadically or along the southern boundary could be moving in from off-site sources. The Pfizer Chemical plant to the east and the former Judson Steel plant to the south are two obvious potential sources.

Some, all or none of the above phenomena could be contributing to the high levels of hydrocarbon found along the southern boundary and intermittently near buildings B, C and D. The lack of a defined product plume is a major problem for this project as it precludes any detailed planning for the locations of the extraction trenches, the bioreactor systems or the infiltration galleries. The, as yet, undefined extent of contamination also means it will be difficult to really assess the level of clean-up desired vs. actually attained at this site. It is therefore imperative that we proceed with careful measurement and sampling of the 18 monitoring wells in an effort to define the expanse, composition and migration of the targeted hydrocarbon plume(s).

Accurate measurements of the groundwater flow will be difficult at this site on account of the proximity (1/10th mile) of the Bay and the resulting strong tidal effects on the water's movement. Up to three feet of rise and fall have been reported. This tidal motion alone could explain the dispersion of the plume(s) beyond original point sources. Nonetheless, it will be important to establish baseline measurements for later detection of depression zones after extraction of contaminated water begins (see sections below).

Optional Water Extraction from Four Inch Wells

As indicated above, six of the eighteen monitoring wells will have 4 inch casings to permit the extraction of contaminated groundwater, should this prove necessary. Three of the wells will be drilled in a line along the southern boundary of the site and are likely to be integrated with the french drain extraction trenches in the same area (see below). This entire southern edge of the property may be used to create a depression zone to pull contaminated water from under buildings B-D while at the same time cutting off the apparent southward migration of the plume into the Judson Steel property. The depression zone along this boundary might also draw contaminated water over from the former Judson Steel property.

The three 4 inch wells along the western boundary (near the fence along the Eastshore Freeway) could serve as a partial containment "fence" should it ever be necessary to recover contaminated water in this area in the event that the plume did accidentally migrate westward instead of towards the depression zone created by the extraction trenches along the southern property line. The extent to which these three wells could really contain or recover contaminated water themselves is unclear. Alternatively, a long gravel trench or other containment barrier could be erected (at a high cost) along the freeway to more effectively block accidental migration of the plume towards the bay, but we consider this unrealistic for the site.

Design and Excavation of French Drain Trenches

Contaminated groundwater will be extracted from a series of french drain trenches installed along the southern boundary of the site with the intention of creating a long depression zone downstream of the apparent plume migration. Exact location and orientation of the trenches must await plume definition and more extensive groundwater characterization data expected from the upcoming drilling and monitoring of the 18 wells.

The extraction trenches will be excavated 18 inches wide and eleven feet deep to gain full access to the groundwater surface even at extreme low tide. The trenches will be at least 50 feet in length (up to 200 feet) depending on the interference of existing storm sewers, pipes, utilities and structures. Maximal coverage of the southern and western boundaries of the site will be attained if trenches are installed along the respective property lines along the parking lot behind building D. Long stretches of trenching could then extend along the property lines from the southwest corner to effectively catch the migrating plume. This entrapment of the plume could be enhanced by the careful infiltration of treated water, nutrients and bacteria along the sides of building D, up to approximately 150 - 200 feet to the north and east of the trenches.

The french drains will be lined with a synthetic drainage fabric (e.g., Mirafi) which will serve as a sediment control barrier. Bay mud sediments are considered to be a potential problem if much silting occurs in the clarifiers or tanks of the bioreactor systems. The trenches will then be packed with class I graded pea gravel to a depth of five feet for optimal flow of contaminated groundwater at any tide level. The drainage fabric will then be folded over to enclose the graded gravel and engineered fill removed during the excavation will be returned to fill in the remaining troughs. Landscaping or paving will be restored. These trenches will have 4 inch perforated PVC pipes installed to enhance the flow of contaminated water to the groundwater depression pumps (pneumatically operated PVC pumps).

The rise and fall of the tidal groundwater presents an interesting challenge for the continuous pumping of contaminated water into the bioreactor systems. If the pump inlets are placed only in the low tide zone, floating hydrocarbon product will only be recovered at low tide (the rest of the time, only water would be extracted). Similarly, if placed in the high tide zone, pump inlets would only recover product at high tides (sucking air the rest of the time). Therefore, we have devised an automated dual pumping system that permits continuous recovery of water and product on the vertically moving tidal groundwater surface. Two separate pump systems will be installed at the french drains, one with access to the high tide water zone, the other placed to recover hydrocarbon from the low tide water zone. Level sensors will activate the appropriate pumping system to ensure that the maximal recovery of free product and dissolved phase hydrocarbon occurs, irrespective of the tide level. Alternatively, floating pump inlets may be employed to siphon floating free product and contaminated water to the surface for treatment, but these devices are expensive and prone to failure.

Design and Installation of Bioreactor Systems

Two permanent bioreactor systems will be constructed on site for the biodegradation of petroleum hydrocarbons in contaminated water extracted from the french drain trenches and 4 inch wells along the southern and western property lines. These 2,000 gallon bioreactors will then serve as continuous flow chemostats to grow up additional bacterial cultures for reinfiltration with nutrients back into the contaminated soil "upstream" of the product plume. The process of biodegrading hydrocarbons in the extracted groundwater and the contaminated soil will therefore occur in two distinct phases, as described below.

Each bioreactor system will consist of an initial clarifier tank equipped with an oil/water separator to recover free product (if present) and up to four 500 gallon bioreactor vessels for the continuous biodegradation of the dissolved phase hydrocarbon. Excess free product will be collected for recycling by a commercial oil recovery service.

By establishing a concentration gradient through the four vessels of each bioreactor, the biodegradation process can readily achieve parts per billion levels of hydrocarbon from starting material that was in the parts per million level of initial contamination. Long retention times and moderately slow flow rates through the system (e.g., 1-2 gal/min) will ensure compliance with the November 26, 1986 NPDES permit variance issued by the San Francisco Bay Regional Water Quality Control Board to P.I.E. Nationwide for the discharge of treated water brought to the surface at this site (see copy of this letter in the October 1 version of the original proposal).

An additional single 1,000 gallon mobile BATCH culture bioreactor will be used to infiltrate oxygenated water, nutrients and high densities of the "diesel blend" bacteria into contaminated soil areas around buildings B and C (southeast corner). This batch bioreactor will use tap water rather than extracted groundwater to periodically grow up bacterial cultures. The batch bioreactor will also be employed to grow up bacterial cultures for treating excavated contaminated soil from the trenching operations using augmented soil farming techniques.

CytoCulture bioreactor proprietary designs used on this site include efficient sparging and mixing systems, automated nutrient dispensing systems, automated tracer (Lithium chloride) dispensers, continuous seeding of bacteria from dry cultures and process control systems which minimize the maintenance to weekly visits by technical personnel.

Precautionary measures for the containment of the bacteria and contaminated water include the construction of 18 inch walls around the concrete slab on which the bioreactor systems are built in case of spills. These continuous systems will also process residual contaminated water from the monitoring wells. Should silting of bay mud sediments occur, the tanks will have to be pumped out by commercial sanitary service companies.

"Pump and Treat" Phase of Operation with Discharge to Sewer

The three bioreactor systems described above will be put into operation as soon as permitted to begin treatment of hydrocarbon contaminated groundwater pumped out of the french drain trenches and the 4 inch extraction wells along the southern property line of the site. The flow rates, nutrient levels, pH and dissolved oxygen levels, and retention times will be optimized to achieve the most rapid biodegradation possible. Treated water which meets the current RWQCB levels acceptable for surface discharge (as per the November 26, 1986 NPDES permit variance letter) will be discharged temporarily into the storm sewers along the southern edge of the site. Acceptable levels means no more than 100 ug/liter of total petroleum hydrocarbon in the water. Once some evidence of hydraulic control of mounding int the groundwater has been established with the monitoring wells, and the concerns for spreading the plume have been addressed with an adequate soil treatment stategy, the treated water will be mixed with nutrients and fresh cultures of bacteria for reinfiltration into the unsaturated zones of the soil upstream of the plume (see sections below). If any delays are encountered in starting up the reinfiltration phase, the bioreactors will continue operating at maximum capacity to clean-up contaminated groundwater with discharge of the treated water into the storm sewer.

Verification of Compliance with NPDES Permit Variance Letter

Compliance with the San Francisco Regional Water Quality Control Board NPDES variance letter of November 26, 1986 will require extensive monitoring of the treated water in the bioreactors prior to discharge. The exact schedule has been spelled out in the variance letter, requiring daily, then weekly sampling and analysis. Total hydrocarbon, phenol and polynuclear aromatic analyses will be performed by local laboratories whereas CytoCulture/Sybron will monitor the bacterial counts. This information will be used to fine tune the biokinetics of hydrocarbon substrate utilization in terms of flow rates, nutrient addition, pH control, dissolved oxygen levels and retention times within the four tanks of each system.

The treated water does not need to meet drinking water quality standards, although our experience at other bioreclamation sites in the State indicate this approach can lower hydrocarbons and polynuclear aromatics to the parts per billion range. Ironically, the water is clean enough for discharge into storm sewers (direct to the Bay) but it cannot be returned to the contaminated soil from where it came.

Concerns over Reinfiltration of Treated Water

The most pressing issue which threatens the permitting of our plans to reinfiltrate treated water and bacteria back into the soil on this site is the possibility of dispersing rather than containing the product plume during treatment. If the plume were to migrate westward directly to the bay (or southward to the nearby creek), the hydrocarbon would foul the seawater and render all of our attempts at cleaning this site futile. There is no threat to any drinking water supplies in the area; all the groundwater is tidal brackish water. Furthermore, it is widely held that the Emeryville area's aquifers have been substantially polluted from years of heavy industrial and chemical manufacturing activity.

Nonetheless a bad precedent was set in the central valley by an attempt to reinject treated water at a site. In spite of apparent precautions to monitor the process, the infiltration of treated water at that site caused a major dispersion of the original plume into previously clean adjacent areas.

We believe the situation will be very different at this site. The hydrogeologists tell us that whatever flow rates for reinfiltration are achieved (e.g., 2 gals/min X 3 bioreactors), the total amount of water introduced into the soil will contribute minimally to the natural tidal and surface drainage effects on the plume migration, particularly during the winter season. Every effort is being made to contain all migrating free or dissolved phase product from the original underground tank pit area under building D by installing 400 linear feet of extraction trenches to the west and south of this area. This area will be extensively surveyed for possible migration using the monitoring well system proposed in our Initial Site Characterization Study.

"Reinfiltration" Phase of the Bioreclamation Project

The first step in this phase of the project is to attempt to attain some hydraulic control over the area around building D where the underground storage tanks had been located. We plan to routinely sample at least six of the 18 proposed moniotring

wells. However, the hydrogeologists at Alton Geoscience have already expressed strong doubts about accurately measuring groundwater migration in the presence of such strong tidal effects. It may be impossible to establish true hydraulic control given a three foot rise and fall of the tide, in which case we will have to rely on extensive trenching to adequately control any possible migration of free or dissolved phase product. The monitoring wells will however continue to provide baseline and subsequent operating values for levels of petroleum vs. natural hydrocarbons, bacterial counts, and lithium chloride tracer concentrations once the reinfiltration process begins.

Reinfiltration will involve blending expanded cultures of the BTX strains of Sybron bacteria with nutrients and treated water (that already meets the NPDES permit variance levels for discharge to sewer) in the chemostat bioreactor. At optimal cell densities, the slurry will be mixed automatically with lithium chloride tracer and pumped through an array of perforated pipes known as the "Infiltration Gallery" (see sections below).

Design and Construction of Infiltration Galleries

The distribution of bacterial cultures and nutrients suspended in reclaimed water from the site will require a series of perforated pipe leach fields referred to as infiltration galleries. The galleries consist of 2 inch PVC pipe manifolds connected to parallel perforated 2 inch PVC pipe (up to 20 foot lengths) packed in gravel beds over or upstream of the contaminated zones of soil. At this site, much of the contaminated ground is now under buildings, so the only choice left is to place the infiltration piping upstream (north) of the presumed groundwater gradient established by a combination of natural flow and the depression zone created by the pumping water from extraction trenches along the southern property line. One likely location would be beneath the newly installed landscaping "islands" in the shopping center parking lot.

Leach field piping is to be packed in graded pea gravel at a depth of about three feet, well above the highest tide level for the groundwater. Each bioreactor system will have at least two infiltration galleries corresponding to extraction trenches downstream along the southern boundary. Plumbing connections from the bioreactors to the leach fields may utilize existing 2 inch PVC piping now running under some of the buildings. In cases were this is not available or practical, above ground hose lines may have to be installed around the buildings and buried in troughs across the parking lots.

Optimization of Bacterial Culture Infiltration

Once the infiltration galleries have been constructed and the permits for start-up of soil treatment have been issued, the reclaimed water from the bioreactors (assuming the treated water is in compliance with NPDES discharge regulations) will be further cultured with laboratory selected bacteria capable of emulsifying and degrading hydrocarbons absorbed to the soil.

Expansion cultures will be optimized for maximal growth kinetics by adjusting hydrocarbon substrate levels, the addition of nitrogen (diammonium phosphate) and phospate nuturients, pH and aeration (oxygen). Continuous flow of organisms and nutrients out of the bioreactors and into the soil should prevent overgrowth or clogging of the pipes by keeping the organism culture densities under control.

Part of the original infiltration plan was to take advantage of seasonal high tides and heavy rains to disperse the bacteria vertically into unsaturated zones above the normal tide levels.

Product Plume Monitoring by Hydrocarbon Analyses

Given the great concern over the possible spreading of the (as yet undefined) hydrocarbon product plume, samples will be taken weekly, then monthly from eight pre-selected monitoring wells for measuring total hydrocarbon levels around the plume. Total petroleum hydrocarbon (TPHC) chemistries will be performed locally using modified EPA method 8015 to distinguish gasoline, diesel fuel and motor oil fractions as was done with the most recent borings (B1-B4) in the Site Characterization Report.

Water Infiltration Monitoring by Tracer Analysis

Lithium chloride solutions will be dispensed automatically into the bioreactor effluent containing the bacterial cultures and nutrients on their way to the infiltration galleries. A concentrated stock solution of lithium chloride will be diluted into the bioreactor effluent on its way to the infiltration galleries. Since this inert, non-toxic salt is rarely found in natural seawater or groundwater, even a few ppm levels will be easily detected by routine sampling analyses of the same eight monitoring wells. Laboratory analyses will be performed simultaneously with the bacterial characterization studies on the same eight monitoring well samples (weekly at first, then monthly) at Sybron's research facility in Virginia. Dr. Douglas Goldsmith, Director of Research at Sybron Biochemical, has had considerable experience with this method and will assist us on this project.

Monitoring of Exogenous Bacterial Cultures in Groundwater

The same eight monitoring wells which will be routinely sampled for hydrocarbon chemistries and tracer analysis will also be assayed for total bacterial plate counts. Periodic assays for phenotypic enzyme activities will confirm the identity of the infiltrating bacteria which have diffused away from the infiltration galleries. Typically the augmented bacterial cultures can attain densities in bioreactors of several orders of magnitude greater than the natural indigenous strains. However limitations of nutrients, and especially of oxygen, will most likely suppress the densities of added bacteria found in soil.

Routine Reporting of Monitoring Data and Clean-Up Results

As per our NPDES permit variance letter, reporting of daily, weekly and monthly results for total petroleum hydrocarbons will proceed on schedule. These reports will be augmented with data on tracer levels, bacterial counts and hydrogeology monitoring of the plume and groundwater on and off site.

Next Report Due: Phase II Report on Hydrogeology and Site Characterization Studies (Alton Geoscience and CytoCulture)

For further information or updates for this Operational Plan, please call the Project Director at CytoCulture (Tel. 564-1516).

Randall J. von Wedel, Ph.D.
Project Director
CytoCulture International, Inc.

Figures

Tables

Appendices

Introduction

Overview of Program

In previous site characterization and geotechnical studies performed by Alton Geoscience and others, it was determined that hydrocarbon-affected soil and ground water existed beneath the site. Please refer to the Alton Geoscience report dated November 3, 1987, for a review of pertinent background information and details of previous work.

Objectives

The objectives of this study are to determine the extent and concentrations of hydrocarbons in the soil and ground water and to determine the potential impact, if any, these hydrocarbons may have on utilized ground water and any receiving surface waters.

Site Description

This former trucking facility is located between the Eastshore Freeway and Shellmound Street in Emeryville, California (Please refer to Figure 1, Index Map, and Figure 2, Site Plan). Light and heavy industrial businesses are located north, east, and south of the site. The Eastshore Freeway is located to the west. The site is presently undergoing construction of a retail shopping mall.

Background Review

Geographic Setting

The site is located along the eastern edge of San Francisco Bay at an elevation of approximately 6 feet above mean sea level (N.G.V.D.-1929). San Pablo Ridge is located to the east and northeast. The San Leandro Hills are present to the east and southeast.

The topography is relatively flat near the site, with low rolling hills dominating the surrounding landscape to the east. The topography at the site slopes gently down toward the west.

The San Francisco Bay is located approximately one tenth of a mile west of the site.

Regional Geology

The site is underlain by unconsolidated materials consisting of artificial fill, bay mud, salt-marsh deposits, and alluvial fan deposits of the Temescal Formation.

The Hayward Fault is located approximately 5 miles east of the site.

Regional Hydrogeology

First ground water occurs at a depth of approximately 5 feet. According to the Regional Water Quality Control Board, San Francisco Bay Region, ground water flow in the region is generally toward San Francisco Bay.

It has been reported that tidally induced fluctuations of 2 to 3 feet in ground water levels were observed in former monitoring wells at the site.

Ground Water Quality

The quality of ground water beneath the site is expected to be poor. An Alameda County Department of Public Works representative stated during a telephone conversation that intrusion of high-salinity water occurs at a depth of 70 feet in the City of Alameda, approximately 5 miles south of the site. The California Department of Water Resources (1975) reported that sea-water intrusion in Alameda and Santa Clara Counties is being managed by recharge programs.

Local Well Data

There are no wells within one mile of the site which utilize ground water. According to the Alameda County Department of Public Works, three monitoring wells are located within one mile of the site (Please see Figure 1). One monitoring well is located approximately 0.6 miles southeast of the site and has a total depth of 19 feet. Another monitoring well is located approximately 0.6 miles east of the site and has a total depth of 22 feet. Information regarding the perforated intervals was not available for these wells. The third monitoring well is situated approximately 0.3 miles east of the site. This well has a total depth of 32 feet and is perforated in the interval from 9 to 28 feet. Information regarding sanitary seals was not available for any of these wells.

Subsurface Investigations

Soil Borings

Between March 7 and March 11, 1988, eighteen borings, B-5 (MW-1) through B-22 (MW-18), were drilled at the site to depths of 11.5 to 17.0 feet. Borings B-12 (MW-8) through B-14 (MW-10) are located off site to the east and Borings B-20 (MW-16) through B-22 (MW-18) are located off site to the south. Please refer to the Site Plan in Figure 2 for the boring locations.

Borings B-5 (MW-1), B-6 (MW-2), B-7 (MW-3), B-8 (MW-4), B-11 (MW-7), and B-19 (MW-15) were drilled using ten-inch diameter, hollow-stem augers. The remaining borings were drilled using eight-inch diameter, hollow-stem augers. Soil samples were collected using a standard-penetration sampler fitted with stainless-steel sample-tube inserts. The augers were steam cleaned and the sampler and sample-tube inserts were washed with a solution of sodium tripolyphosphate and rinsed with water prior to each use. Borings B-5 (MW-1), B-8 (MW-4), and B-19 (MW-15) were sampled continuously to provide adequate stratigraphic control. Borings B-6 (MW-2), B-7 (MW-3), B-9 (MW-5), B-11 (MW-7), B-18 (MW-14), and B-20 (MW-16) were sampled at a 2.5-foot interval. The remaining borings were sampled at a 4-foot interval.

Soil Description

The Boring Logs, included in Appendix A, present a field description of the soil samples in accordance with the Unified Soil Classification System.

In general, the soils present within the borings consisted of two types, artificial fill and native soil. The artificial fill is composed mostly of loose to dense, moderate yellowish brown and dusky yellowish green, silty sands with lesser amounts of fine-grained sands, and gravelly sands. Three different facies were observed in the native soil. A bay mud facies underlies the fill material and is composed mostly of soft to very soft, black organic silty clays and silts with lighter black organic silty sands, fine-grained sands, and gravelly sands. Underlying the bay mud in the western portion of the site are dark gray to olive gray silty clays, fine- to coarse-grained sands, and gravelly sands. Mottled light brown and light olive gray silty clays underlie the bay mud in the eastern portion of the site.

The fill material and bay mud are thicker in the west and gradually thin eastward. Please refer to the geologic cross sections in Figures 3, 4, and 5 for graphical representations of the subsurface stratigraphy.

A strong diesel odor was detected in the samples and a sheen of free product was present on the sampler during the drilling of Borings B-7 (MW-3), B-8 (MW-4), B-11 (MW-7), and B-19 (MW-15).

Analyses of Soil Samples

Representative soil samples were analyzed for total petroleum hydrocarbons with distinction between the gasoline and diesel ranges using Modified EPA Method 8015. The results of the laboratory analyses are presented in Table 1. The Official Laboratory Reports and Chain of Custody Records are included in Appendix B. Please refer to Figure 6 for the estimated extent of the adsorbed-phase plume.

TABLE 1. Laboratory Results of Soil Samples Analyzed for Total Petroleum Hydrocarbons Using Modified EPA Method 8015.

Boring	Depth (feet)	Total Petroleum Hydrocarbon (ppm)	Hydrocarbon Range
B-5 (MW-1)	5.5	30	Diesel
B-6 (MW-2)	---	-----	----
B-7 (MW-3)	8.0	17,000	Diesel
B-8 (MW-4)	8.5	5,400	Diesel
B-9 (MW-5)	5.0	10	Diesel
B-10 (MW-6)	5.5	ND<10	----
B-11 (MW-7)	7.0	10,000	Diesel
B-12 (MW-8)	5.5	ND<10	----
B-13 (MW-9)	5.5	20	Diesel
B-14 (MW-10)	5.5	ND<10	----
B-15 (MW-11)	4.5	ND<10	----
B-16 (MW-12)	5.5	90	Diesel
B-17 (MW-13)	5.5	800	Diesel
B-18 (MW-14)	7.5	14,000	Diesel
B-19 (MW-15)	7.0	2,100	Diesel
B-20 (MW-16)	5.5	15	Diesel
B-21 (MW-17)	9.5	240	Diesel
B-22 (MW-18)	5.5	10	Diesel

ND = Not Detected, ppm = Parts Per Million

Monitoring Well Installation

Monitoring Wells MW-1 through MW-18 were installed in Borings B-5 through B-22, respectively. Monitoring Wells MW-1 (B-5), MW-2 (B-6), MW-3 (B-7), MW-4 (B-8), MW-7 (B-11), and MW-15 (B-19) were constructed using 4-inch diameter PVC casing. The remaining wells were constructed using 2-inch diameter PVC casing. Please refer to the Well Construction Details included in Appendix A.

Fluid Level Monitoring

Fluid levels and product thicknesses were monitored between March 10 and March 15, 1988, at various times in relation to the tidal cycle. The monitoring data and list of approximate times of high and low tides for the Emeryville area are presented in Appendix C. Monitoring data indicate that the tidally influenced depth to ground water ranges from approximately 3.2 to 9.5 feet. Monitoring Well MW-7 (B-11) was monitored at approximately 0810 hours on March 10, 1988, and 1.32 feet of free product was detected. A low tide occurred at approximately 1000 hours. Monitoring Well MW-7 (B-11) was monitored again on March 15, 1988, at 0817 hours and 0.02 feet of free product was detected. A high tide occurred on March 15, 1988, at approximately 0847 hours. Please refer to Figure 7 for the estimated extent of the free product plume.

Ground Water Sampling and Analyses

Between March 10 and March 14, 1988, the monitoring wells were monitored, developed, and sampled. The wells were developed by removing a minimum of four standing well volumes of water. The water was pumped from each well with an air-diaphragm pump into fifty-five gallon drums which were stored at the site. Ground water samples were collected using a clean Teflon bailer and immediately transferred to zero-headspace glass bottles, packed in ice, and transported to a State-Certified laboratory. Monitoring Well MW-7 (B-11) was not sampled due to the presence of free product on the ground water. Monitoring Well MW-11 (B-15) remained dry after one well volume of water was removed and therefore was also not sampled.

Ground water samples were analyzed for total petroleum hydrocarbons (TPHC) with distinction between the gasoline and diesel ranges in accordance with Modified EPA Method 8015. Ground water samples from Monitoring Wells MW-13 (B-17) and MW-14 (B-18) were also analyzed for benzene, toluene,

xylenes, and ethylbenzene (BTXE) using EPA Method 602. The Official Laboratory Report and Chain of Custody Record are included in Appendix D. Tables 2 and 3 present the results of the laboratory analyses of the ground water samples. Please refer to Figure 8 for the estimated extent of the dissolved-phase plume.

The water sample collected from Monitoring Well MW-9 (B-13) was also analyzed for specific conductance. A value of 1260 umhos/cm was determined using EPA Method 120.1. The total dissolved solids (TDS) in a water sample can be estimated by multiplying the specific conductance value by 0.65. This indicates that the sample from Monitoring Well MW-9 (B-13) contained 819 parts per million (ppm) TDS.

TABLE 2. Results of Laboratory Analyses of Ground Water Samples Using Modified EPA Method 8015.

Well Number	Diesel-Range TPHC (ppm)
MW-1 (B-5)	ND<1
MW-2 (B-6)	0.05
MW-3 (B-7)	0.15
MW-4 (B-8)	1.2
MW-5 (B-9)	ND<1
MW-6 (B-10)	ND<0.05
MW-7 (B-11)	-----
MW-8 (B-12)	ND<0.05
MW-9 (B-13)	ND<1
MW-10 (B-14)	ND<1
MW-11 (B-15)	-----
MW-12 (B-16)	0.05
MW-13 (B-17)	1.7
MW-14 (B-18)	ND<1
MW-15 (B-19)	1.8
MW-16 (B-20)	ND<0.05
MW-17 (B-21)	ND<0.05
MW-18 (B-22)	ND<0.05

Notes: ppm = Parts Per Million, TPHC = Total Petroleum Hydrocarbons, ND = Not Detected, ----- = Not Analyzed.

TABLE 3. Results of Laboratory Analyses of Ground Water Samples Collected From Monitoring Wells MW-13 and MW-14 Using EPA Method 602.

Well Number	Benzene (ppm)	Toluene (ppm)	Xylenes (ppm)	Ethyl-benzene (ppm)
MW-13	ND<0.0005	ND<0.0005	ND<0.0005	ND<0.0005
MW-14	ND<0.0005	ND<0.0005	ND<0.0005	ND<0.0005

Notes: ppm = Parts Per Million, ND = Not Detected,

Findings

Twelve on-site and six off-site monitoring wells were installed to depths of 11.5 to 17.0 feet below grade between March 7 and March 11, 1988.

Two basic soil types were encountered during drilling. Artificial fill, composed mostly of silty sands with lesser amounts of fine-grained and gravelly sands, is present to depths of approximately 6 to 10 feet. The artificial fill is underlain by native soils of three facies: 1) Bay mud composed mostly of black organic silty clays and silts with lesser amounts of lighter black organic silty sands, fine-grained sands and gravelly sands, 2) Dark gray to olive gray silty clays, fine- to coarse-grained sands, and gravelly sands that underlie the bay mud in the western portion of the site, and 3) Mottled light brown and light olive gray silty clays that underlie the bay mud in the eastern portion of the site. The fill and bay mud thicken toward the west.

Elevated levels of diesel-range total petroleum hydrocarbons (TPHC) were detected in soil samples collected during drilling of Borings B-7 (MW-3), B-8 (MW-4), B-9 (MW-5), B-17 (MW-13), B-18 (MW-14), B-19 (MW-15), and B-21 (MW-17). Hydrocarbon concentrations in samples from these borings range from 240 ppm in Boring B-21 (MW-17) to 17,000 ppm in Boring B-7 (MW-3). Samples analyzed from the other borings contained TPHC concentrations less than 100 ppm.

Free product is present in Monitoring Well MW-7 (B-11), located near the western edge of the site. A product thickness of 1.32 feet was detected during low tide on March 10, 1988. A thickness of 0.02 feet was detected on March 15, 1988, during high tide. Free product was not detected in any other monitoring well.

Dissolved-phase diesel-range total petroleum hydrocarbons were detected in water samples from Monitoring Wells MW-2, MW-3, MW-4, MW-12, MW-13, and MW-15 (0.05, 0.15, 1.2, 0.05, 1.7, and 1.8 ppm, respectively). Dissolved-phase hydrocarbons were not detected in samples from any other well. Laboratory analyses of ground water samples from Monitoring Wells MW-13 and MW-14 did not detect any volatile aromatic hydrocarbons (BTXE).

Conclusions

Based on the initial fluid-level monitoring data, the free product plume appears to be well defined to the north, east, and south of Monitoring Well MW-7 (B-11), but extends an unknown distance toward the west.

Low-level dissolved-phase hydrocarbons appear to be localized along the southern and western property margins. The western margin of the plume is currently undefined. The findings of this study do, however, indicate that the dissolved-phase plume is of limited lateral extent and exhibits low concentrations of total petroleum hydrocarbons immediately to the north, east, and south of the free product plume. The findings also indicate a lack of volatile aromatic hydrocarbons immediately to the north and south of the free product plume. These observations are consistent with the low-solubility characteristics of diesel-range hydrocarbons.

Diesel-range hydrocarbons detected in soil samples collected during drilling indicate that the adsorbed-phase plume is present in the southwestern portion of the site. The plume appears to extend slightly off site to the south and an undetermined distance off site to the west. The presence of adsorbed-phase hydrocarbons (240 ppm) detected in the soil sample analyzed from Boring B-21 (MW-17), located on the property south of the site, appears to be anomalous. It is unlikely that hydrocarbons from the source area at the site could have migrated to the location of Boring B-21 (MW-17) without affecting the soil around Boring B-22. The reason for this anomaly is not yet known.

Recommendations

Alton Geoscience recommends that an extraction trench be excavated along the western margin of the property to remove free product from the subsurface and inhibit westward migration of product in the area of Monitoring Well MW-7. Alton Geoscience further recommends that one bioreactor be installed at the southwestern corner of the site to treat the

water recovered from this trench. The effluent should be tested and disposed of in accordance with the sanitary sewer discharge permit.

Based on the elevated hydrocarbon concentrations in the soils, the presence of product observed during excavation of Borings B-7, B-8, B-11, B-18, and B-19 (MW-3, MW-4, MW-7, MW-14, and MW-15, respectively), and the free product accumulation in Monitoring Well MW-7, it is possible that free product may occur cyclically in the monitoring wells in this area. In addition, free product accumulation in Monitoring Well MW-7 has been shown to vary significantly with tidally influenced changes in the monitoring well water elevation. Therefore, Alton Geoscience recommends that fluid levels be monitored in all wells for at least one tidal cycle to ensure adequate definition of the free product plume and to better define the hydrodynamics of the site. If free product is detected, the extent of the plume should be re-evaluated and the need for an additional trench along the southern property margin should be considered.

Alton Geoscience appreciates the opportunity to provide technical services for Cyto Culture International, Inc. Please call if you have any question regarding this project.

Respectfully submitted,

ALTON GEOSCIENCE

Terrence A. Fox
Project Geologist

Jeffery W. Wiegand C.E.G. 331
Vice President

TAF/REL/JWW

References

California's Ground Water, 1975, Department of Water Resources, Bulletin Number 18.

County of Alameda, Department of Public Works, 1987, Personnel Communication.

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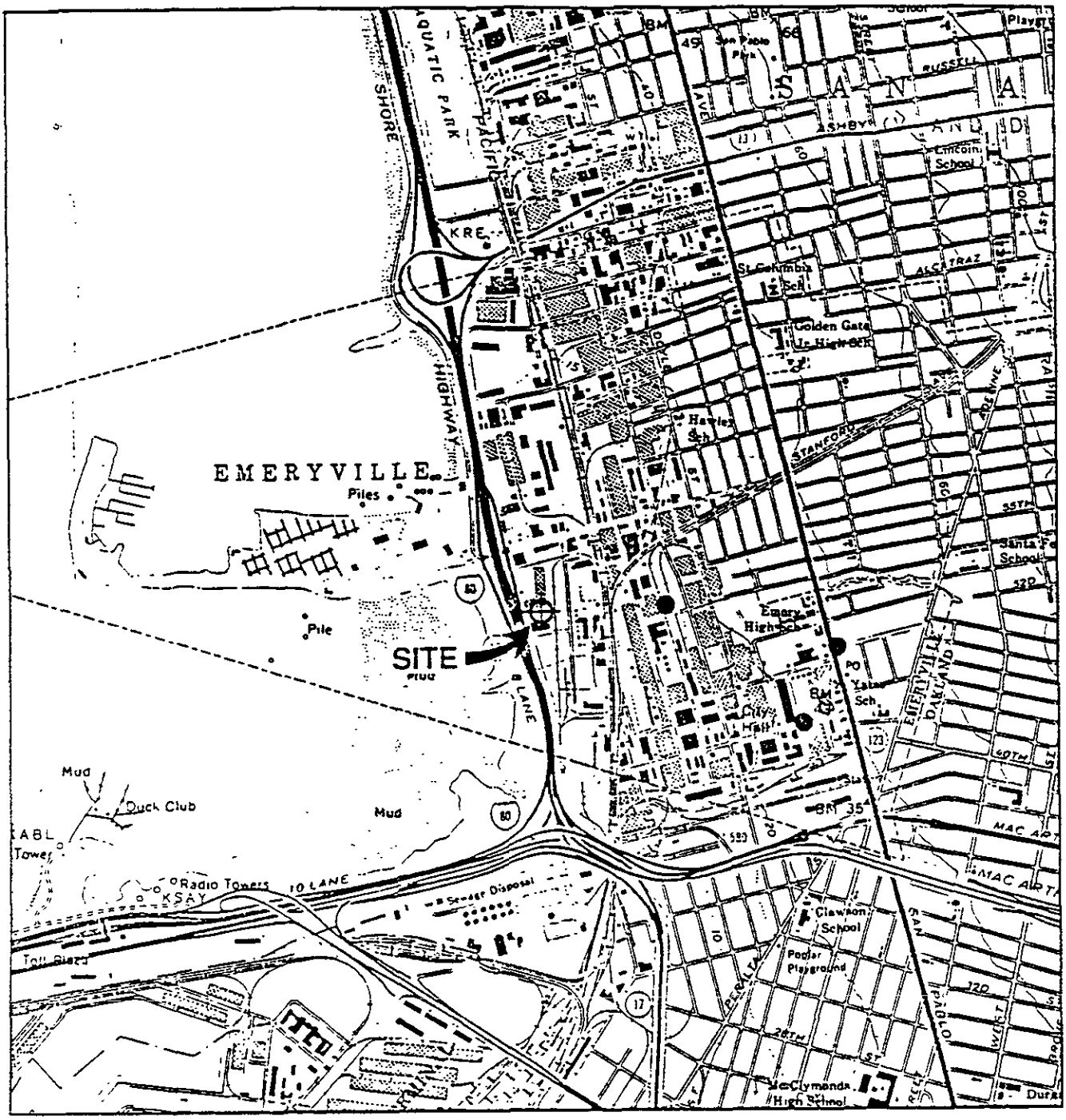

LEGEND

● Well Locations

SOURCE:

United States Geological Survey
7.5 minute Topographic Map:
Oakland West Quadrangle

FIGURE 1: INDEX MAP

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

ALTON GEOSCIENCE
16510 ASTON ST
IRVINE, CA 92714

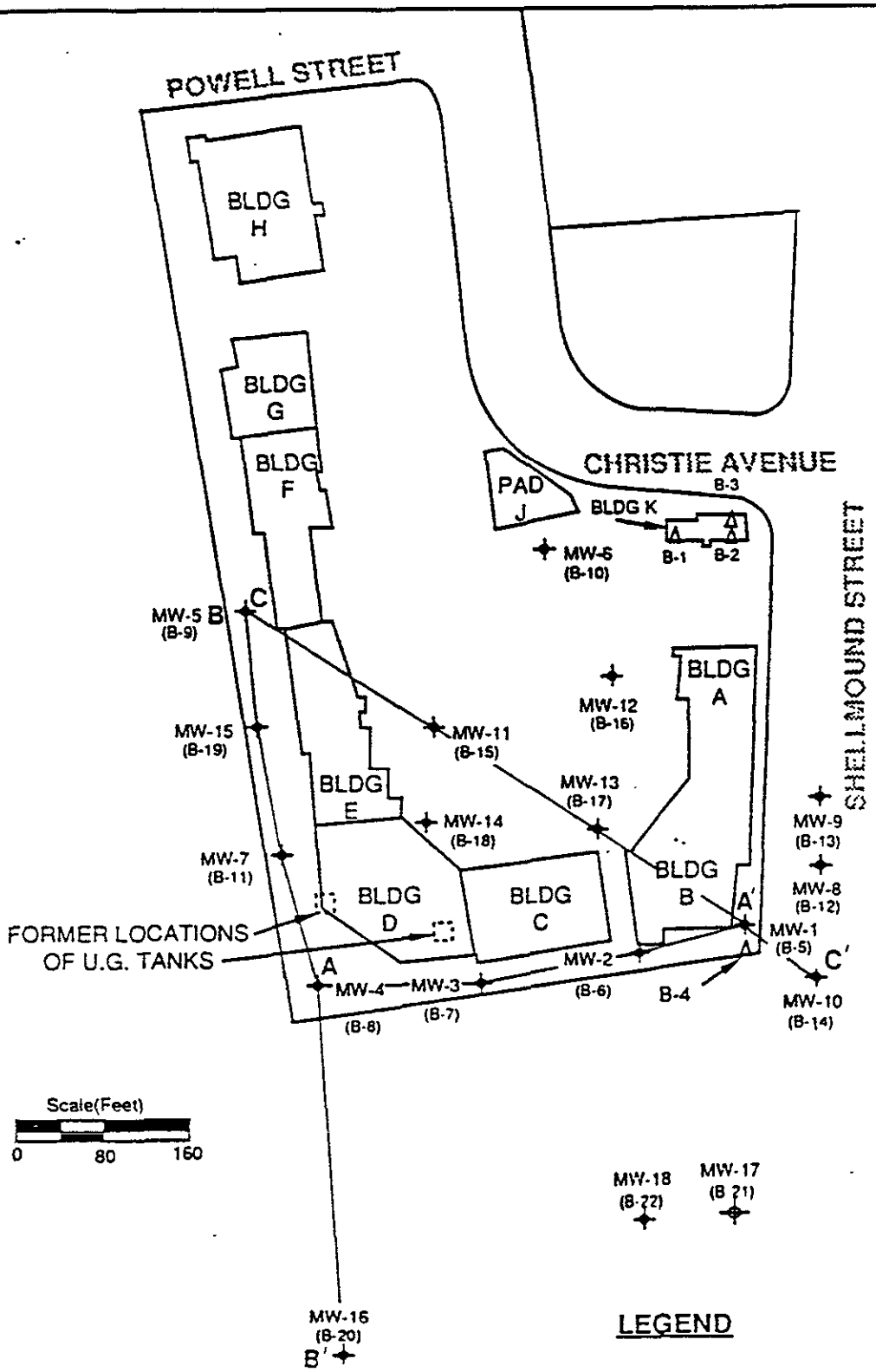

FIGURE 2: SITE PLAN SHOWING LOCATION OF MONITORING WELLS

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

LEGEND

- ✦ Monitoring Well Location
- Δ Boring Location
- A—A′ Cross-Section Line

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

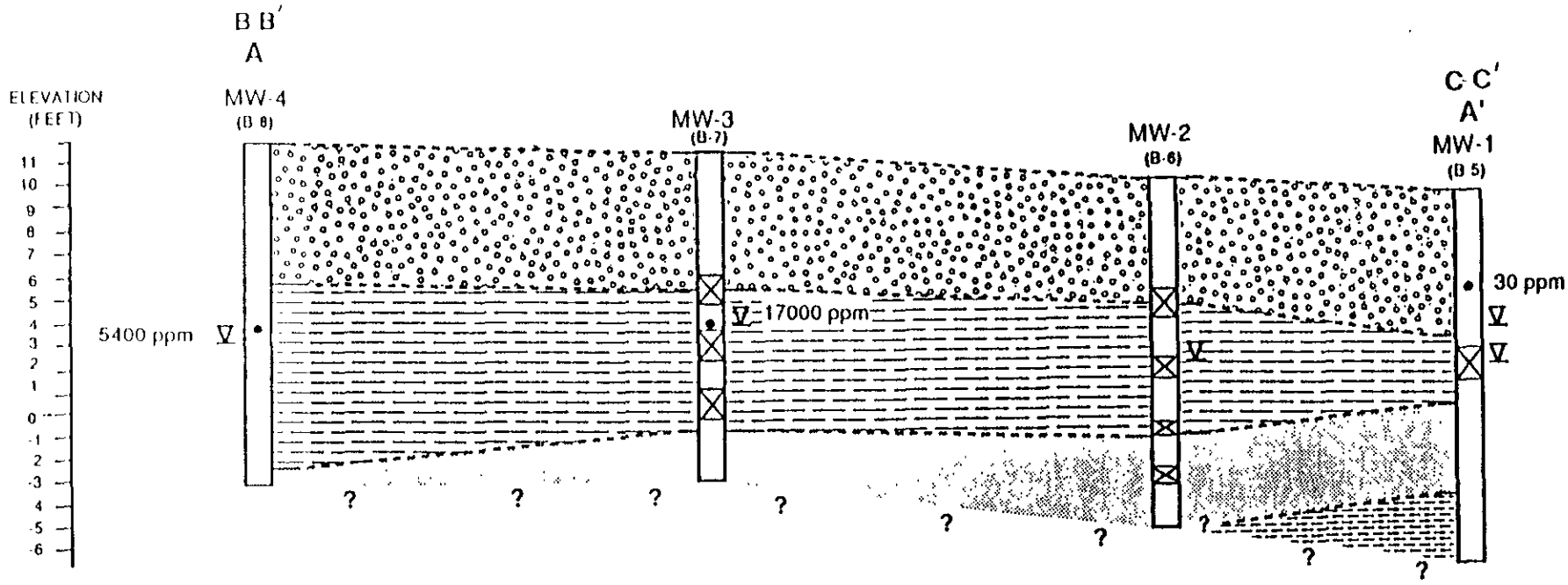

FIGURE 3: CROSS SECTION A-A' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 30 ppm • Sample Location
- No Sample

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16510 ASTON ST.
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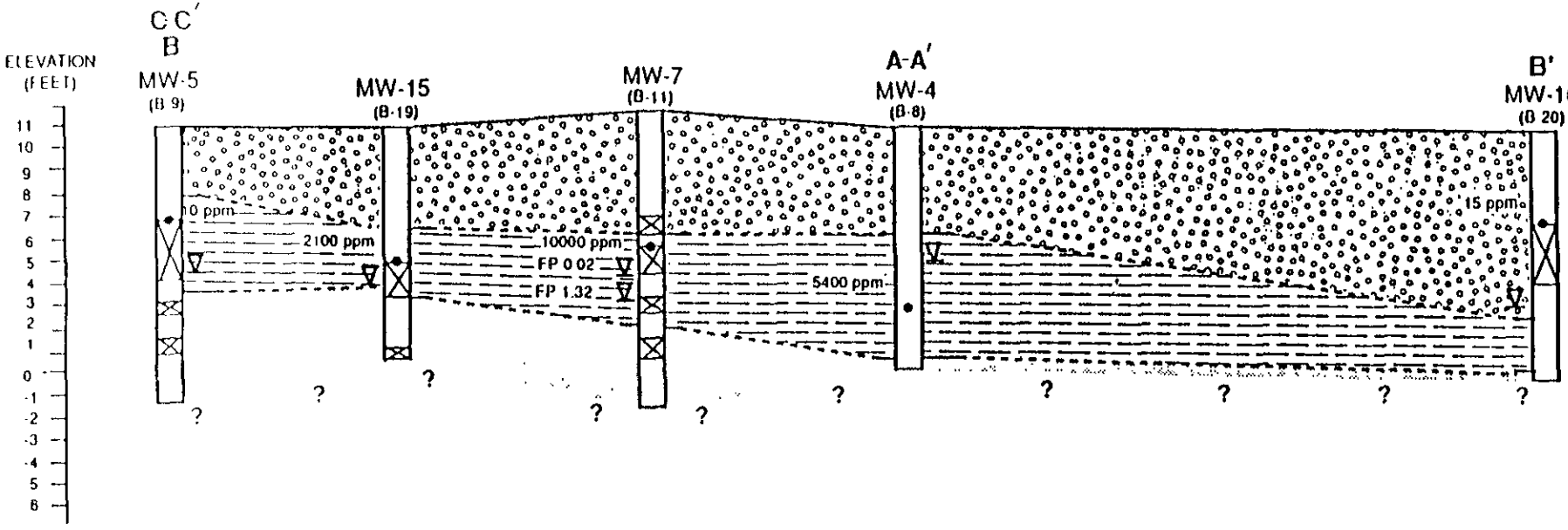

FIGURE 4: CROSS SECTION B-B' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Fluid Level Measurement
- Sample Location
- 5400 ppm
- No Sample

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IRVINE, CA 92714

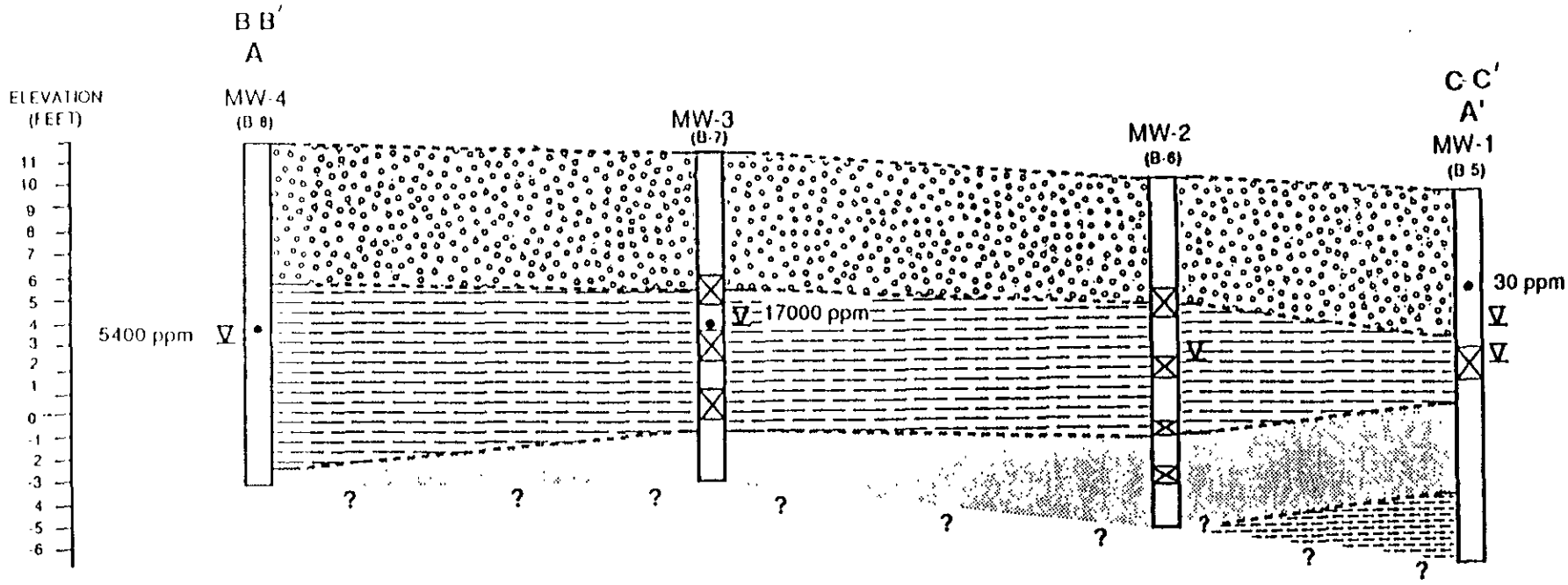

FIGURE 3: CROSS SECTION A-A' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 30 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

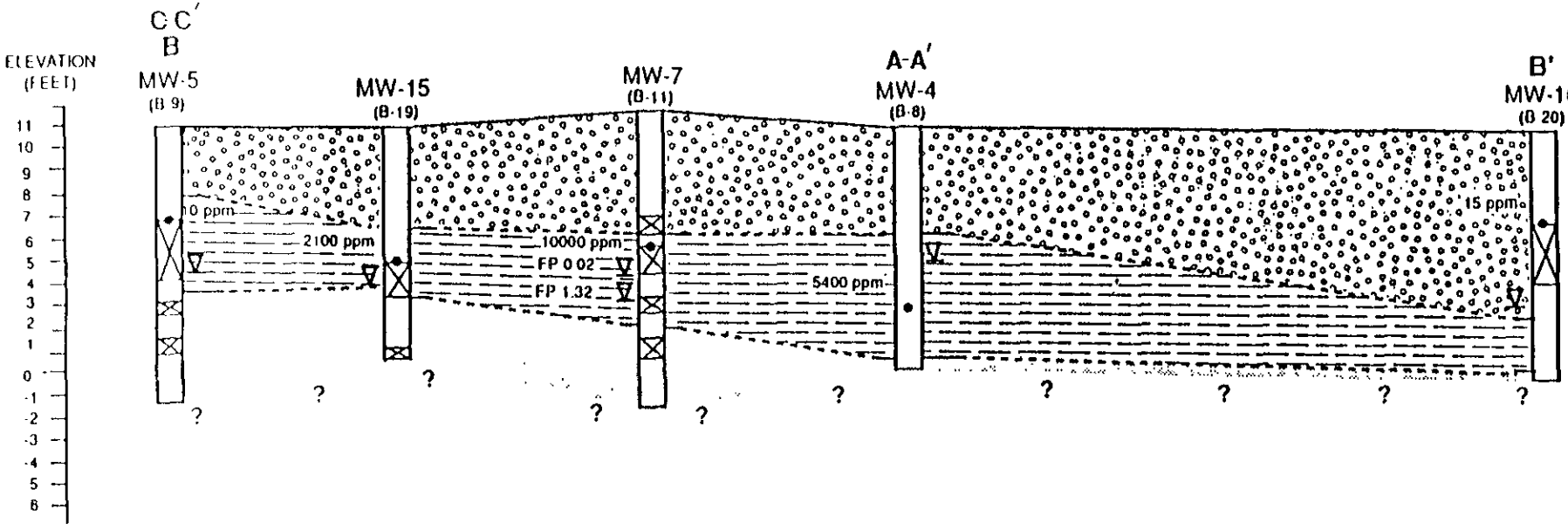

FIGURE 4: CROSS SECTION B-B' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Fluid Level Measurement
- Sample Location
- 5400 ppm
- No Sample

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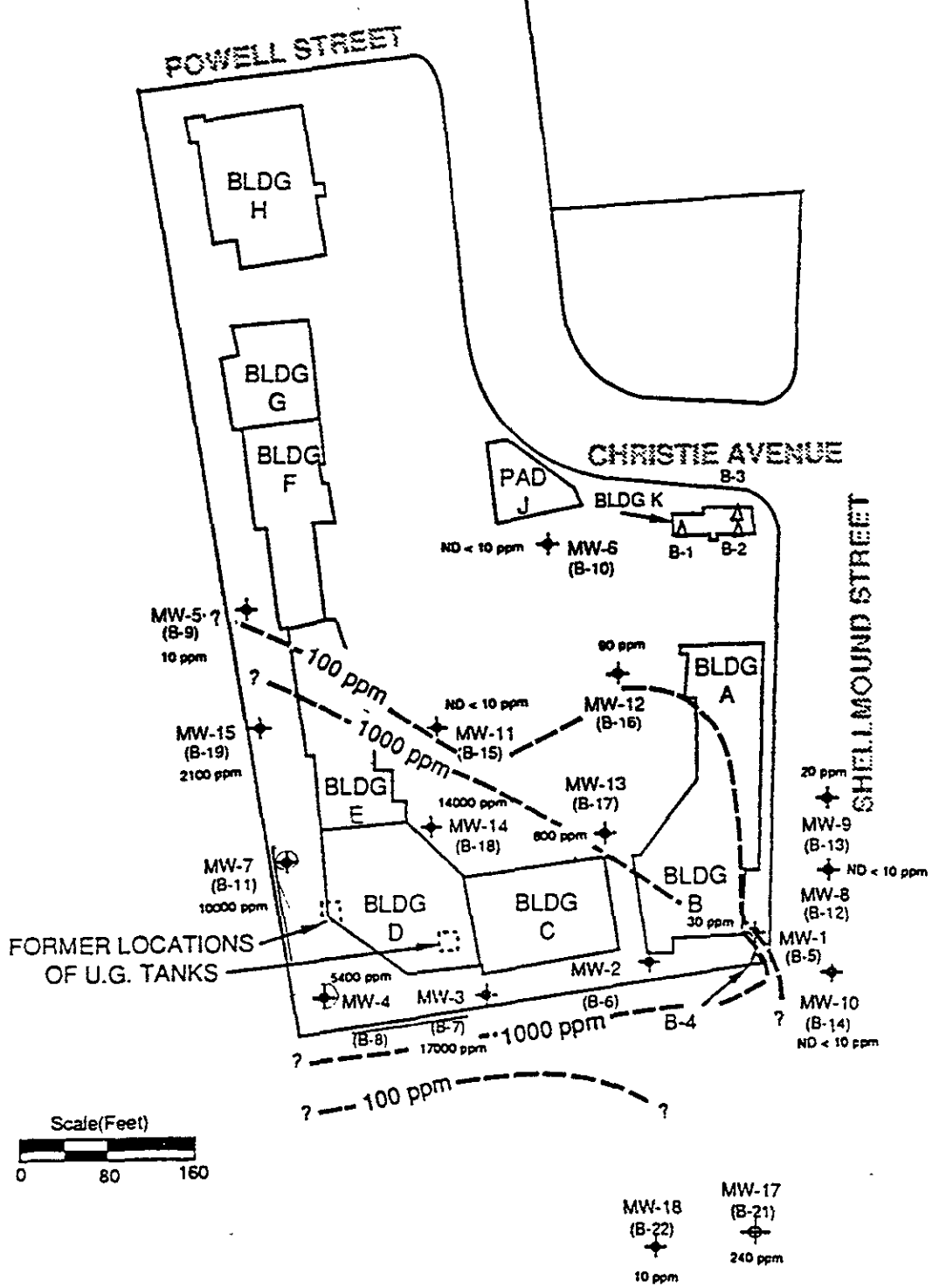

FIGURE 6: SITE PLAN SHOWING ESTIMATED EXTENT OF ADSORBED-PHASE PLUME

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE: Contour lines are interpreted based on analysis of soil samples collected on 10-7-87 between 3-10-88 and 3-11-88

LEGEND

- Monitoring Well Location
- Concentration Contour Line
- Boring Location

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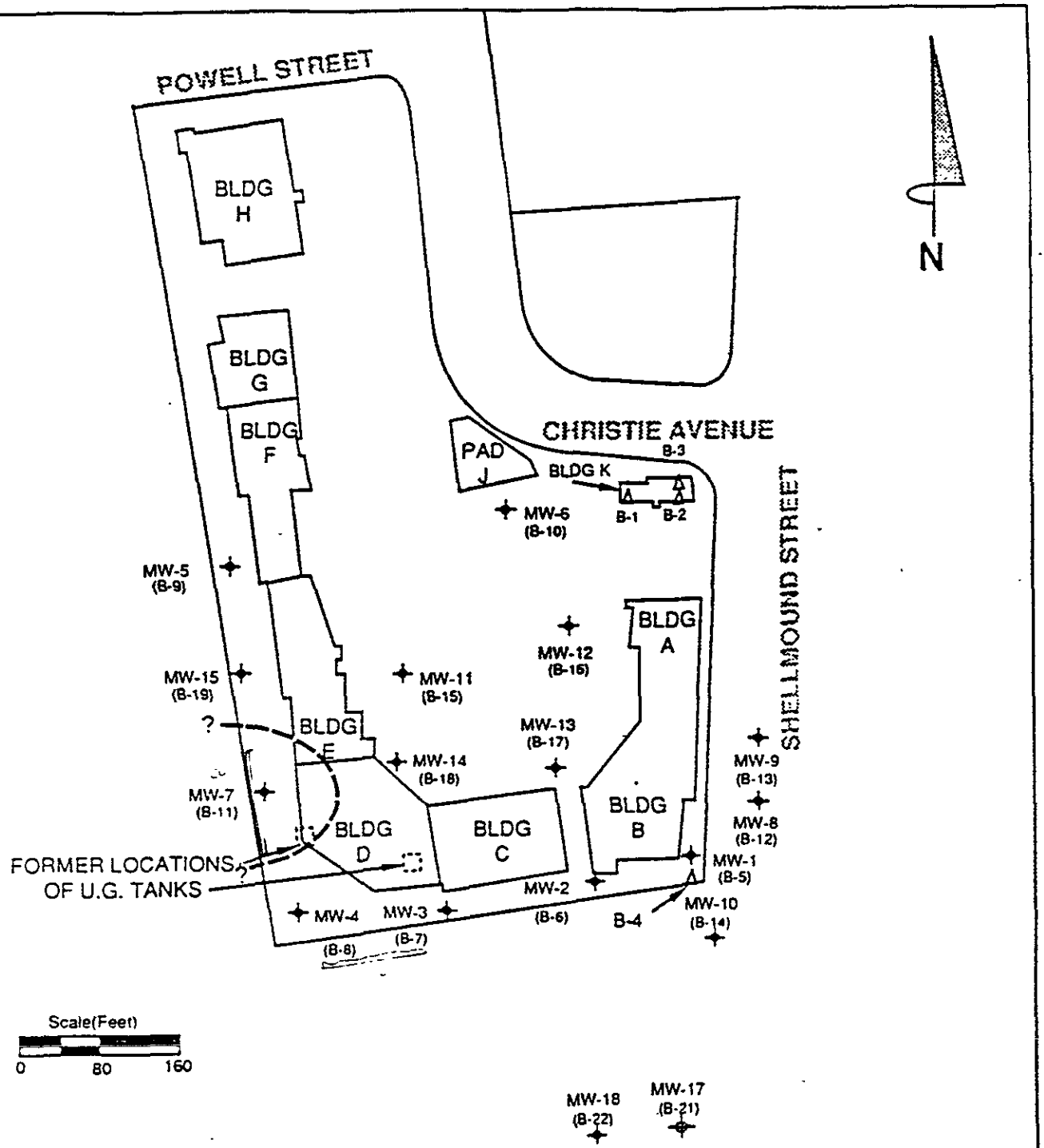
16510 ASTON ST.
IRVINE, CA 92714



LEGEND

- ⌖ Monitoring Well Location
- — — Estimated Extent Of Free Product Plume
- Δ Boring Location

FIGURE 7: SITE PLAN SHOWING ESTIMATED EXTENT OF FREE PRODUCT PLUME
P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Estimated extent is interpreted based on monitoring data collected between 3-10-88 and 3-15 88

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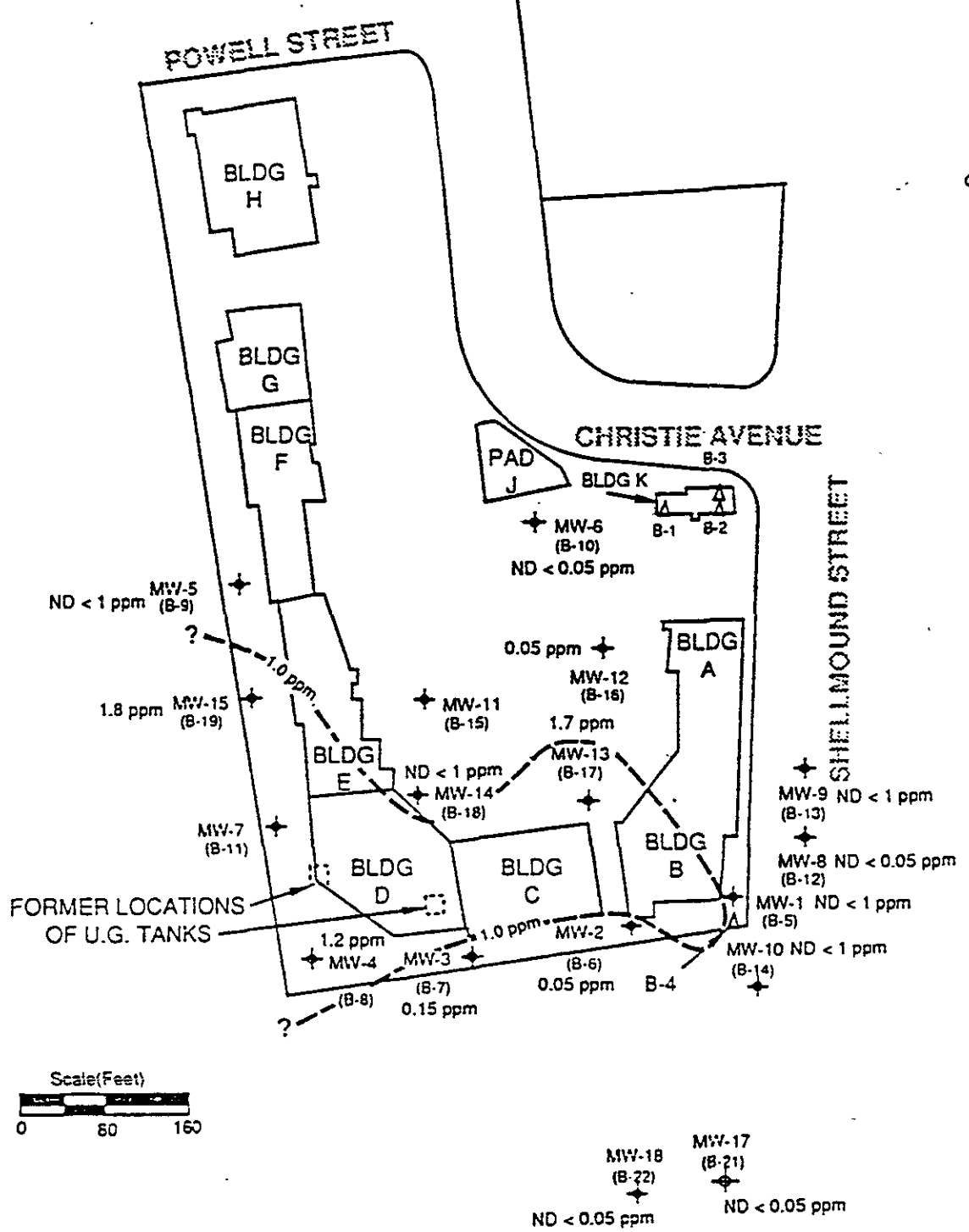

FIGURE 8: SITE PLAN SHOWING ESTIMATED EXTENT OF DISSOLVED-PHASE PLUME

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE: Contour lines are interpreted based on analysis of ground water samples collected between 3-10-88 and 3-15-88

LEGEND

- Monitoring Well Location
- Concentration Contour Line
- Boring Location

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

CytoCulture
INTERNATIONAL INC.
Biotechnology Research, Scale-Up and Marketing

Phase II Report on

Hydrogeology and Site Characterization Studies

for

P.I.E. Nationwide Property
5500 Eastshore Freeway
Emeryville, CA

in preparation for

IN SITU SITE REMEDIATION OF SOIL AND GROUNDWATER

HYDROCARBON CONTAMINATION BY

AUGMENTED BIORECLAMATION USING

LABORATORY SELECTED BACTERIAL CULTURES

by

CytoCulture International, Inc.

in a Joint Venture with

Sybron Chemicals, Inc.

in Collaboration with

Alton Geoscience

June 3, 1988

CONFIDENTIAL INFORMATION

submitted to

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Introduction

CytoCulture International, Inc. and Sybron Chemicals, Inc. have been contracted as a Joint Venture to attempt to reclaim soil and groundwater contaminated with diesel hydrocarbons at the former P.I.E. Nationwide truck terminal in Emeryville. A preliminary Site Characterization Study was completed by Alton Geoscience and submitted as a Phase I Report to the Department of Health Services (Toxic Substances Control Division, Alternative Technology and Policy Development Section) last November. An Operational Plan for the site remediation was then submitted on December 18 as a supplement to the original proposal of July 29.

In March of this year, Alton Geoscience was contracted to install and sample 18 monitoring wells at the site in order to better define the diesel contamination plume. Their results are presented here along with their detailed geological and hydrogeological characterization of the site as the Phase II Report for this remediation program. This information will guide the design of the bioreactor systems for treating contaminated groundwater drawn from extraction trenches and for reinfiltrating the treated water upfield so as to inoculate contaminated soil with additional bacteria and nutrients.

This remediation project has been structured into distinct phases beginning with the preliminary and final Site Characterization Studies (Phases I, II), followed by the Phase III decontamination of groundwater using Sybron bacteria in above ground bioreactors, and ending with the Phase IV reinfiltration of the treated water with additional bacterial cultures to inoculate the contaminated soil. This phased approach is described in the Operational Plan of December 18, 1987.

Results of Site Characterization Studies

Free Product Plume

In spite of the expected widespread presence of free diesel product in the groundwater along the southern and western boundaries of the property (see Initial Site Characterization Report by Alton Geoscience, November 3, 1987), free product was measured only at monitoring well 7, directly west of the former underground tank locations. Previous investigations in 1986 by Groundwater Technology (see p.4, op.cit.) reported free product in three wells drilled around the tank pit area where Building D of the new shopping center now stands. Directly to the south of this area, monitoring well 3 had no apparent free product in spite of an adsorbed phase hydrocarbon level of 17,000 ppm.

Figure 7 of the enclosed report shows the newly estimated extent of free product plume from the single data point obtained in the most recent Alton Geoscience investigation only. No explanation has been given for why free product has not appeared in other wells to the south in spite of the presence of high levels of adsorbed phase hydrocarbon, but it would appear that free product is migrating primarily in a westerly direction at this time. Tidal action may have dispersed free product into other areas which are now under buildings.

Dissolved Phase Hydrocarbon Levels in Groundwater

Dissolved phase hydrocarbon contamination in the groundwater is surprisingly low (< 2 ppm) in spite of previous studies conducted by Groundwater Technology suggesting total petroleum hydrocarbon levels from 3 to 600 ppm in wells drilled where Building D now stands. Figure 8 shows a 1 ppm concentration contour line for the site plan as determined in the most recent Alton study.

Adsorbed Phase Hydrocarbon Levels in Soil

The enclosed Report on Site Characterization Studies completed by Alton Geoscience on April 28, 1988 summarizes data collected from soil borings in October 1987 and March 1988. As expected from preliminary studies and observations at the site, the soil contamination on site is basically confined to the southwestern quadrant of the property in the vicinity of the locations for the former underground tanks.

Table 1 lists the laboratory results for soil samples analyzed from previous test borings and the recent monitoring well drillings. Contamination levels for the southwestern area of the site range from 5,400 ppm to 17,000 ppm in the subsurface soils in or above the groundwater table.

Figure 2 has a site plan depicting the approximate locations of the corresponding borings and wells. Figure 6 is the same site plan superimposed with concentration contour lines as estimates of the extent of the adsorbed phase product in the soil. The diesel hydrocarbon concentration values from Table 1 are shown by the corresponding borings and monitoring wells. The highest soil contamination (17,000 ppm) found to date came from a sample taken eight feet beneath the surface at monitoring well 3, directly south of where the underground tanks had been located (now under Building D). Although no free product was found in any of the monitoring wells along the southern boundary, there is no question that the soil in the saturated zone of this area is heavily contaminated, presumably from previous southward migration of free product through this area over the years.

Results of soil boring sample analysis by the 1986 Groundwater Technology investigation (see Table 1, Initial Alton Report) confirmed the presence of adsorbed phase product (e.g., 6,800 ppm at GT-6) immediately west of the former tank locations.

Figure 4 shows a representative cross section of the subsurface stratigraphy indicating where the samples were taken relative to the overlying artificial fill, bay mud sediments and prevailing tidal groundwater levels. Contamination is most apparent underneath the fill in the black bay mud sediments and mixed soils of the saturated zones.

Product Plume Definition

The FREE PRODUCT plume, from this recent Alton Geoscience study (Figure 7), appears to be confined in the vicinity of monitoring well 7 and the area eastward under Building D. Previous studies in 1986 by Groundwater Technology confirmed the presence of free product beneath the area now under Building D.

The DISSOLVED PHASE plume in the groundwater, although moderately low in concentration, follows a concentration contour line similar to that of the adsorbed phase hydrocarbon contamination, as shown in Figure 8. In the recent investigation reported here by Alton Geoscience, dissolved phase hydrocarbon levels never exceeded 2 ppm. In the 1986 study by Groundwater Technology, dissolved phase petroleum hydrocarbon levels of up to 600 ppm were reported for the area under Building D.

The extent of the ADSORBED PHASE contamination plume appears to be well defined as evidenced by the low levels of hydrocarbon found in the surrounding 11 monitoring wells to the north, east and south of the southwest quadrant of the property (Figure 6). From previous borings (see Initial Report) and the recent studies summarized here, the heavily contaminated soils lie under Building D and extend predominantly westward and southward all along the nearest bordering property lines. The anticipation of these findings led to the installation of six monitoring wells with four inch casings along the southern and western boundaries so they could later serve as extraction wells as described in the December 18, 1987 Operational Plan. Four of the six (not the most northerly nor the most easterly) four inch casing wells proved to have high adsorbed phase contamination levels, but ONLY ONE of the 4" wells had detectable free product (MW-7).

The contamination plume could not be defined beyond the western property line (Caltrans fence) along Interstate 80, but is presumed inaccessible and possibly stabilized on account of the freeway constructed there in 1953.

RECOMMENDATIONS

Based on results of the most recent Alton Geoscience Site Characterization and previous investigations, the following recommendations have been formulated to update our Operational Plan of December 18, 1987:

1. Install an extraction trench (approximately 200 feet) and complete bioreactor system (2,000 gallon, continuous flow) along the western property line across from Building D to recover free product and inhibit further western migration of diesel fuel in the area around Monitoring Well 7 (see Figure 7). Trench specifications have been described in the Operational Plan. Alternatively, larger extraction wells could be installed.

2. Install a second extraction trench (also about 200 feet) and bioreactor system just south of and parallel to the southern property line extending from near the southwest corner of the property eastward to beyond Monitoring Well 3. This depression zone will retrieve contaminated groundwater and may recover remaining free product present under or south of Building D. This trenching should also inhibit further southward migration of contaminated water or any undetected dissolved product.

3. The TWO continously operating bioreactor systems in the southwest corner of the property will treat contaminated groundwater extracted from their respective trenches along the southern and western boundaries. This system will consist of a 250 gallon clarifier and twin 1,000 gallon bioreactor tanks to maintain an anticipated flow rate of 1-2 gal per min and a retention time on the order of 8-12 hours. An optional oil/water separator will probably be available but probably not be necessary as the rate of bacterial biodegradation is expected to keep up with the influent levels of diesel product. The system will include a means of automatically dispensing and ionic tracer (e.g., sodium bromide or potassium thiocyanate) - see Operational Plan.

4. Pump and treat contaminated groundwater with both bioreactor systems to determine optimal operating parameters and to control product migration southward or westward in the area enclosed by the trenching system. Treated water, temporarily diverted to the sewer, will meet discharge limits set by the SF Bay RWQCB NPDES permit variance letter for this site of November 25, 1986. This pump and treat operation constitutes Phase III of the project.

5. Install reinfiltration trenches upfield from the extraction trenches to inoculate contaminated soil on both sides of Building D with treated water containing nutrients, an oxygen source and high densities of the diesel-specific cultures of bacteria.

6. Once product migration and mounding control has been demonstrated with the bioreactor/trench system, and RWQCB and DHS permission has been granted to proceed, initiate Phase IV reinfiltration with treated water, nutrients and bacterial cultures around Bldg D.

7. Additional reinfiltration galleries are planned for the contaminated soil south of buildings B and C in an attempt to treat the observed "hot spot" contaminations mentioned in the Operational Plan. Since groundwater contamination levels are so low (< 1 ppm in MW-1, MW-2 and MW-3), current plans now call for setting up a mobile 1,000 gallon BATCH bioreactor system which will periodically seed the soil in other contaminated areas of the site (such as around Buildings B and C) with batch cultures of diesel blend bacteria grown up on site using tap water.

In other words, this third batch bioreactor will not process groundwater but will periodically generate high density cultures for reinfiltration into long trenches running parallel to the Buildings and to the southern property line. Since the batch bioreactor will not be continuously oxygenating the soil, we intend to use facultative organisms capable of biodegrading diesel hydrocarbons under anaerobic conditions. In addition, we propose to introduce dilute hydrogen peroxide (< 500 ppm) to provide an oxygen source for the more efficient aerobic bacterial cultures. Specifications for this reinfiltration process will be presented in a forthcoming progress report and Operational Plan for Phase IV.

8. The Phase IV Reinfiltration Program will be monitored by testing selected monitoring wells for changes in petroleum hydrocarbon levels or the appearance of lithium chloride tracer and/or elevated bacterial counts. The proposed extraction trenching should adequately protect against any migration of free product or dissolved phase hydrocarbons south or west from the former tank pit areas under Building D.

It is important to note that in addition to the proposed extraction trenches, six 4" casing monitoring wells are now installed along the western property line (MW-7 and MW-15) and the entire southern property line (MW-1, MW-2, MW-3, MW-4) to create an additional "fence" for extracting contaminated water should any unexpected migration of the plume occur. See the discussion on optional water extraction methods in the Operational Plan.

Additional details on the operation, monitoring and verification of compliance for this soil/groundwater bioreclamation project are presented in the Operational Plan of December 18, 1987 or can be obtained from the Project Director at CytoCulture.

CytoCulture INTERNATIONAL INC.
Biotechnology Research, Scale-Up and Marketing

Dec 1986

Loc
Remarks

CytoCulture/Sybron Bioreclamation Project for ~~P.I~~.E. Emeryville

Updated: December 18 (last Update was November 14)

List of Permit and Regulatory Agencies & Status Reports

I. California Regional Water Quality Control Board
San Francisco Bay Region

1111 Jackson Street, Room 6040
Oakland, CA 94607

Tel. 464-0840

Executive Officer: Roger B. James
(see letter for NPDES permit to P.I.E. of November 25, 1986)

Toxics Clean Up Division - Local Program Coordination

Senior WRCE: Mr. Peter W. Johnson

WRCE contact: Mr. Gregory S. Zentner

Status: Unwilling to issue permit for "reinjection" solely on grounds of inadequate monitoring personnel or qualified personnel in other (county) agencies; major concern is that reinjected water will spread plume; otherwise no objections to water treatment or even to discharge of treated water into nearby storm sewers. Unwilling to have meeting with us even at our insistence to at least discuss alternatives;

Recourse: Appeal to Executive Office; find agency person or third party to assist in monitoring plume hydrogeology; change approach to one of "perculation" of treated water into soil as in normal irrigation practices for agriculture.

Update: Greg Zentner called November 4 to announce his decision to pass this project/permiting on to an associate in another section in the hopes of expediting our request for a variance to reinfuse treated water at the Emeryville site.

New Contact RWQCB: Lester Feldman - 464-
Section of Solvents (not underground tank leakage as was Greg Zentner)

This person has a reputation for in turn passing on the authority to monitor/permit projects to others, so Greg was hoping he would allow Fred Tornatore (with whom he will discuss

this issue) at the Office of Alternative Technologies to monitor our hydrogeologic control. This would then allow us to be issued a variance letter from the SF Bay RWQCB to proceed with our treatment/reinfusion project as planned.

As of November 10, Fred was willing to cooperate, but had not spoken directly to Lester (only to Greg so far). Fred wants to review the site characterization study (due from Alton Geoscience this week) before venturing any further. The plan is to consider our project as a "demo" for a new "alternative technology" in wastewater treatment. Only if he feels that the site and technology merit this status will he be justified in spending his time reading our reports and visiting the site.

Plan: Write a cover letter, review our current plans with emphasis on:

1. Expanded capacity to monitor and control hydrogeology via 10 on-site wells and 6 offsite wells distributed radially around treatment area, with extra wells between site and bay. Planning for rigorous chemical monitoring of at least six wells for changes in total HC levels (monitor plume).

2. Monitor spread of reinfiltrated treated water and bacteria by using a lithium chloride tracer automatically dispensed in bioreactor effluent. Routine analysis of critical six wells for both LiCl and bacterial count to monitor spread of treated water.

3. Extensive french drain trenching to span most of south perimeter of property in effort to catch plume which appears to be migrating onto adjacent former Judson Steel site.

4. Reinfiltration gallery of shallow perforated pipes on back side of plume and under some buildings to introduce active bacteria to contaminated soils.

5. Schedule treatment and reinfiltration to begin in late January to take advantage of rains and winter tides to better distribute bacteria into unsaturated zones of soil above contaminated areas of fill.

II. State Department of Health Services
Toxic Substances Control Division
2151 Berkeley Way
Annex 7
Berkeley, CA 94704

Supervisor, Hazardous Materials: Dick Bergard
Tel. 540-3396

Supervisor, Site Mitigation Program: Howard Hatayama
851 Shellmound
Berkeley
Tel. 540-3401

Staff: Susan Solarz (very helpful)

Our contact: **Janet Naito** (biological treatment assessor)
Hazardous Waste Specialist

Other lesser Variance Permit contacts:

Dan S. Murphy
Mike James

Status: All would be interested in learning more about proposal and technology, but nobody here seems to have outright jurisdiction any longer.

They recommend we contact the Sacramento office directly for site variance permits as per mandate passed down in Sept. We will make presentation to them shortly in any case. See V.

Update: Call November 25 from Janet Naito (returning my call) RE: "concerns" expressed by Dwight Honig about our biological treatment plans. She is now in charge of all biological clean up projects in this district for DHS, although has limited experience. She is an environmental scientist (not a geologist nor biologist). Pleasant, helpful. Requested copy of plan and update, so letter sent off Dec. 1 along with abbreviated copy (no costs) of October 1 version.

Update: On December 15, after several attempts to get through, I spoke with Janet RE: our proposal. She still has not read our proposal and does not seem very worried about anything (so far). She has been in communication with Fred Tornatore and she understands our dependency on that Office for the monitoring assistance in order to get RWQCB to issue a variance for reinfiltration. She also described Lester Feldman as very busy, but able to give a "quick turn around" on any document which he takes the time to read. So far we have had no contact with him directly, pending outcome of Fred T. and John W. at Alt. Tech.

III. Alameda County Department of Health
Central Health Clinic
470 27th Street No. 324
Oakland, CA 94612

Ted Gerow, Previously in charge of underground tank leakage program; now acting more as liaison
Tel 874-6434

Hazardous Materials Management Program
Tel. 874-7237

Mr. Rafat Shahid
Chief Hazardous Materials Management
Department of Environmental Health for Alameda Cty.

Staff: Ed Howell
Tom Peacock

Status: Tom Peacock would like to see us Oct. 14 @ 9 AM
Attitude is skeptikal towards RWQCB right to prevent us from proceeding given that what we are doing is really just "perculating" water into soil (as in irrigation), not true reinjection, so therefore no regulatory constraint.

Update: We visited this group on October 14 and met with:

Lowell Miller - Senior Hazardous Materials Spec.

(attentive, skeptical, wants more info.)

Storm Goranson - Hazardous Materials Specialist (attentive, more experienced in engineering aspects of hydrogeology and tank leakage; would be good contact to develop, but new in this agency)

Flood Control Group in Pleasanton: Mr. Craig Mayfield
Tel. 484-2600

Status: Emeryville in not in their jurisdiction for issuing permits for drilling monitoring wells - see Building Inspector or Fire Dept. in Emeryville
They are not interested in dealing with us at this time.

IV. Emeryville Dept. Public Works

Bill Burke - Building Inspector
654-6161 (call 9AM to 10AM only)

Status: Cool about letting us proceed with borings and drilling monitoring wells without any written consent or formal permits so long as we clear everything with the site contractor superintendent (DEVCON): Chuck. Done.

If we drill out in the street (no easement), we need to erect barriers for traffic.

Eventually we should get written notices from this office. Bill can only be reached by phone between 9 and 10 a.m.

V. State of California - Department of Health Service (DHS)

Toxic Substances Control Division (916) 324-1826
Alternative Technology Section
400 P Street - 4th Floor
Sacramento, CA 95814

Contacts:

Frederick A. Tornatore - Senior Hazardous Materials Spec.
(916) 322-9224 OUR CONTACT

John M. Wesnousky, P.E. - Senior Waste Management Engineer
(916) 322-2543 SUPERVISOR

Alan T. Ingham, P.E. - Senior Waste Management Engineer
(916) 322-2543 NO DIRECT ROLE IN OUR PROJECT

Status: These gentleman were very gracious to us and interested in our proposal for biological remediation at the Emeryville site. They express the same specific concern as does RWQCB over the issue of accidentally spreading the product plume during reinfiltration. They requested more information and a Site Characterization Report. Task 1 to be initiated.

Updates:

November 17: Site Characterization Report (Alton Geoscience) sent with CCI cover letter to Fred T. outlining our strategies to contain product plume and increase monitoring wells.

December 11: After several conversations directly with Alton, Fred finally called us (we tried reaching him all week) to spell out their concerns with the site, the data and our plans. A 45 minute conversation ensued over the issue of one vs. three bioreactors, site soil heterogeneity, no plume definition, uneasiness they have with infiltration until we prove that we can handle the water treatment itself, interest in more wells off-site, etc. These and other points are addressed in our "Operational Plan" as requested by Fred T. to give "details of our conceptual plans". Draft sent over to Chris Falbo 12/14. Plan revised with Chris Falbo's comments and sent to Fred Tornatore on Dec. 18; copies sent to Alton and Sybron. Now plan to drill 18 wells, starting around Jan. 13. Fred has indicated before that we do not need any permits from his agency to proceed with drilling (we presume we only need permission from Emeryville; county and flood control agencies are not interested - no jurisdiction anymore). Fred will review our Operation Plan in the interim; once we can demonstrate adequate hydraulic control at the site and we have defined the plume sufficiently to proceed, Fred has said that he would probably assign a geologist from DHS headquarters in Sacramento to monitor our project.

CytoCulture
ENVIRONMENTAL
BIOTECHNOLOGY
A Division Of CytoCulture International Inc.

May 15, 1990

Mr. William Meckel
Source Control Division
East Bay Municipal Utility District
Mail Stop 59 P.O. Box 24055
Oakland, CA 94623

RE: Wastewater Discharge Permit (Groundwater Treatment)
EBMUD Account # 001-00002
FOURTEENTH monthly report of treatment and discharge operations for April 1990

CytoCulture/Sybron Chemicals are herein reporting on the results for the fourteenth month of continuous biological treatment of diesel-contaminated groundwater and the discharge of the treated water into an EMBUD interceptor at the former P.I.E. Nationwide truck terminal in Emeryville. Laboratory analytical results are enclosed along with our Daily Facility Log Sheets.

At the end of March, the north and south bioreactor systems were in continuous operation processing diesel-contaminated groundwater at a rate of 1.5-2 gpm (2500 gpd).

Operating Conditions in April

In the first week of the month the groundwater extraction flow rate from the combined N & S trenches maintained at approximately 1.5 gpm. As has been previously documented, the flow rates are inconsistent and vary with rainfall activity/groundwater levels. Free product ("aged diesel") was collected from both trenches intermittently and was skimmed from the oil/water separators on April 1 and 5.

Both bioreactor systems appeared to be operating normally except that the south system continued to have a lower biomass density. The decreased density of bacteria has plagued the system since December and could present a problem if high levels of hydrocarbon were to pass rapidly through the bioreactors.

The steady decline in groundwater flow rates since the winter are of concern since it appears that the water table this summer will be even lower than experienced last summer (when flow rates dropped to 2 gpm or less).

21 WASHINGTON AVENUE POINT RICHMOND CA 94801
(415) 233-0600 FAX (415) 233-3777

Repeated attempts to re-adjust and re-configure the pneumatic pumping system with alternate parts failed to significantly improve flow rates. Tests were conducted to prove that each well pump could process 1.5 to 2 gpm when the pumps were temporarily pulled out of the trench wells and placed in 5 gallon buckets of tap water. Hence, we confirmed that the decreased flow was likely to be caused simply by the lower apparent water table. Further evidence of a regionally depressed aquifer was indicated by the on/off intermittent operation of the well pumps (equipped with bubbler tubes to switch the controllers on when the water level is high enough). Furthermore, the pumps often were delivery air along with water, another indication the system was pumping the trenches dry. During these drought periods of low water flow, the oil recovery system accumulates higher amounts of free product for recycling.

On April 2, the compressor was shut down for four hours for general servicing. On April 10 the compressor was shut down for 2.5 hours to service the well pumps and investigate the low flow rates. On April 16 and April the compressor was shut down for 1 hour for routine maintenance.

The total amount of water treated in the month of April was estimated from the averaged flow rate (1.35 gpm, 1900 gpd) to be 57,000 gallons. The total groundwater treated from March '89 through the end of April was 1,286,000 gallons.

Sample Analysis

Since there have been over 10 months of normal operation, the treated effluent and the groundwater influent are monitored by CytoCulture twice a month. In addition EBMUD takes conformational samples of the system effluent once a month.

On April 10 a south trench influent sample (IS-109) and a combined system effluent sample (E-110) were taken for routine analysis. A second set of influent/effluent samples were taken by CytoCulture on April 24 (IS-111, E-112).

Data from both sampling periods indicated that the system was operating normally and the treated effluent discharge was non-detectable for TPH and BTXE.

SUMMARY OF GROUNDWATER TREATMENT RATES

Dates	Average Flow	Net Volume
April 1990	1.35 gpm (1900 gpd)	57,000 gal.
3/89-4/90		1,229,000 gal.
Groundwater treated since start-up:		1,286,000 gal.

LABORATORY ANALYSIS OF GROUNDWATER TREATMENT SAMPLES

Tests run by Curtis & Tompkins, Ltd (Berkeley, CA) on samples collected by CytoCulture field technicians:

(1) Extractable Petroleum Hydrocarbons in Aqueous Solutions-California DHS Method-LUFT (EPA modified 8015)
(2) BTXE-EPA method 8020

ND=Not-detectable; Detection limits for TEH/TPH, ND=0.50 mg/L
Detection limits for BTXE, ND=1.0 g/L

Sample #	Date	Description	Contaminant (ppb) Benz	Tol	Xyl	EBenz	ppm TPH
IS-109	4/10	South trench influent	ND	ND	ND	ND	26,000
E-110	4/10	Combined N/S effluent	ND	ND	ND	ND	ND
IS-111	4/24	South trench influent	ND	ND	ND	ND	ND
E-112	4/24	Combined N/S effluent	ND	ND	ND	ND	ND

The extraction trench influent ranges from contaminated water saturated with product (>500 ppm) to clean brackish water, depending on weather conditions and tidal inflow.

The treated effluent discharges have registered as non-detectable for total petroleum hydrocarbons and for benzene, toluene, xylene and ethylbenzene, with two exceptions over the course of the past 12 months. Effluent treated water has almost invariably contained a healthy bacterial floc. This floc settles out of solution in approximately 30 minutes, leaving a clear, transparent and odorless supernatant.

UPDATE ON REINFILTRATION PLANS

CytoCulture still plans to construct a series of infiltration galleries under the parking lot pavement along both sides of building D (upfield of both the north and south extraction trenches in an attempt to achieve some "hydraulic control" of infiltrated water). Please refer to CytoCulture's Phase II Report and Operational Plan for details on the proposed infiltration program for seeding contaminated soil with bacteria.

A detailed proposal was submitted to the client (P.I.E.) in January 1990 for the construction of an additional 400 feet of groundwater extraction trenches along the west and south boundaries of the property to further capture migrating product and contaminated water. The trenches would employ an additional 8 groundwater pumps delivering an estimated 8-12 gpm of contaminated water to the existing bioreactor treatment system.

The Phase IV remedial action proposal also calls for the construction of 200 feet of reinfiltration trenches north and east of Building D at the shopping center. This reinfiltration gallery would receive nutrients and bacteria-laden treated water back into the water table upfield of the heavily contaminated zones under the building.

This remedial action proposal (Phase IV) was presented to the Department of Health Services, Office of Alternative Technology in March of this year. Pending client approval and funding, the proposal would then be introduced to other regulatory agencies (Alameda County, RWQCB, DHS). Construction could start within 3 weeks, once the plans for expanded extraction trenches, installation of the reinfiltration trenches and the hydrogeological study have been approved.

The Phase IV proposal also calls for a thorough groundwater and hydrogeological study to monitor the current gradient, determine to what extent the local water table is tidally influenced and to ascertain that our extraction trenches are indeed creating the expected zone of depression in the water table to have an impact on the contaminated soils beneath the shopping center. A second important consideration will be the evaluation of the hydraulic control over the immediate area in anticipation of reinfiltration activities. It is still presumed that some percentage of the treated groundwater will directed back into the contaminated zones covered by all the buildings and asphalt.

The reinfiltration process is a gradual one, with a phased approach to redirecting treated water from the EBMUD interceptor to the infiltration galleries beneath the parking lot pavement in the shopping center.

CytoCulture Bioremediation Project
for Former P.I.E. Nationwide Truck Terminal Site
Emeryville, CA

Laboratory Analytical Results for April 1990
including BTXE and TPH/TEH data
provided by Curtis & Tompkins, Ltd.

Each sample data set is preceded by the
corresponding Chain of Custody sheet.

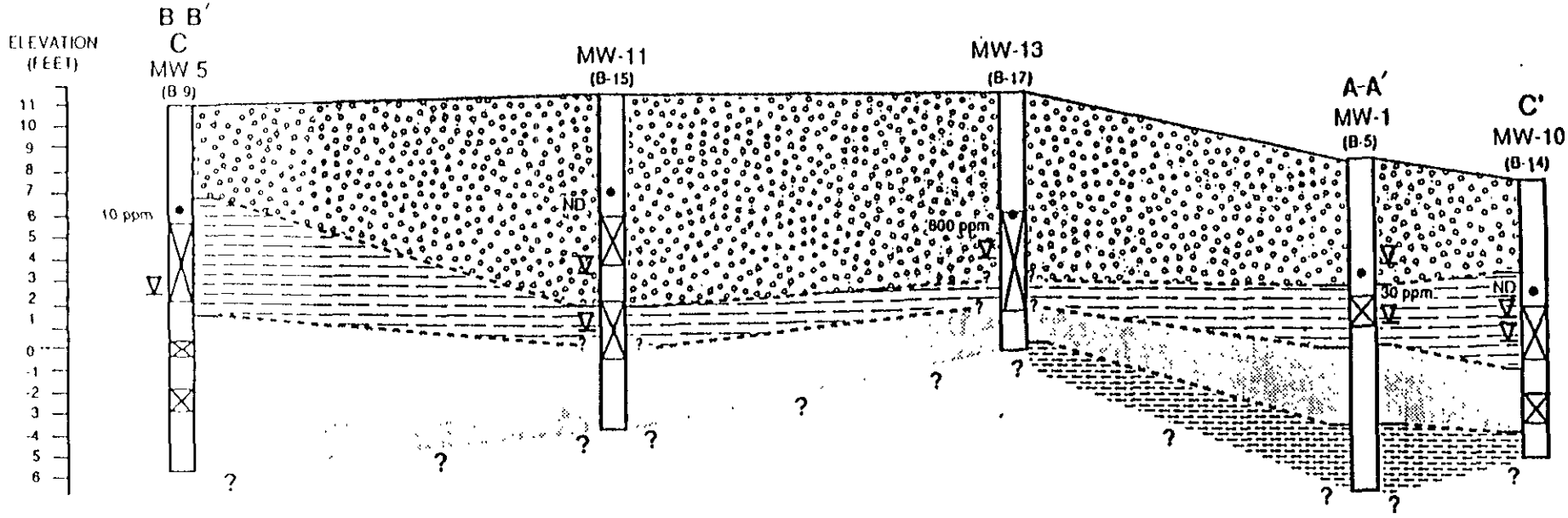


FIGURE 5: CROSS SECTION C-C'
SHOWING SUBSURFACE
STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments.
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 5400 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

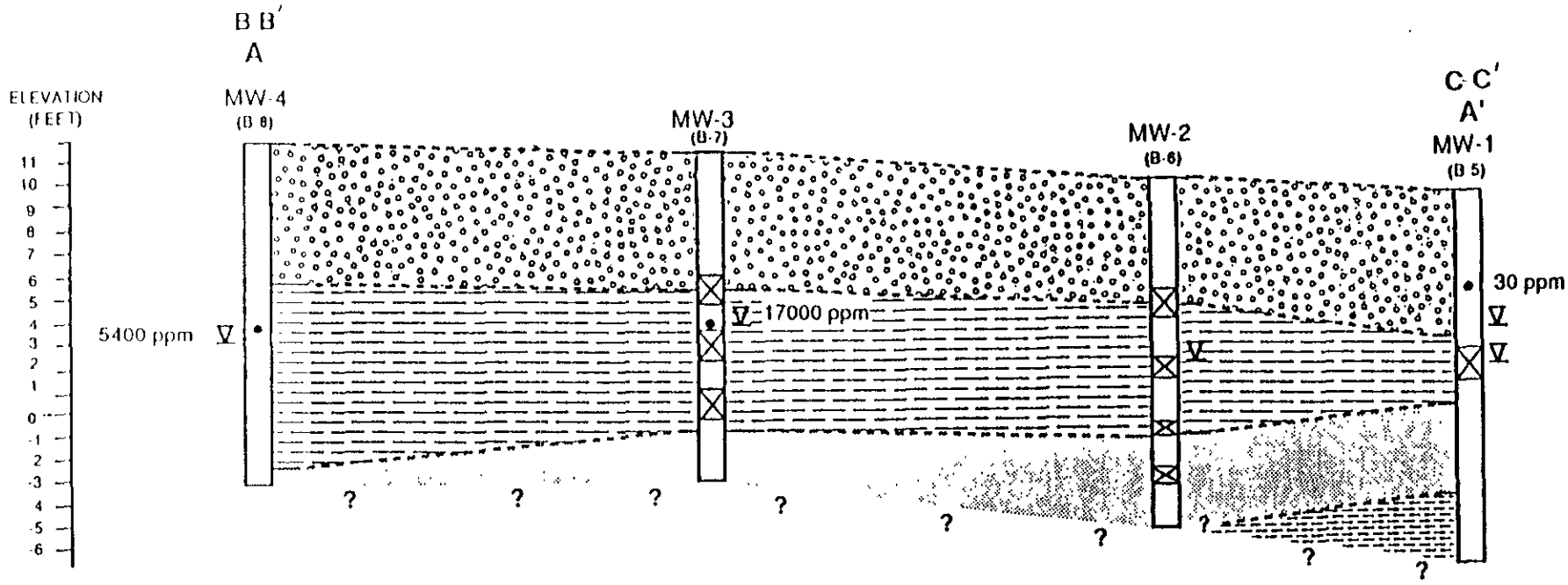


FIGURE 3: CROSS SECTION A-A' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 30 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

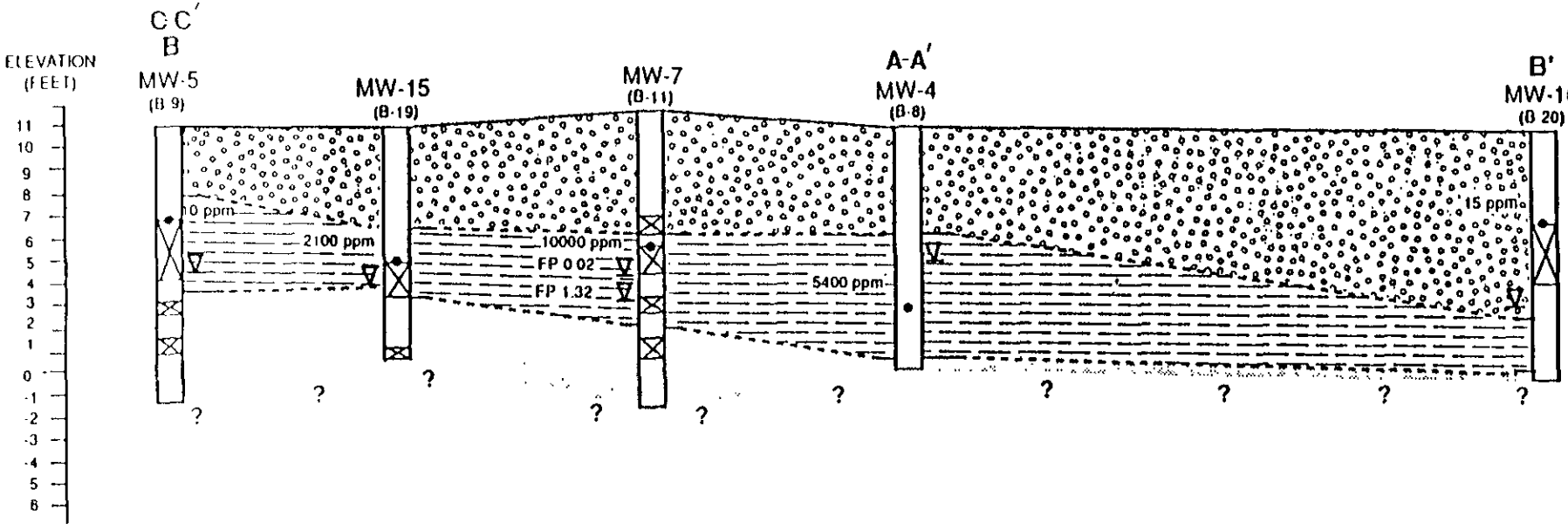


FIGURE 4: CROSS SECTION B-B' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Fluid Level Measurement
- Sample Location
- 5400 ppm
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

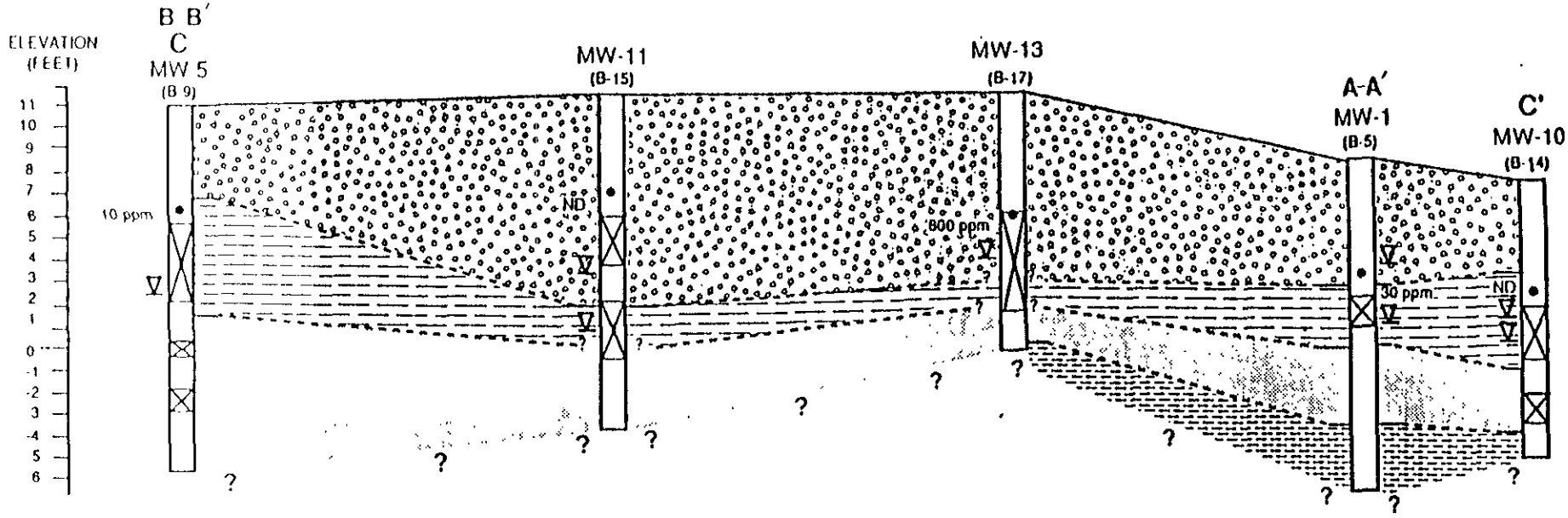


FIGURE 5: CROSS SECTION C-C'
SHOWING SUBSURFACE
STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments.
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 5400 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

16015K

Chain of Custody Form

Curtis & Tompkins, Ltd
2323 Fifth Street
Berkeley, California 94710
(415) 486 0900

Samplers K.G.

Job Description PIE - Emeryville

Job Number CYTO

Client Contact R. VonWaden

Recorder R.v.w/K.G.

Matrix: Water	Soil	Waste	Oil	# containers	Method Preserved: H_2SO_4	HNO_3	Ice	None	Other	Sample Number	Sampling Date: Yr	Mo	Dy	Time	SAMPLE NOTES
X								X		IS-1.09	90	04	10	1615	South branch influent
X								X		E-1.10	90	04	10	1615	Effluent to 2 gpm

ANALYSIS REQUESTED

EPA 601/8010	EPA 602/8020	EPA 624/8240	EPA 625/8270	Title 22 Metals	EPA PP Metals (+	EPA Method - TEH	Benzene-Toluene-Xylenes	Oil and Grease	EPA 608/8080 Pesticides + PCB's
						X	X		
						X	X		

Laboratory Notes :

Normal turnaround

Chain of Custody Record

Relinquished by: (signature) Date/Hr	Received by (signature)
R.VonWaden 4/10/90 455	
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Dispatched by: (signature) Date/Hr	Received for lab by (signature) 4/10/90

16:5K

Curtis & Tompkins, Ltd., Analytical Laboratories. Since 1878
2323 Fifth Street. Berkeley, CA 94710. Phone (415) 486-0900

DATE RECEIVED: 04/10/90
DATE REPORTED: 04/20/90

LAB NUMBER: 100150

CLIENT: CYTO CULTURE INTERNATIONAL

REPORT ON: 2 WATER SAMPLES

PROJECT ID: PIE EMERYVILLE

RESULTS: SEE ATTACHED

QA/QC Approval

Final Approval

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 100150
CLIENT: CYTO CULTURE INTERNATIONAL
PROJECT ID: PIE EMERYVILLE

DATE RECEIVED: 04/10/90
DATE EXTRACTED: 04/11/90
DATE ANALYZED: 04/18/90
DATE REPORTED: 04/20/90

Extractable Petroleum Hydrocarbons in Aqueous Solutions
California DOHS Method
LUFT Manual October 1989

LAB ID	CLIENT ID	KEROSENE RANGE (mg/L)	DIESEL RANGE (mg/L)	REPORTING LIMIT (mg/L)
100150-1	IS-109	ND	26	0.50
100150-2	E-110	ND	ND	0.50

ND = Not detected at or above reporting limit.

QA/QC SUMMARY

RPD, %	8
RECOVERY, %	102

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 100150
CLIENT: CYTO CULTURE INTERNATIONAL
PROJECT ID: PIE EMERYVILLE

DATE RECEIVED: 04/10/90
DATE ANALYZED: 04/12/90
DATE REPORTED: 04/20/90

Benzene, Toluene, Ethyl Benzene, Xylenes by EPA 8020
Extraction by EPA 5030 Purge and Trap

LAB ID	CLIENT ID	BENZENE (ug/L)	TOLUENE (ug/L)	TOTAL XYLENES (ug/L)	ETHYL BENZENE (ug/L)	REPORTING LIMIT * (ug/L)
100150-1	IS-109	ND	ND	ND	ND	1.0
100150-2	E-110	ND	ND	ND	ND	1.0

ND = Not detected at or above reporting limit.

* Reporting Limit applies to all analytes.

QA/QC SUMMARY

RPD, %	1
RECOVERY, %	89

Curtis & Tompkins, Ltd
2323 Fifth Street
Berkeley, California 94710
(415) 486 0900

Chain of Custody Form

Samplers KG

Job Description PIE

Job Number

Client Contact CYTOCULTURE

Recorder PG

Matrix: Water	Matrix: Soil	Matrix: Waste	Matrix: Oil	# Containers	Method Preserved: H_2SO_4	Method Preserved: HNO_3	Method Preserved: Ice	Method Preserved: None	Method Preserved: Other	Sample Number	Sampling Date: Yr	Mo	Dy	Time	SAMPLE NOTES
X										I-111	90	04	23		influent
X										E-112	90	04	23		effluent

ANALYSIS REQUESTED	EPA 601/8010	EPA 602/8020	EPA 624/8240	EPA 625/8270	Title 22 Metals (*)	EPA pp Metals (*)	EPA Method-TPH	Benzene-Toluene-Xylene(s)	Oil and Grease	EPA 608/8080 Pesticides & PCB's
							X	X		
							X	X		

Laboratory Notes :

1 week normal turnaround

Chain of Custody Record

Relinquished by: (signature) Date/Hr	Received by (signature)
Peter Creed 4/24/90	
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Dispatched by: (signature) Date/Hr	Received for Lab by (signature) Norma Poirier 4/24/90

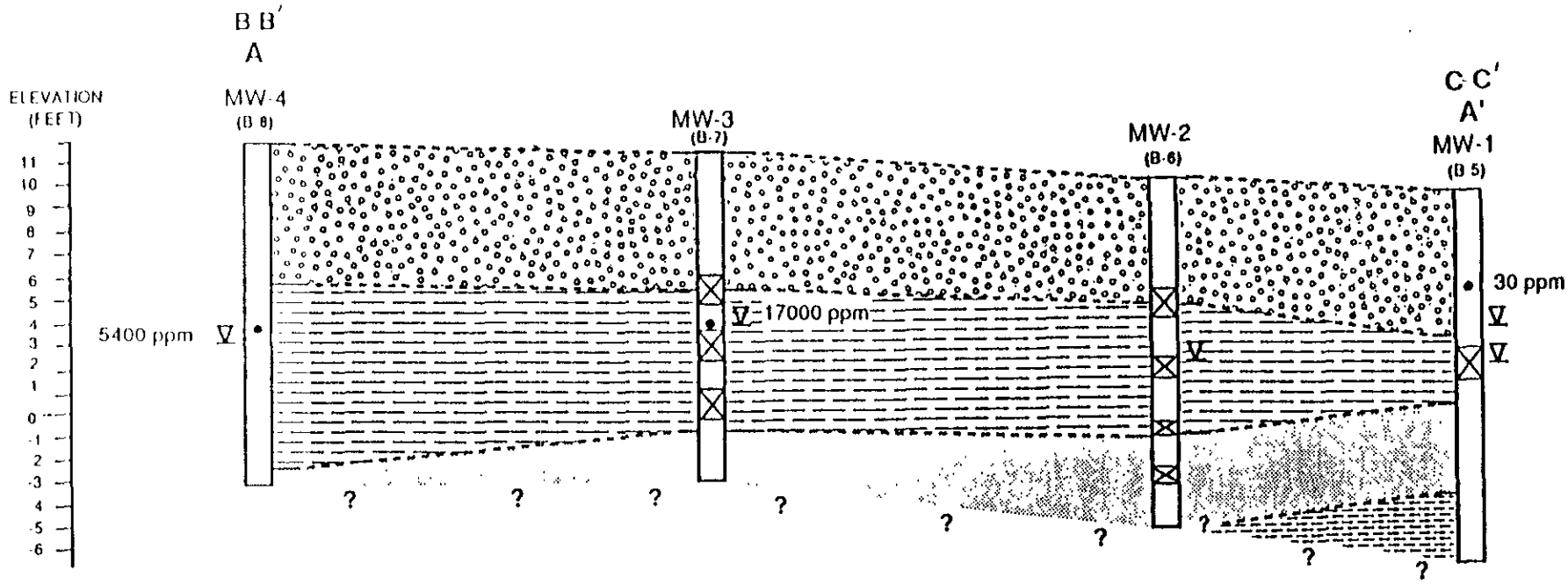


FIGURE 3: CROSS SECTION A-A' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 30 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

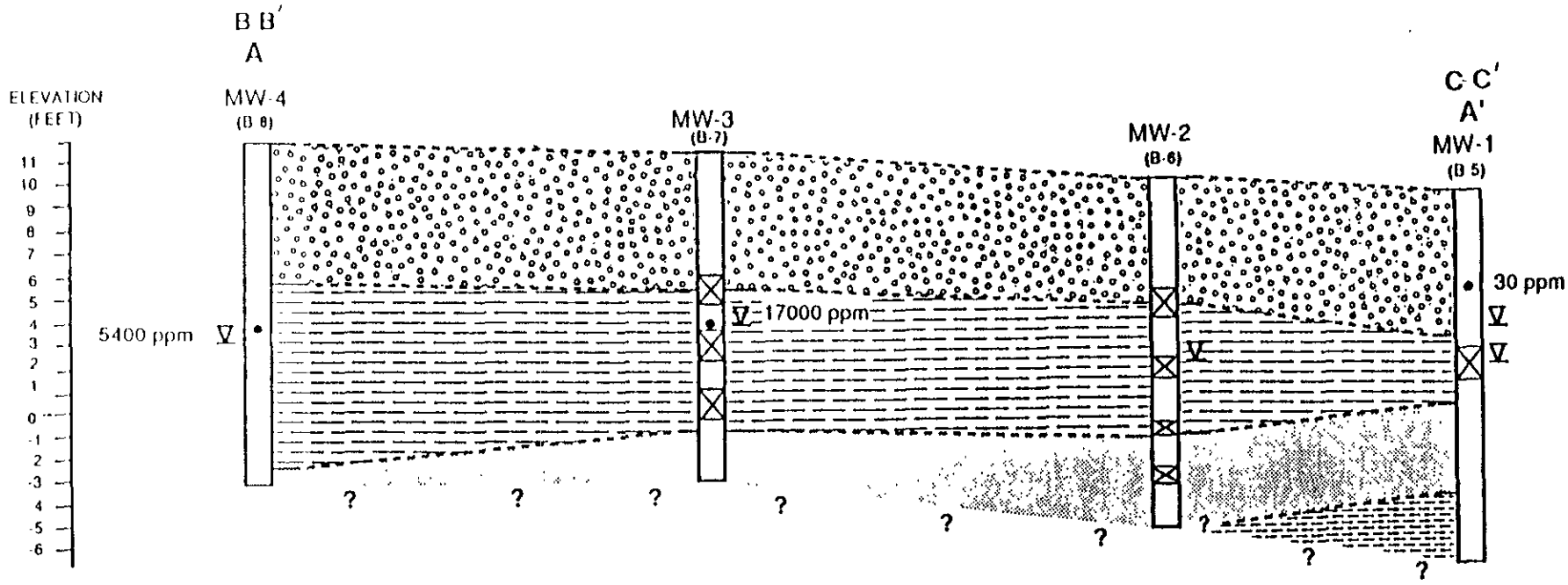


FIGURE 3: CROSS SECTION A-A' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 30 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

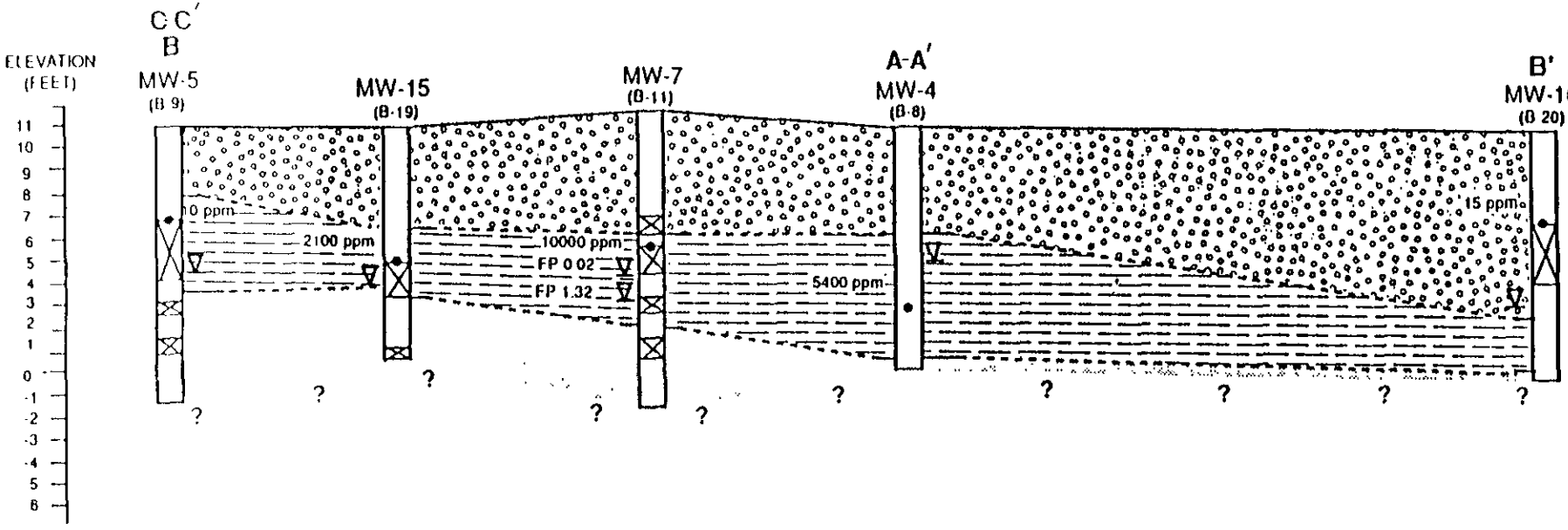


FIGURE 4: CROSS SECTION B-B' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Fluid Level Measurement
- Sample Location
- 5400 ppm
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

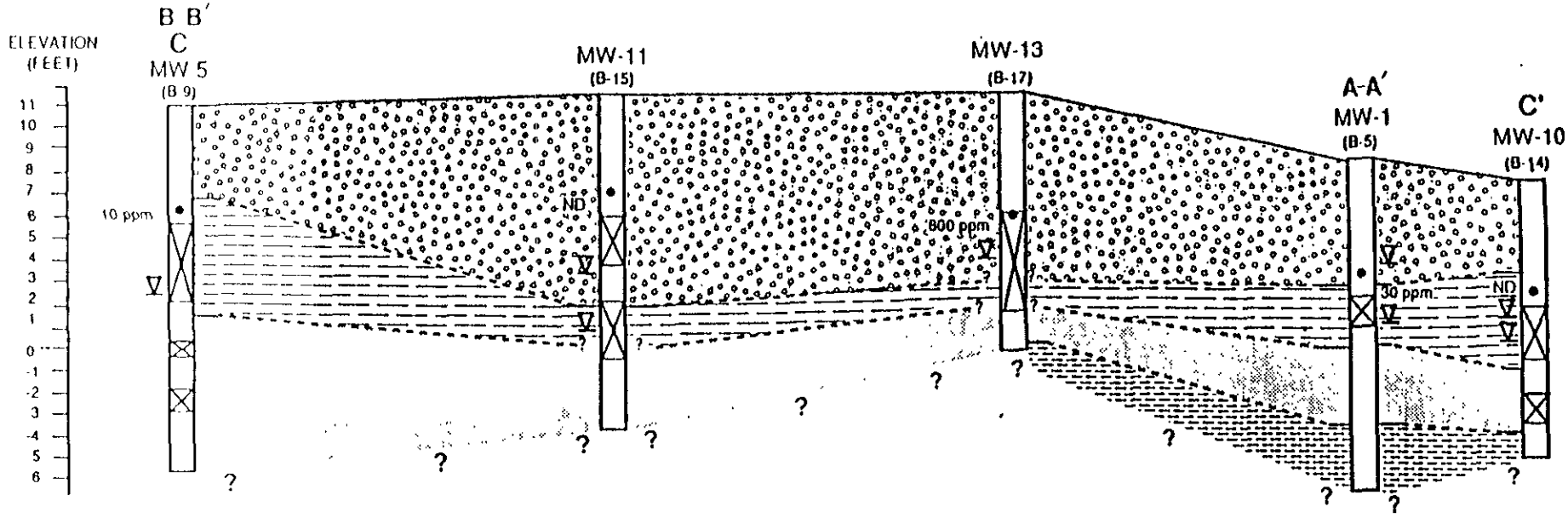


FIGURE 5: CROSS SECTION C-C'
SHOWING SUBSURFACE
STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments.
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 5400 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

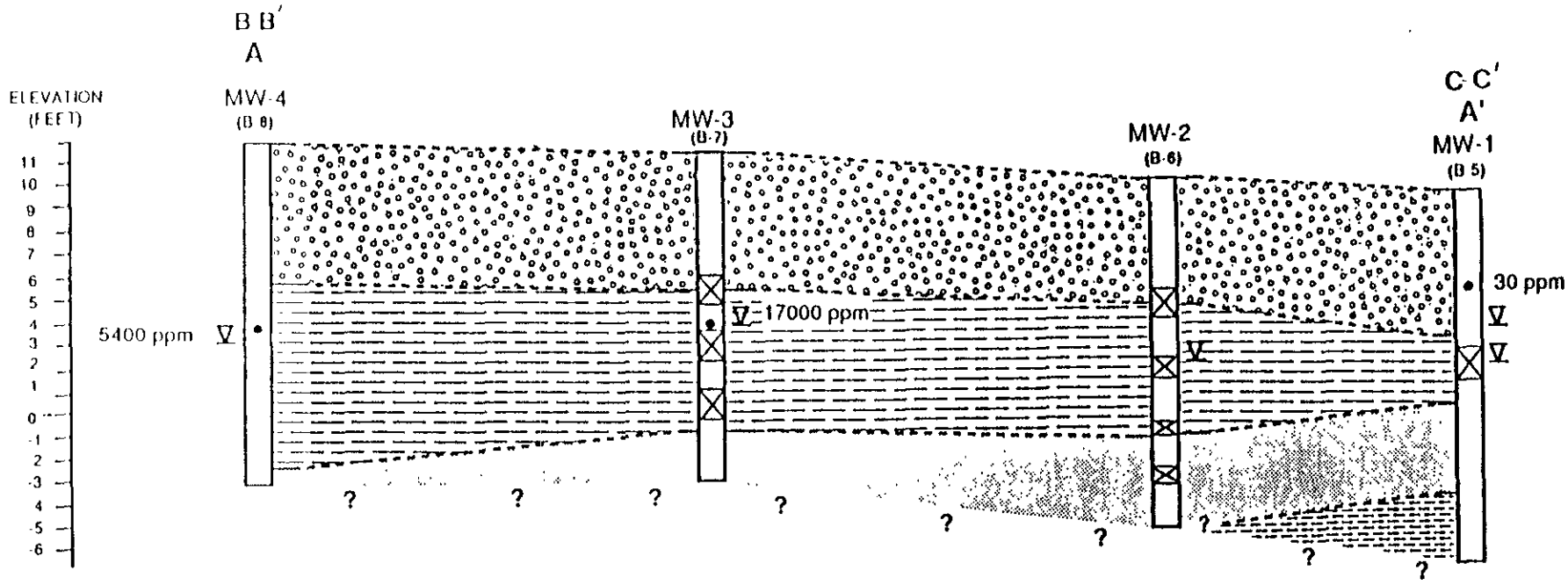


FIGURE 3: CROSS SECTION A-A' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 30 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

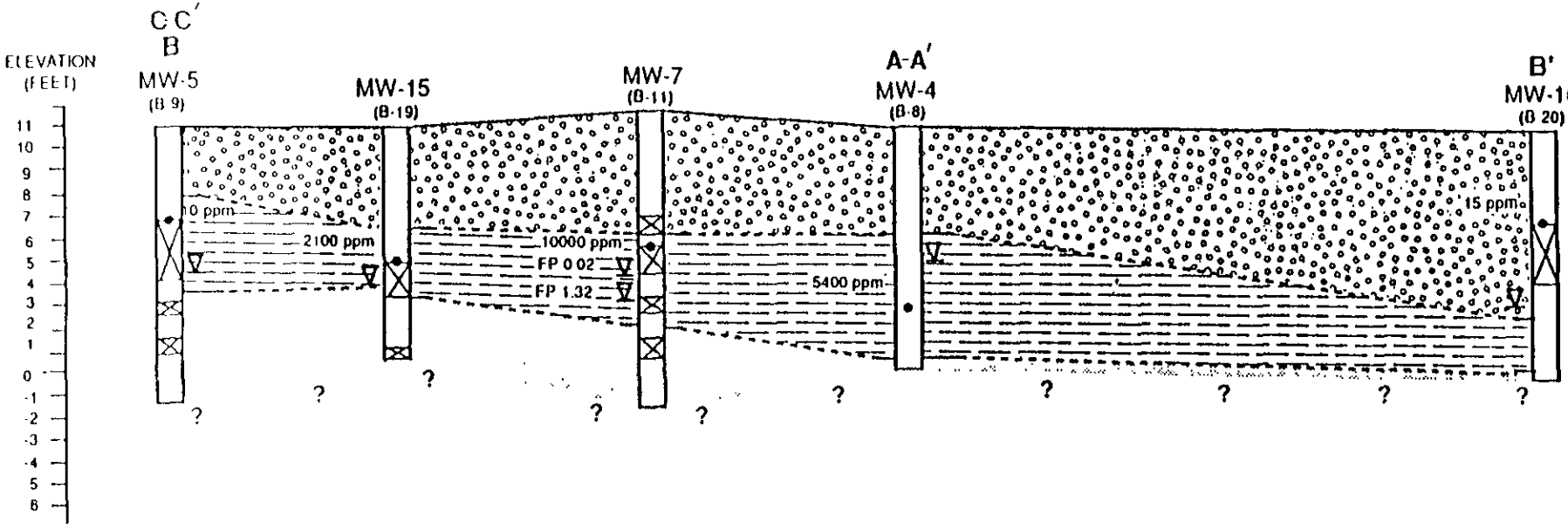


FIGURE 4: CROSS SECTION B-B' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Fluid Level Measurement
- Sample Location
- 5400 ppm
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

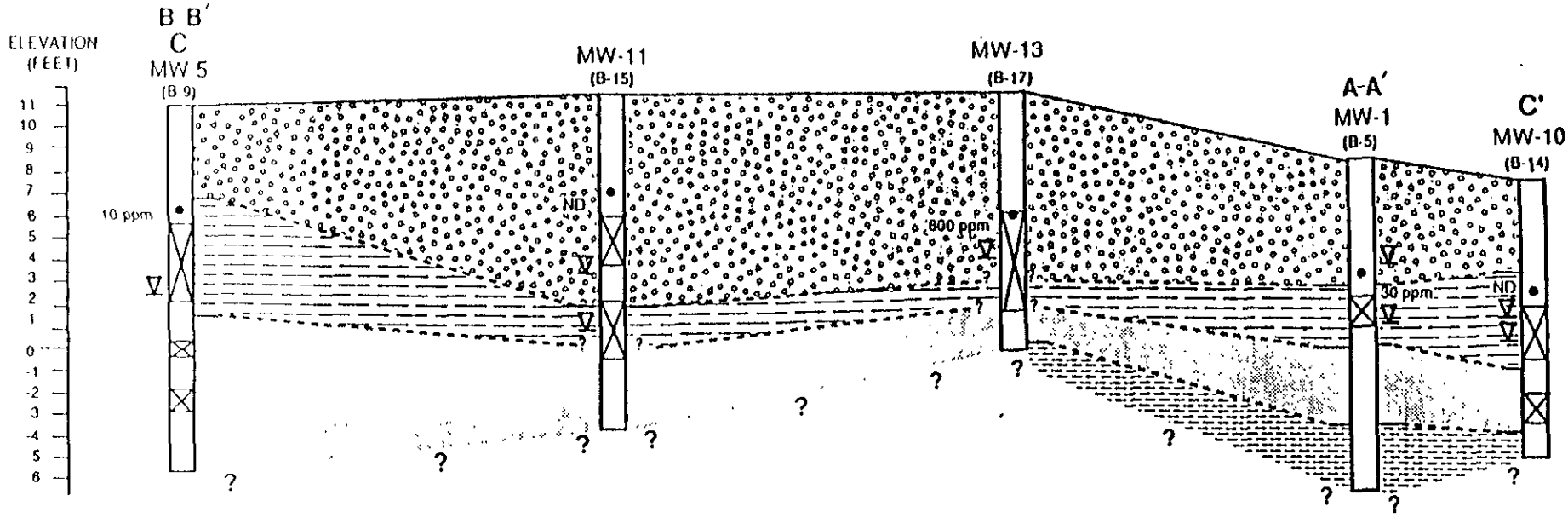


FIGURE 5: CROSS SECTION C-C'
SHOWING SUBSURFACE
STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments.
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 5400 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

16015K

Chain of Custody Form

Curtis & Tompkins, Ltd
2323 Fifth Street
Berkeley, California 94710
(415) 486 0900

Samplers K.G.

Job Description PIE - Emeryville

Job Number CYTO

Client Contact R. VonWaden

Recorder R.v.w/K.G.

Matrix: Water	Soil	Waste	Oil	# containers	Method Preserved: H_2SO_4	HNO_3	Ice	None	Other	Sample Number	Sampling Date: Yr	Mo	Dy	Time	SAMPLE NOTES
X								X		IS-1.09	90	04	10	1615	South branch influent
X								X		E-1.10	90	04	10	1615	Effluent to 2 gpm

ANALYSIS REQUESTED

EPA 601/8010	EPA 602/8020	EPA 624/8240	EPA 625/8270	Title 22 Metals	EPA PP Metals (+	EPA Method - TEH	Benzene-Toluene-Xylenes	Oil and Grease	EPA 608/8080 Pesticides + PCB's
						X	X		
						X	X		

Laboratory Notes :

Normal turnaround

Chain of Custody Record

Relinquished by: (signature) Date/Hr	Received by (signature)
R.VonWaden 4/10/90 455	
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Dispatched by: (signature) Date/Hr	Received for lab by (signature) 4/10/90

16:5K

Curtis & Tompkins, Ltd
2323 Fifth Street
Berkeley, California 94710
(415) 486 0900

Chain of Custody Form

Samplers KG

Job Description PIE

Job Number

Client Contact CYTOCULTURE

Recorder PG

Matrix: Water	Matrix: Soil	Matrix: Waste	Matrix: Oil	# Containers	Method Preserved: H_2SO_4	Method Preserved: HNO_3	Method Preserved: Ice	Method Preserved: None	Method Preserved: Other	Sample Number	Sampling Date: Yr	Mo	Dy	Time	SAMPLE NOTES
X										I-111	90	04	23		influent
X										E-112	90	04	23		effluent

ANALYSIS REQUESTED	EPA 601/8010	EPA 602/8020	EPA 624/8240	EPA 625/8270	Title 22 Metals (*)	EPA pp Metals (*)	EPA Method-TPH	Benzene-Toluene-Xylene(s)	Oil and Grease	EPA 608/8080 Pesticides & PCB's
							X	X		
							X	X		

Laboratory Notes :

1 week normal turnaround

Chain of Custody Record

Relinquished by: (signature) Date/Hr	Received by (signature)
Peter Creed 4/24/90	
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Dispatched by: (signature) Date/Hr	Received for Lab by (signature) Norma Poirier 4/24/90

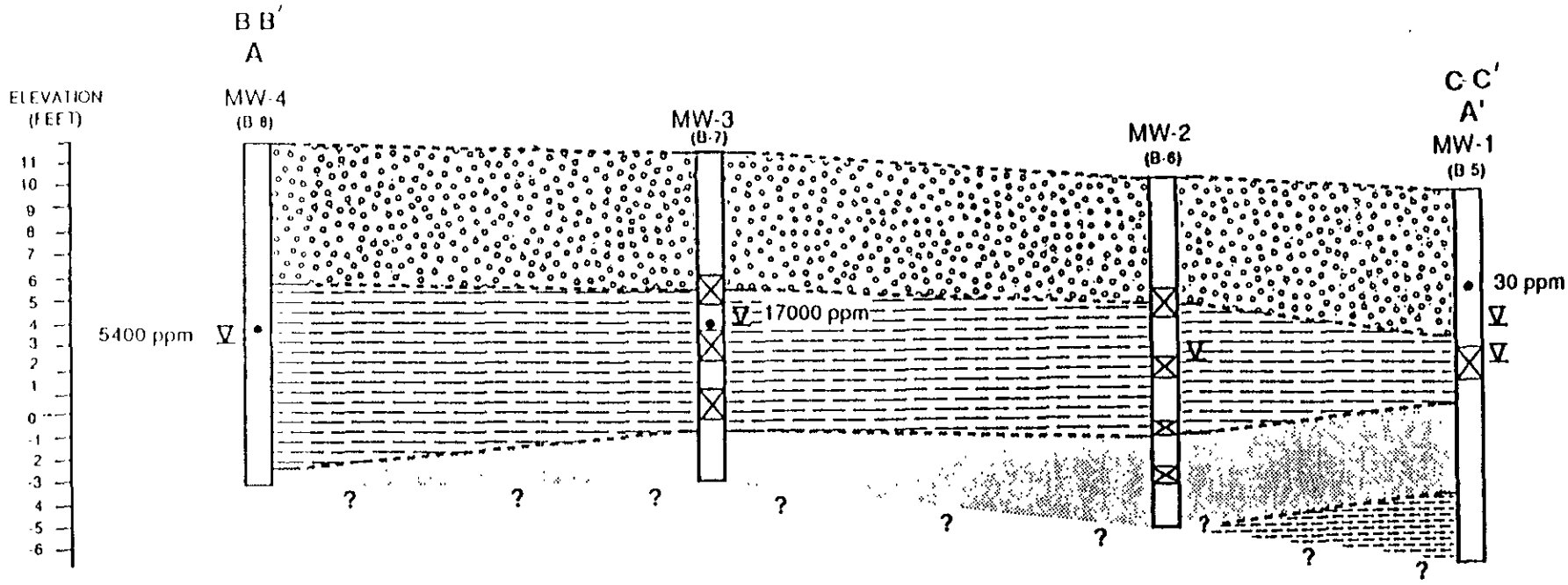


FIGURE 3: CROSS SECTION A-A' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 30 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

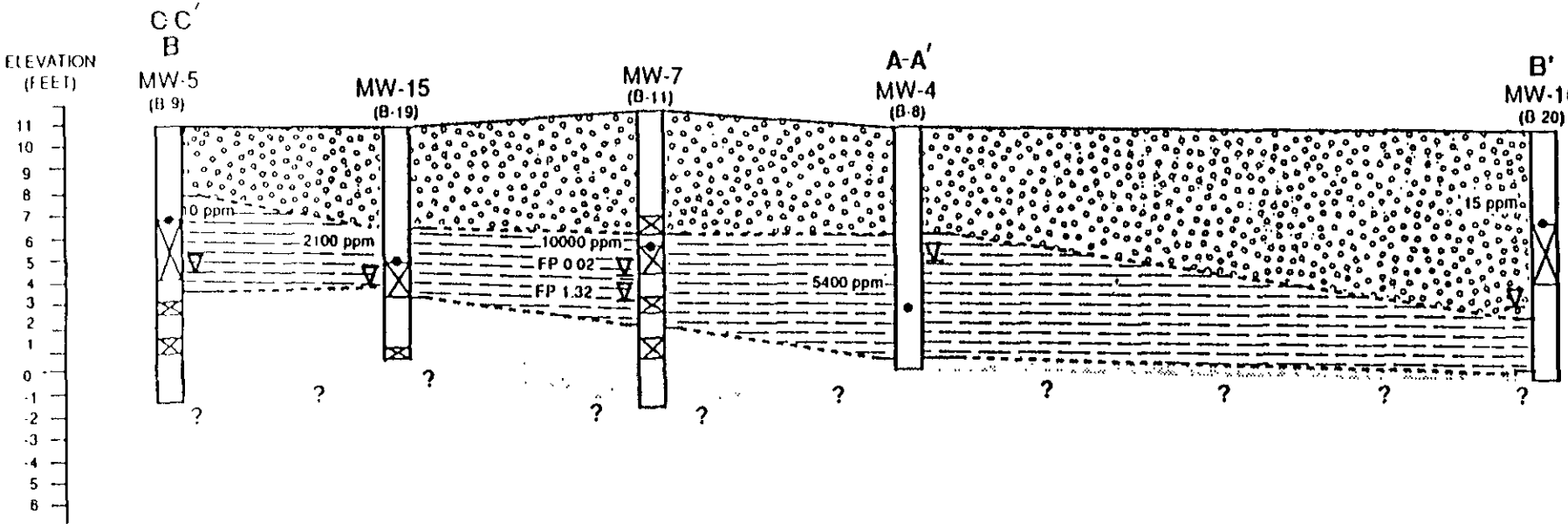


FIGURE 4: CROSS SECTION B-B' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Fluid Level Measurement
- Sample Location
- 5400 ppm
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

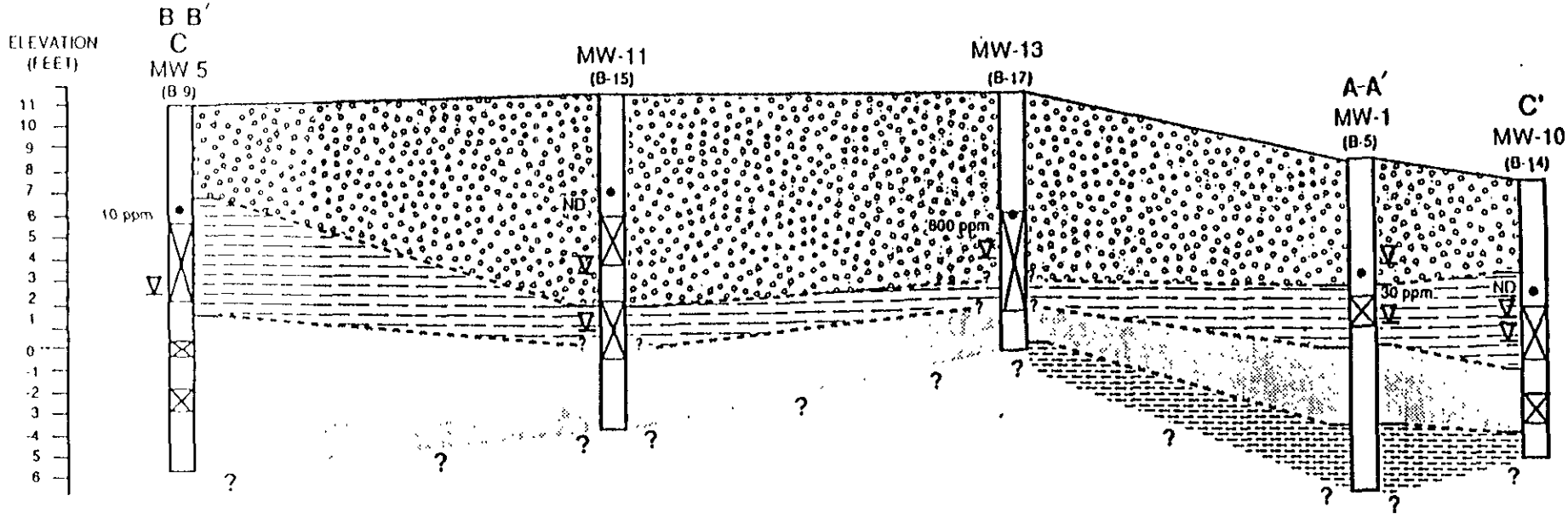


FIGURE 5: CROSS SECTION C-C'
SHOWING SUBSURFACE
STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments.
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 5400 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

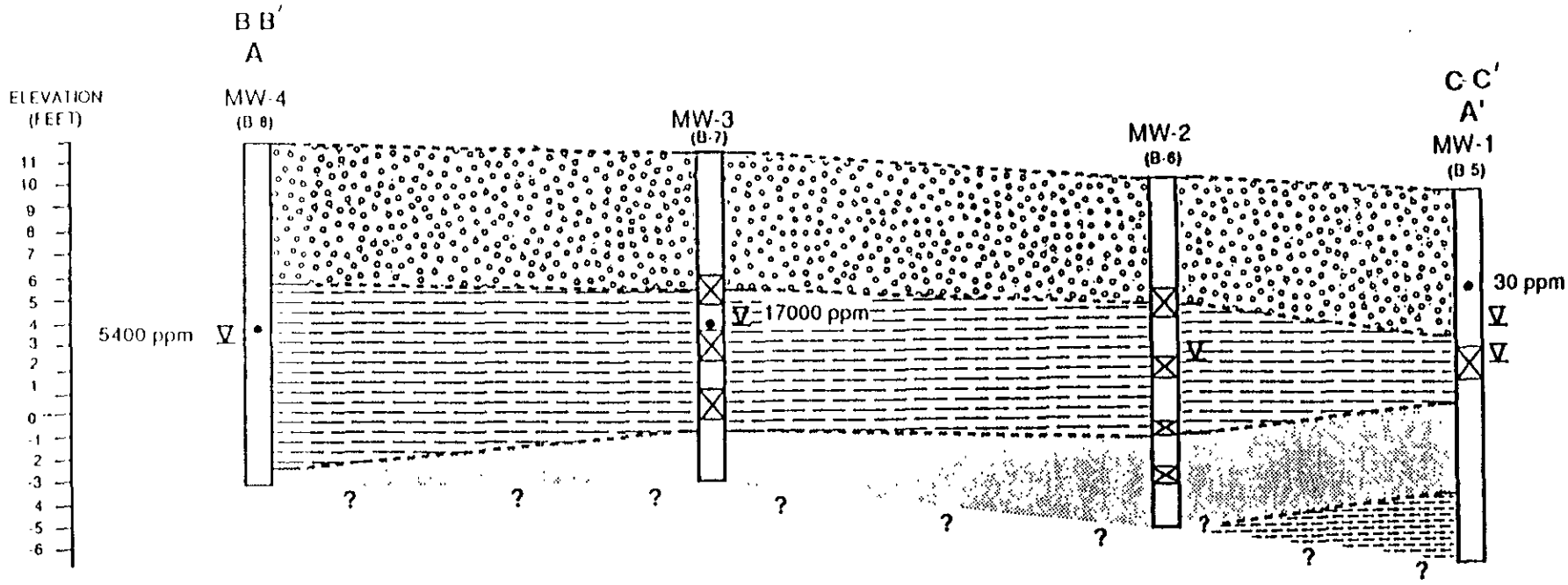


FIGURE 3: CROSS SECTION A-A' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 30 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

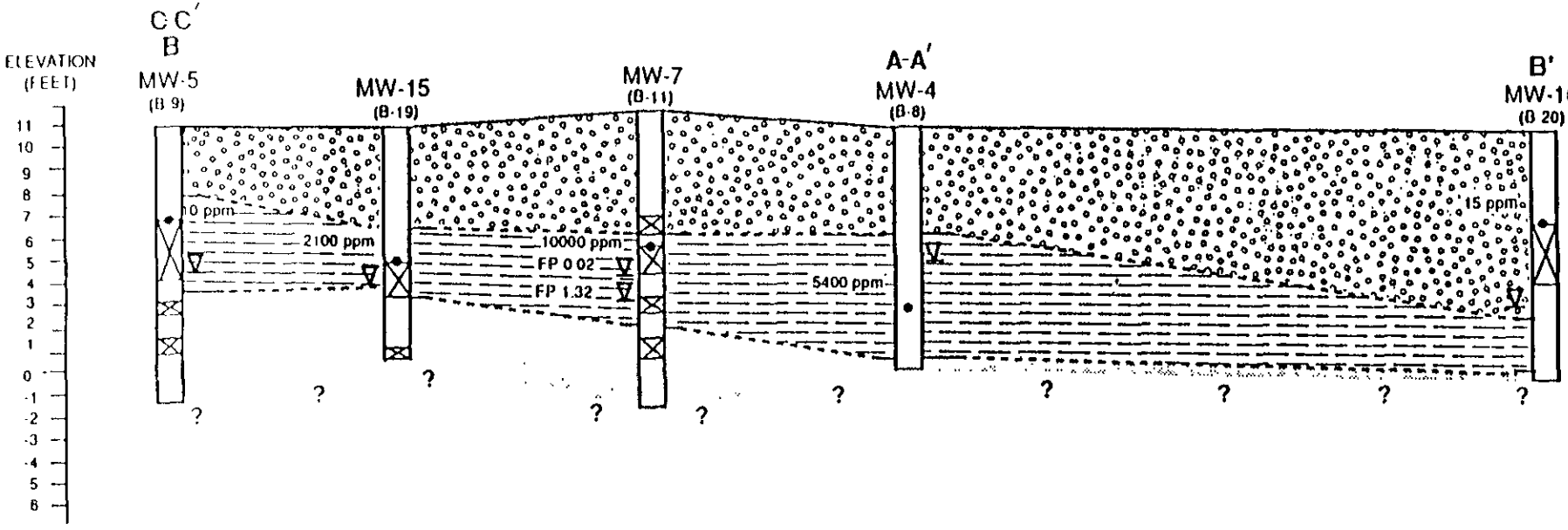


FIGURE 4: CROSS SECTION B-B' SHOWING SUBSURFACE STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Fluid Level Measurement
- Sample Location
- 5400 ppm
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

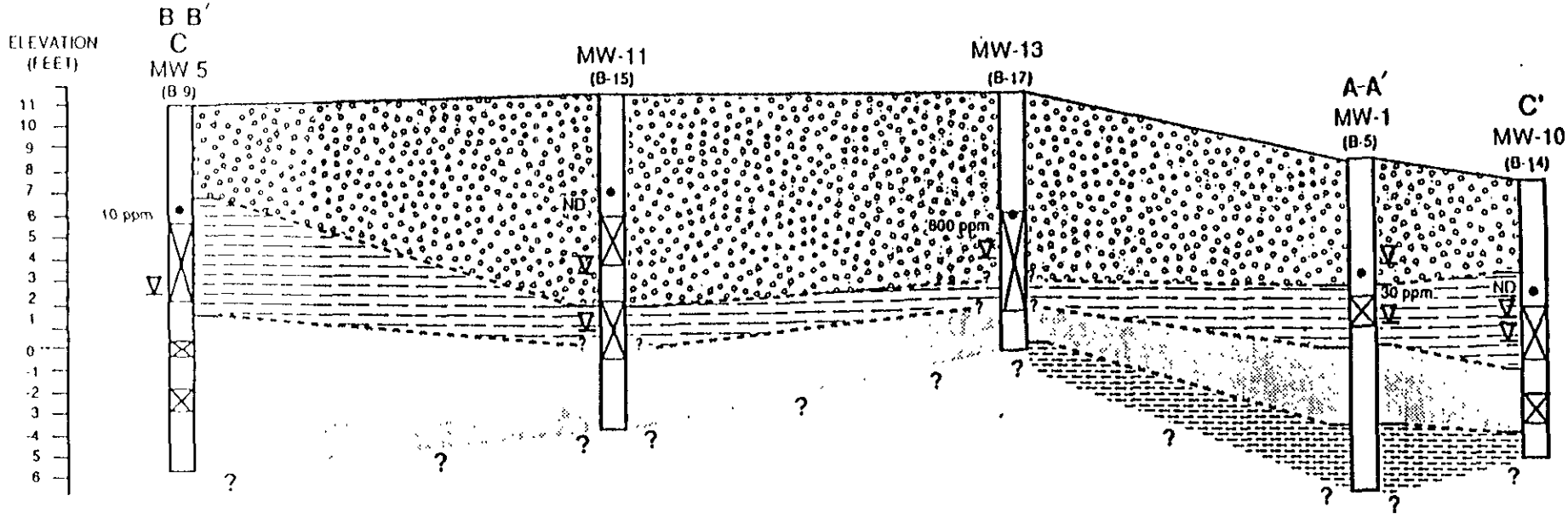


FIGURE 5: CROSS SECTION C-C'
SHOWING SUBSURFACE
STRATIGRAPHY

P.I.E. Nationwide
5500 Eastshore Freeway
Emeryville, California

NOTE Fluid levels are tidally influenced.
See Appendix C for fluid level monitoring data.

Scale(Feet)
0 50 100

LEGEND

- Artificial Fill
- Black Bay Mud Sediments.
- Olive Gray / Dusky Green Sands, Silts, and Clays
- Light Brown and Light Olive Gray Silty and Sandy Clays
- Fluid Level Measurement
- 5400 ppm • Sample Location
- No Sample

ALTON GEOSCIENCE
16510 ASTON ST.
IRVINE, CA 92714

Curtis & Tompkins, Ltd
2323 Fifth Street
Berkeley, California 94710
(415) 486 0900

Chain of Custody Form

Samplers KG

Job Description PIE

Job Number

Client Contact CYTOCULTURE

Recorder PG

Matrix: Water	Matrix: Soil	Matrix: Waste	Matrix: Oil	# Containers	Method Preserved: H_2SO_4	Method Preserved: HNO_3	Method Preserved: Ice	Method Preserved: None	Method Preserved: Other	Sample Number	Sampling Date: Yr	Mo	Dy	Time	SAMPLE NOTES
X										I-111	90	04	23		influent
X										E-112	90	04	23		effluent

ANALYSIS REQUESTED	EPA 601/8010	EPA 602/8020	EPA 624/8240	EPA 625/8270	Title 22 Metals (*)	EPA pp Metals (*)	EPA Method-TPH	Benzene-Toluene-Xylene(s)	Oil and Grease	EPA 608/8080 Pesticides & PCB's
							X	X		
							X	X		

Laboratory Notes :

1 week normal turnaround

Chain of Custody Record

Relinquished by: (signature) Date/Hr	Received by (signature)
Peter Creed 4/24/90	
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Relinquished by: (signature) Date/Hr	Received by (signature)
Dispatched by: (signature) Date/Hr	Received for Lab by (signature) Norma Poirier 4/24/90

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (415) 486-0900

DATE RECEIVED: 04/24/90
DATE REPORTED: 05/02/90

LAB NUMBER: 100262

CLIENT: CYTO CULTURE INTERNATIONAL

REPORT ON: 2 WATER SAMPLES

PROJECT ID: PIE EMERYVILLE

RESULTS: SEE ATTACHED

QA/QC Approval

Final Approval

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 100262
CLIENT: CYTO CULTURE INTERNATIONAL
PROJECT: PIE EMERYVILLE

DATE RECEIVED: 04/24/90
DATE EXTRACTED: 04/30/90
DATE ANALYZED: 04/30/90
DATE REPORTED: 05/02/90

Extractable Petroleum Hydrocarbons in Aqueous Solutions
California DOHS Method
LUFT Manual October 1989

LAB ID	CLIENT ID	GASOLINE RANGE (mg/L)	KEROSENE RANGE (mg/L)	DIESEL RANGE (mg/L)	REPORTING LIMIT (mg/L)
100262-1	I-111	ND	ND	ND	0.50
100262-2	E-112	ND	ND	ND	0.50

ND = Not detected at or above reporting limit.

QA/QC SUMMARY

RPD, %	17
RECOVERY, %	103

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 100262
CLIENT: CYTO CULTURE INTERNATIONAL
PROJECT: PIE EMERYVILLE

DATE RECEIVED: 04/24/90
DATE ANALYZED: 04/24/90
DATE REPORTED: 05/02/90

Benzene, Toluene, Ethyl Benzene, Xylenes by EPA 8020
Extraction by EPA 5030 Purge and Trap

LAB ID	CLIENT ID	BENZENE (ug/L)	TOLUENE (ug/L)	TOTAL XYLENES (ug/L)	ETHYL BENZENE (ug/L)	REPORTING LIMIT * (ug/L)
100262-1	I-111	ND	ND	ND	ND	1.0
100262-2	E-112	ND	ND	ND	ND	1.0

ND = Not detected at or above reporting limit.

* Reporting Limit applies to all analytes.

QA/QC SUMMARY

RPD, %	1
RECOVERY, %	90

Cyto Culture
ENVIRONMENTAL
BIOTECHNOLOGY
A Division of Cyto Culture International Inc

August 24, 1990

John Ster, Sylvia Lee
Office of Properties and Real Estate
P.I.E. NATIONWIDE, INC.
P.O. Box 2408
Jacksonville, FL 32203 FAX 904-798-2303

RE: Emeryville Former Truck Terminal Bioremediation Project

Dear Mr. Ster and Ms. Lee:

We are increasingly concerned about the reports of accumulating diesel fuel on the former Emeryville terminal property and adjacent land to the south. We were contacted by The Martin Group Properties last week and their geotechnical consulting group, Pacific Environmental Services, to explain why we were no longer treating the groundwater at the site which they continue to believe to be the source of petroleum hydrocarbon contamination on their property. Apparently, the Martin Group have received permits to build the new Marriott Hotel on the site immediately south of the former P.I.E. property and they are now poised to begin construction.

Understandably, the Martin Group expressed their concern that we were no longer capturing the migrating product along the boundary with their property; we immediately called Blymyer & Sons to report both calls. Pacific Environmental Services told us they had measured over a foot of diesel product at our MW-7 (along the freeway) and several inches of product in our MW-3 (along the south boundary) and their MW-1 (directly south of our trench along the south boundary). Their reports will be submitted to the Department of Health Services, the Regional Water Quality Control Board and the Alameda County Department of Public Health.

Taken together these findings and actions underscore the urgency to get our groundwater bioremediation system operational again. Our existing trenches have been intercepting plumes of diesel migrating south towards the new Marriott Hotel site and west towards the Bay. The regulatory agencies involved are aware that we are "temporarily" shut down for an annual overhaul, but we have not stressed the fact that we are not able to start up until our overdue invoices are paid.

[illegible] WASHINGTON AVENUE POINT RICHMOND CA 94801
[illegible]

As for addressing the reports of free product, our current system has removed over 800 gallons of product from the two existing 65 foot extraction trenches. The proposed expansion of this project, submitted in January, calls for additional trenching which would more than double the barrier for capturing product and contaminated groundwater migrating south or west, including the areas around MW-3 and MW-7 which continue to have significant free product. Along with this expansion, we had also proposed a site assessment of the current contamination and a modelling of our proposed in situ work, both of which are long overdue.

CytoCulture is therefore urging P.I.E. Nationwide to pay all past due invoices (December 199, March-May, 1990) so that we may begin continuous groundwater treatment again.

There will be a charge for starting up the system after 3 months of no treatment, and we will need to recycle the 400 gallons of straight product which were collected by the oil-water separators prior to our work stoppage at the end of May. CytoCulture will also have to purchase bacterial cultures from Sybron (we had avoided these additional charges by using surplus cultures from 1989 for treatment in Jan-May 1990).

Please respond by Friday, August 31 in writing indicating a new payment schedule that will allow us to get back on track and begin treating groundwater as soon as possible. If we have not received additional payments by the 31st, we will finally be forced to report these circumstances to the local, state and federal regulatory agencies. Once reported as an inoperative treatment system, the site will be subject to mandatory clean-up procedures. Since the information will then be in the public domain, the Martin Group and the Marriott Hotel developers will have full access to all documents pertaining to site clean-up.

We urge you to take immediate action to correct this potentially serious confrontation with regulatory agencies and adjacent property owners by making substantial payments on these overdue invoices. We would much prefer to address their concerns by resuming and expanding our bioremediation program.

Thank you for responding to these requests in a timely fashion.

Sincerely,

Randall J. von Wedel

Randall J. von Wedel, Ph.D.
President

BLYMYER
ENGINEERS, INC.

September 5, 1990
BEI Job No. 8648

Mr. Randall J. von Wedel
Cyto Culture Environmental
Biotechnology
124 Washington Avenue
Point Richmond, CA 94801

SUBJECT: SITE REMEDIATION
5500 EASTSHORE HIGHWAY
EMERYVILLE, CALIFORNIA

Dear Randall:

Blymyer Engineers has stopped work on the subject job. Please refer all correspondence and invoicing to:

Ms. Sylvia Lee
P.I.E. NATIONWIDE
Box 2408
Jacksonville, FL 32203

All questions concerning management of the subject project should be referred to Ms. Lee.

If you have any questions, please call.

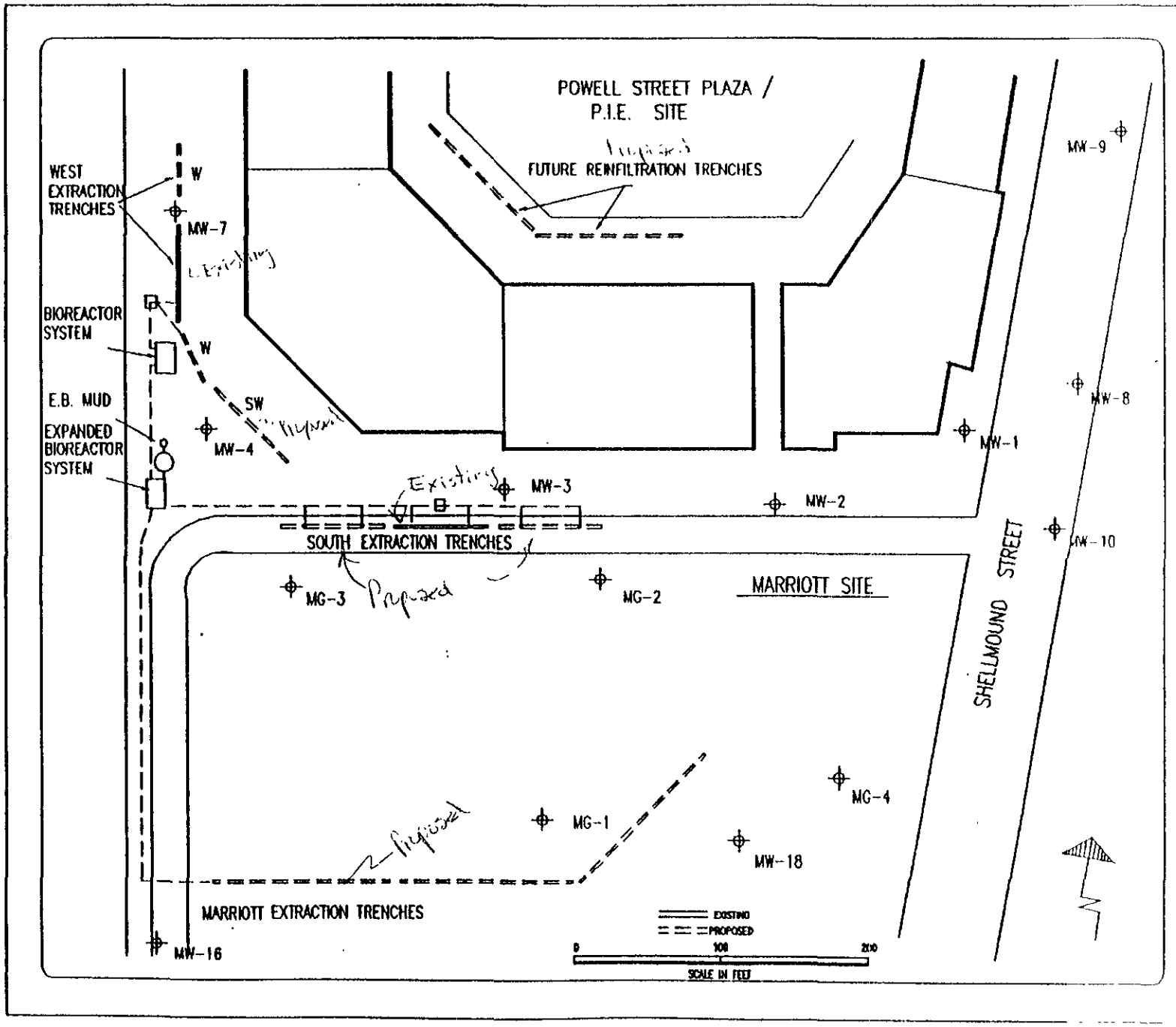
Cordially yours,

BLYMYER ENGINEERS, INC.

James C. Falbo
Manager, Environmental Planning
& Assessment

JCF/ds

cc: Ms. Sylvia Lee



CYTO CULTURE
BIOREMEDIATION

SITE PLAN

THE MARTIN GROUP/ P.I.E. NATIONWIDE INC
EMERYVILLE, CA

SCALE 1"=40'

PIE/MAR
1.
9-28-90