940

ERM EnviroClean-West

1777 Botelho Drive
Suite 200
Walnut Creek, CA 94596
(510) 256-6468
(510) 946-9968 (Fax)

July 12, 1993

Ms. Jennifer Eberle
Hazardous Materials Specialist
Alameda County Hazardous Materials Department
80 Swan Way, Room 350
Oakland, CA 94621

ERM

SUBJECT: Submittal of Workplan for Dongary Investments Site

Dear Ms. Eberle:

On behalf of Dongary Investments, Ltd. (Dongary), ERM EnviroClean-West, Inc. (EnviroClean) is pleased to submit the attached Workplan for a site remediation to be performed at the Dongary site located at 2225 7th Street in Oakland, California. This workplan presents:

- A brief site background;
- Addresses site description;
- A description of the completed work;
- A description of the proposed work; and
- A schedule for completing the proposed work.

Please feel free to contact me at (510) 946-0455 regarding the proposed work and/or workplan.

Sincerely,

ERM ENVIROCLEAN-WEST, INC.

Robert A. Katin, PE, REA
Project Manager

John R. Prall, RG
Senior Geologist

RAK/9152

Enclosure: Workplan for Dongary Site
cc: Mr. Richard C. Hiett, RWQCB - w/enclosure
Mr. Donald W. Ringsby, Dongary Investments - w/4 copies of enclosure

REMEDIATION DONGARY INVESTMENTS, LTD. FACILITY OAKLAND, CALIFORNIA

In response to a request from the Alameda County Hazardous Materials Department (County), ERM EnviroClean-West, Inc. (EnviroClean) is submitting this workplan to perform remediation at the Dongary Investments, Ltd. (Dongary) facility located at 2225 7th Street in Oakland, California (the property is hereinafter referred to as "the site").

This workplan: describes the site layout; references the site characterization; includes site hydrology modeling and assessment and laboratory bench scale testing; presents the proposed site remediation; and provides a general work schedule.

Background

The property is owned by the Port of Oakland, leased to Dongary, who in turn sublease the property to ANR Freight, NW Transport Service, Inc., and Sealand Services, Inc. The site had a total of nine underground storage tanks (USTs): seven bulk diesel USTs, one bulk oil UST, and one waste oil tank. During the summer of 1989, one of the 20,000-gallon diesel tanks failed a leak detection test. Bore holes were placed around the eight remaining tanks and samples of the soil and water were collected and analyzed. Contamination was detected and in March 1990, the one leaking diesel tank was removed. Soil samples were collected and hydrocarbon contamination was found below the former diesel tank. The contaminated soil was excavated, disposed of offsite, and the excavation was backfilled. A report summarizing the soil borings and tank removal was forwarded to the County on June 7, 1991.

On July 27, 1992, six additional diesel tanks and one bulk oil tank were removed. At this date, all seven bulk diesel USTs and the single bulk oil UST have been removed. The removed tanks were inspected, and no holes or indications of leakage were noted in the six diesel tanks; one hole was observed in the bulk oil tank. On August 18, 1992, the remaining 2,000-gallon waste oil tank was removed; no holes or indications of leakage were noted in the single waste oil tank.

Dongary determined the extent and nature of chemical contamination in soil and ground water was a result of leakage from USTs on the site. A report summarizing the soil borings, tank removals, and site characterization was forwarded to the County on March 18, 1993.

Site Description

The Dongary facility is located approximately one mile south of the Interstate 80 toll gate to the Oakland Bay Bridge at the intersection of Maritime and 7th Street, at 2225 7th Street. Two main buildings are located on the site. The proposed remediation will focus on the area between NW Transport/ANR Freight building and the Sealand building. A generalized site plan is presented on drawing B-9152.00-01.

Two tank excavations are still open. The seven tank excavation is approximately 110 feet by 45 feet by 10 to 13 feet deep. The waste oil tank excavation is approximately 18 feet by 12 feet and 11 feet deep. Analysis of composite soil sampling (conducted in September 1992 from the stockpiled soil) detected an average concentration of Total Petroleum Hydrocarbons as diesel (TPH-D) of 5,800 mg/kg.

Based on soil borings, and excavations, RAMCON has reported that there are two distinct lithologies at the site: a well sorted sand exists between four to seven feet below grade; and a poorly sorted clayey sand interval exists between four to ten feet below grade.

Ground water was observed at approximately six to eight feet below grade, and fluctuates approximately 1 foot, due to tidal influences. The gradient was calculated to be 0.0014 feet per foot. Ground water samples collected from all three monitoring wells indicated no detectable concentrations of TPH-D, TPH as motor oil, or diesel blending constituents such as benzene, toluene, ethyl benzene, or xylene.

Based on 16 soil borings and three monitoring wells, the extent of contamination has been estimated, and is indicated on drawing B-9152.00-02.

Summary of EnviroClean Work

On initial evaluation of the site, EnviroClean believed that this was an ideal site for in-situ bioremediation. A proposal was written to Dongary to perform four tasks:

- Task 1 Site Characterization Review
- Task 2 Hydrology
- Task 3 Laboratory Bench Scale Testing
- Task 4 Workplan

Dongary authorized EnviroClean to execute work after a meeting with the County. Below is a summary of work performed, by task.

Task 1 - Site Characterization Review

Dongary had already had a significant amount of site characterization performed. However, prior to designing a remediation system, EnviroClean reviewed the geologic data previously collected from the site in order to determine whether previous estimates of permeability and lithology were reasonable. The data appeared to be reasonable and consistent. Attachment A contains a summary of our geologic review comments.

Task 2 - Hydrology

From the data collected in Task 1, ground water modeling was conducted to determine the optimum location to inject nutrients into the ground water to wet the contaminated soil. Modeling was utilized to determine the optimum location to install ground water recovery wells to reduce the likelihood of offsite migration of the nutrients. The entire basis for in-situ bioremediation is dependent upon the regulatory agencies allowing the soil piles of contaminated soil from the two tank excavations to be used as backfill. This remediation process requires a consistent material to ensure equal flowpaths of nutrient flow. A different backfilled material will not likely have the same porosity and density as the native materials. Furthermore, this remediation process will treat the backfilled soil, in-situ, and will: avoid the cost of off-hauling to a Class I landfill; avoid the politically incorrect method of transferring the contamination to "someone else's back yard"; and eliminate filling up limited space in the few remaining landfills with low levels of contaminated soil.

As indicated on drawing B-9152.00-02, EnviroClean proposes to inject the nutrients using a single injection well (IW-1) located near the center of the site. The injected nutrients are to be contained and withdrawn by five (5) recovery wells (RW-1 through RW-5) located near the site perimeter. All six (6) wells are to be installed down to the underlying clay bed at a depth of approximately 10 feet. Well screens are to run throughout the saturated sand, from about one foot above the water table down to the clay. Six-inch diameter wells are proposed.

Based on modeling, the simulated injection rate should be 1.5 gallons per minute (gpm). The total extraction at all five RWs equals the injection volume at the center well. The extraction rate at each RW is approximately 0.3 gpm. Modeling indicates that this design will: contain the nutrient mixture from offsite migration; disperse it throughout the contaminated backfill material; and extract it. Drawing B-9152.00-03 indicates selected nutrient flow paths from the IW-1 to RW-1 through RW-5. If all possible nutrient flow paths were drawn, the "series" of flow paths would produce nutrient fronts indicated on this drawing. The computed position of the nutrient front is indicated at various elapsed times.

The nutrient front is expected to saturate all contaminated soil in six months to a year. Injection of nutrients and recirculation of ground water will be continued until clean-up levels required by the regulators are achieved. Based on a meeting on April 15, 1993, with the Regional Water Quality Control Board (RWQCB) and the County, cleanup levels are to be established at a later date. However, soil clean up levels of 500-1,000 ppm TPH-D in the soil were considered reasonable if soil contamination does not leach into the ground water; and ground water cleanup levels of 100-200 ppb TPH-D were also considered reasonable. It was also stated in the meeting that based on Porter-Cologne regulations, cleanup will probably be required to numerical limits such as ones listed above, or cleanup to a point of diminishing returns. Prior to commencing remediation, it is requested that the County and RWQCB concur that the above limits are acceptable. Once remediation has been completed, injection of nutrients will be discontinued.

Task 3 - Laboratory Bench Scale Testing

Once the modeling portion of Task 2 was completed, indicating that in-situ bioremediation is technically feasible from a hydrology point of view, EnviroClean continued work by commencing Task 3. A one gallon sample was collected from two different monitoring wells at the site, MW-1 and MW-2. A wastewater characterization was performed on each sample, prior to commencing any testing. The laboratory analysis were:

Analysis	Concentration
NH_3-N	2.5 mg/L
PO_4	0.9 mg/L
TCOD	40 mg/L
SCOD	16 mg/L
TSS	107 mg/L
VSS	13 mg/L
TPH-Gasoline	<0.4 mg/L
TPH-Kerosene	<0.4 mg/L
TPH-Diesel	<0.4 mg/L

These results indicated there were nutrients present in the ground water to support bioremediation, therefore the amount of additional nutrients required to stimulate in-situ bioremediation will be reduced. Although laboratory results indicated no detectable total petroleum hydrocarbon as gasoline, kerosene, or diesel, and there is not a large concentration of chemical oxygen demand (COD), the water samples had a distinct hydrocarbon odor.

Biological testing was conducted using respirometers. This method monitors oxygen consumption of the indigenous site organisms found in the ground water sample to verify biological activity. It also allows evaluation of what nutrients and oxygen levels need to be added to the ground water to stimulate the population growth of naturally occurring bacteria, so that it can decompose the diesel contamination in a reasonable period of time.

It was determined that the optimum concentration of nutrients was in the range of 7-8 mg NH_3-N/L and 3-4 mg PO_4/L. Oxygen needs appear to be approximately 25 pounds O_2/day for every 100 gpm of ground water circulated.

By the end of the laboratory bench scale testing the levels of COD had reduced significantly, oxygen consumption indicated biodegradation, there was no detectable TPH by laboratory analysis, and there was no noticeable hydrocarbon odor. Therefore, our conclusion is that in-situ biodegradation is an effective remediation method for this site. A summary of our laboratory bench scale testing is submitted as Attachment B.

Task 4 - Workplan

Upon completion of Task 3, which indicated that from a biodegradation point of view, in-situ bioremediation was technically and economically feasible, EnviroClean has prepared this Workplan to propose the concept of in-situ bioremediation to the regulatory agencies. After obtaining the agency concurrence, a specific design will be prepared which will specify equipment and system construction details.

Proposed Work

It is not possible to estimate the extent of questions that may arise from the agencies. Rather than proceeding with a design, and then incurring additional costs to modify the design, EnviroClean believes additional work should be postponed until regulatory concurrence is received. Upon obtaining concurrence with the concept of in-situ bioremediation, EnviroClean will develop a cost estimate for the next phase of the project, which has the following tasks:

Task 5	Environmental and Building Permits
Task 6	Remediation System Design
Task 7	Remediation System Construction
Task 8	System Start-up and Routine Operation & Maintenance

To follow is a summary of proposed work to be performed, by task.

Task 5 - Environmental and Building Permits

Environmental regulatory agencies such as the County, RWQCB, and the City/County Building Department typically review remediation systems prior to authorizing permission to proceed. The Building Department may require a review of design drawings for civil, mechanical, and electrical perspectives.

Task 6 - Remediation System Design

Based on Tasks 1 through 3, EnviroClean proposes to install 6 wells (five RWs and one IW). A mixing tank with an agitator will be utilized to blend a nutrient solution which may be injected with a small metering pump. An air compressor may be utilized to increase the oxygen concentration in the ground water. The specific equipment, piping, conduit & wire, and process control scheme is still to be developed.

Task 7 - Remediation System Construction

Once Task 5 and 6 are complete, the designed and permitted system will be installed on site.

Task 8 - System Start-up and Routine Operation & Maintenance

After Task 7 is complete, a batch of nutrient solution will be made, individual components will be precommissioned, the entire system will be commissioned, and then the in-situ bioremediation system will be started up.

Schedule

Tasks 5 through 8 can be initiated immediately upon receipt of written approval of this workplan by the County. We estimate that a system start-up letter report can be submitted approximately nine weeks after Workplan and funding approval. This schedule includes: one week for obtaining well permits from Zone 7; two weeks for scheduling and performing the well installation; four weeks for design, specifying components, and receiving equipment; and two weeks for system construction and installation.

To expedite the project, the County may send an advance copy of the workplan approval to EnviroClean at FAX (510) 946-9968. The form below would meet Dongary's needs

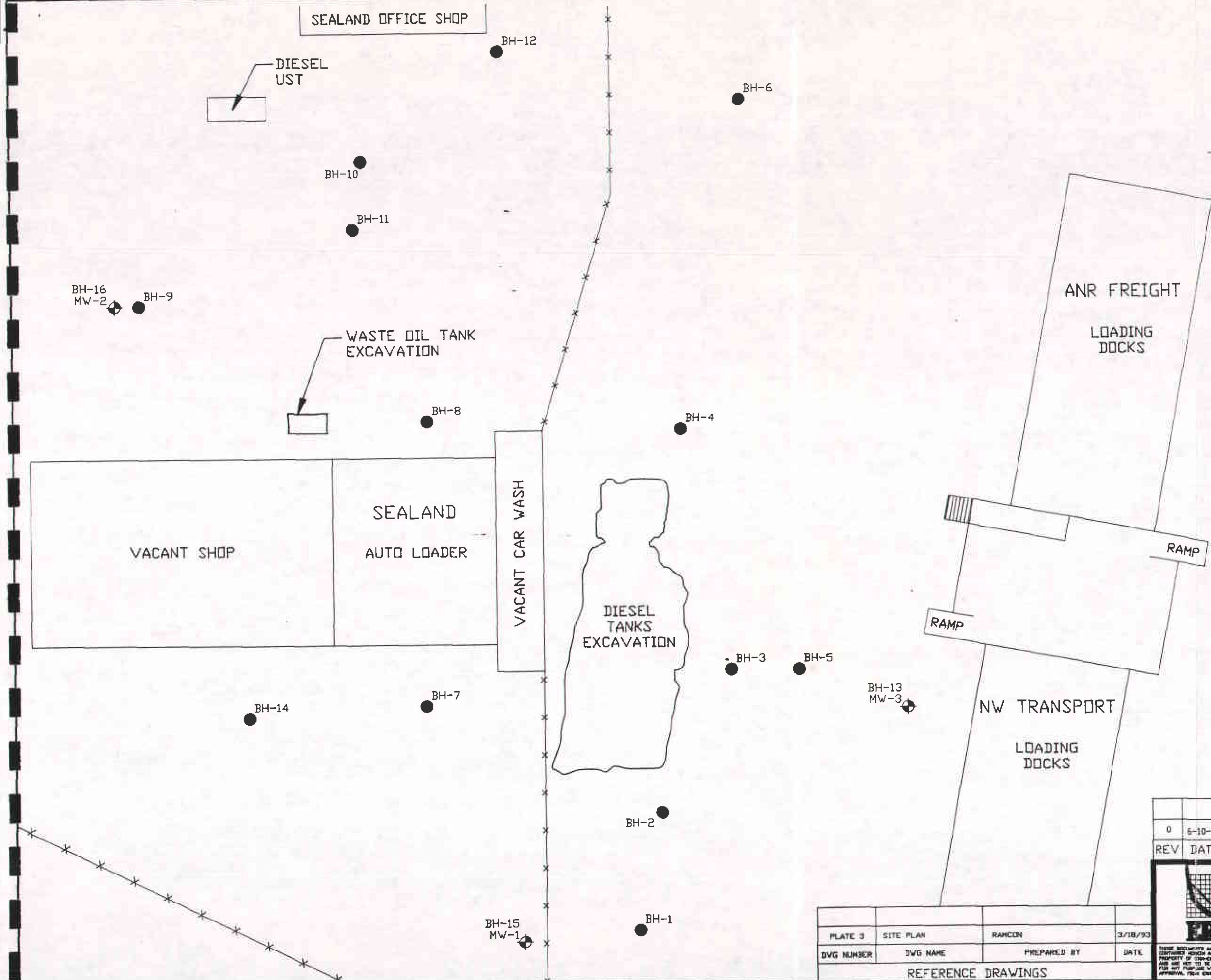
Attachments: Site Plan--drawing B-9152.00-01
Estimated Extent of Contamination--drawing B-9152.00-02
Nutrient Enrichment & Capture--drawing B-9152.00-03
Attachment A--Site Geologic & Hydrologic Review
Attachment B--Summary of Laboratory Bench Scale Testing

The Dongary Workplan (dated July 12, 1993) is accepted and approved by the County.

By: ________________________________

____________________________________ ________________

(Printed Name/Title) (Date)



LEGEND

- MW-3 — GROUNDWATER MONITORING WELLS
- BH-2 — SOIL BORING LOCATION
- BH-13 — SOIL BORING NUMBER
- —x—x— EXISTING FENCE

GENERAL NOTES

1. SOUTHERN PACIFIC & 7th STREET ARE OFF SCALE, BUT ARE TO THE EAST. NAVAL SUPPLY CENTER, OAKLAND ARE OFF SCALE, BUT IS TO THE SOUTH.

North

Fig A

0 20 40 80

SCALE IN FEET

DWG NUMBER	DWG NAME	PREPARED BY	DATE
PLATE 3	SITE PLAN	RAMCON	3/18/93

REFERENCE DRAWINGS

REV	DATE	REVISION	APPD	REV BY
0	6-10-93	ISSUED FOR CLIENT REVIEW	[illegible signature] PE	SLS

ERM

THESE DOCUMENTS AND INFORMATION CONTAINED HEREIN ARE THE EXCLUSIVE PROPERTY OF ERM-ENVIROCLEAN-WEST AND ARE NOT TO BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT WRITTEN APPROVAL FROM ERM-ENVIROCLEAN-WEST

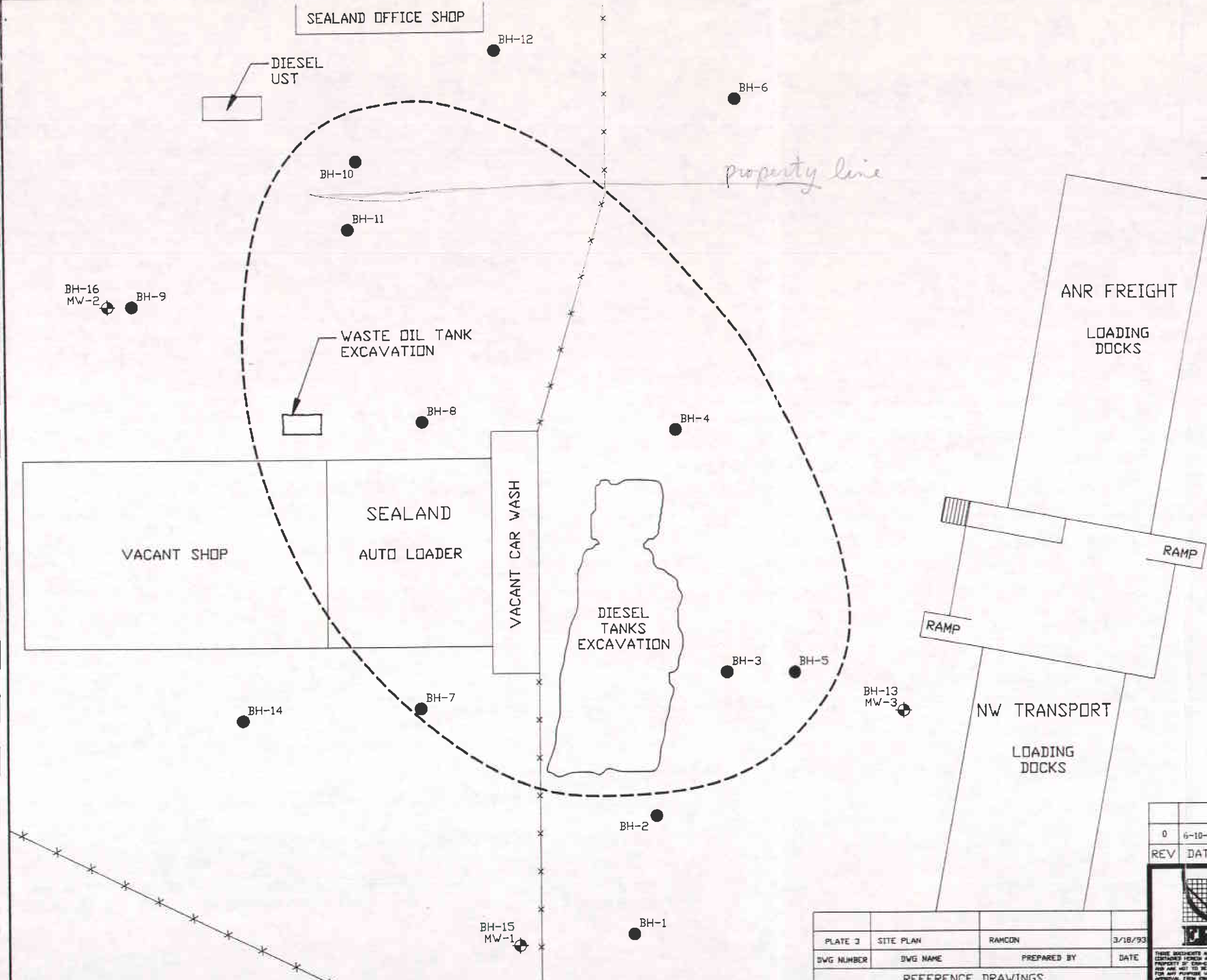
SITE PLAN

1" = 40' | RAMCON | SCHLABACH | B-9152.00-01
6/10/93 | KEN L. E. | [illegible signature] PE | 9152.00

DONGARY INVESTMENTS - OAKLAND
2225 7th STREET
OAKLAND, CALIFORNIA

REV 0

ERM - EnviroClean - WEST



LEGEND

MW-3	GROUNDWATER MONITORING WELLS
BH-2	SOIL BORING LOCATION
BH-13	SOIL BORING NUMBER
—x—x—	EXISTING FENCE
– – – – –	ESTIMATED EXTENT OF CONTAMINATION BASED ON DRAWING BELOW

in gw or soil?

GENERAL NOTES

1. SOUTHERN PACIFIC & 7th STREET ARE OFF SCALE, BUT ARE TO THE EAST. NAVAL SUPPLY CENTER, OAKLAND ARE OFF SCALE, BUT IS TO THE SOUTH.

Fig B

PLATE 3	SITE PLAN	RAMCON	3/18/93
DWG NUMBER	DWG NAME	PREPARED BY	DATE

REFERENCE DRAWINGS

REV	DATE	REVISION	APPD	REV BY
0	6-10-93	ISSUED FOR CLIENT REVIEW	L Bond RG	SLS

ERM

THESE DOCUMENTS AND INFORMATION CONTAINED HEREIN ARE THE EXCLUSIVE PROPERTY OF ERM-ENVIROCLEAN-WEST AND ARE NOT TO BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT WRITTEN APPROVAL FROM ERM-ENVIROCLEAN-WEST

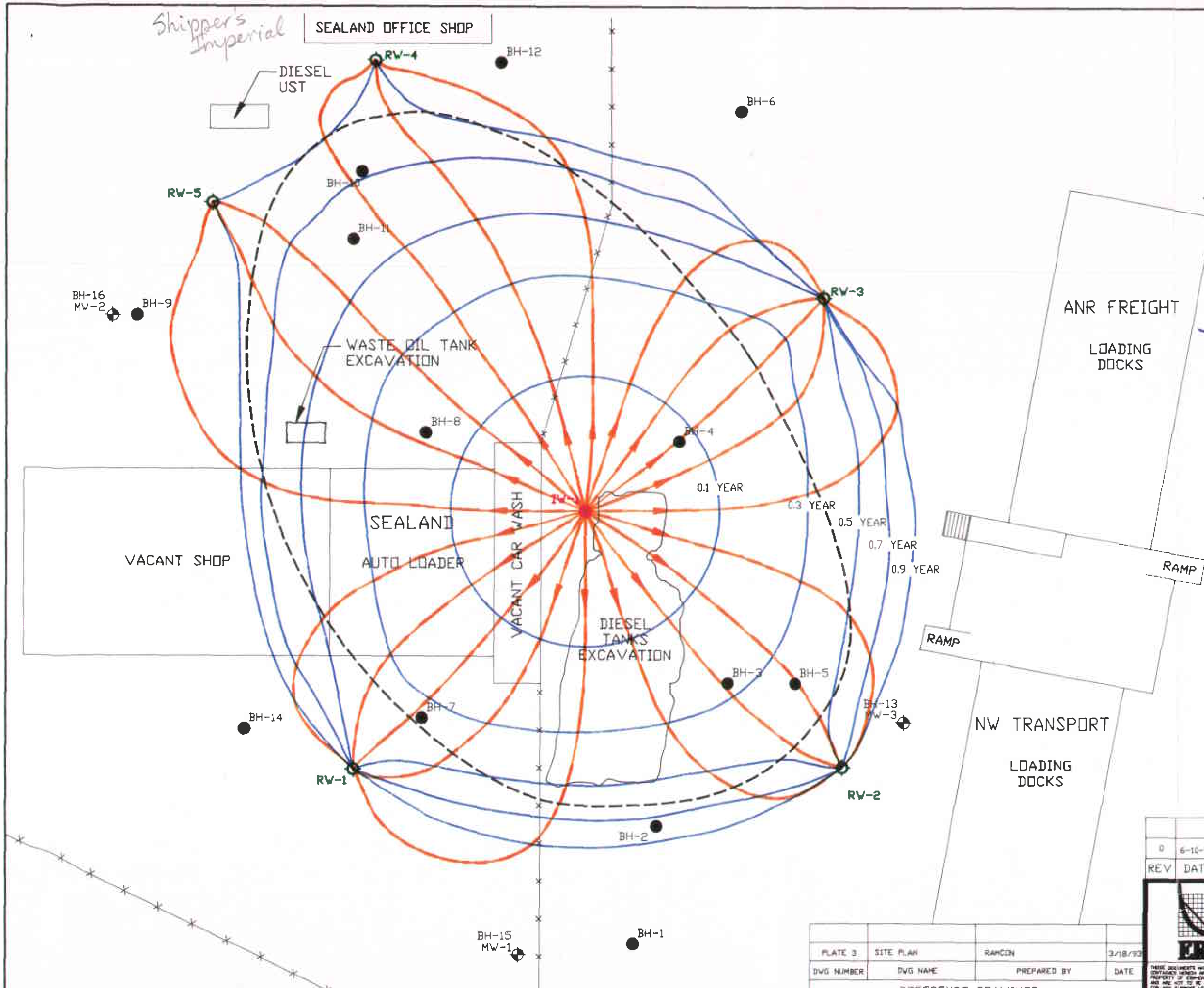
ESTIMATED EXTENT OF CONTAMINATION

1" = 40' | SCHLABACH | B-9152.00-02
6/10/93 | 9152.00

DONGARY INVESTMENTS - OAKLAND
2225 7th STREET
OAKLAND, CALIFORNIA

REV 0

ERM - EnviroClean - WEST



LEGEND

- MW-3 — GROUNDWATER MONITORING WELLS
- BH-2 — SOIL BORING LOCATION
- BH-13 — SOIL BORING NUMBER
- EXISTING FENCE
- ESTIMATED EXTENT OF CONTAMINATION BASED ON DRAWING BELOW
- RV-5 — RECOVERY WELL
- IV-1 — NUTRIENT INJECTION WELL
- NUTRIENT FLOW PATH
- NUTRIENT FRONT

GENERAL NOTES

1. SOUTHERN PACIFIC & 7th STREET ARE OFF SCALE, BUT ARE TO THE EAST. NAVAL SUPPLY CENTER, OAKLAND ARE OFF SCALE, BUT IS TO THE SOUTH.
2. POSITION OF NUTRIENT FRONT IS INDICATED AT ELAPSED TIME.

North

0 20 40 80
SCALE IN FEET

figc

REV	DATE	REVISION	APPD	REV BY
0	6-10-93	ISSUED FOR CLIENT REVIEW	[signature]	SLS

DWG NUMBER	DWG NAME	PREPARED BY	DATE
PLATE 3	SITE PLAN	RAMCON	3/18/93

REFERENCE DRAWINGS

ERM

THESE DOCUMENTS AND INFORMATION CONTAINED HEREIN ARE THE EXCLUSIVE PROPERTY OF ERM-ENVIROCLEAN-WEST AND ARE NOT TO BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT WRITTEN APPROVAL FROM ERM-ENVIROCLEAN-WEST

NUTRIENT ENRICHMENT & CAPTURE

1" = 40' | SCHLABACH | B-9152.00-03
6/10/93 | 9152.00

DONGARY INVESTMENTS - OAKLAND
2225 7th STREET
OAKLAND, CALIFORNIA

REV 0

ERM - EnviroClean - WEST

ATTACHMENT A

SITE GEOLOGIC & HYDROLOGIC REVIEW

HCI HYDROLOGIC CONSULTANTS, INC.

June 25, 1993 HCI-600

Robert A. Katin
ERM EnviroClean-West
1777 Botelho Drive, Suite 200
Walnut Creek, CA 94596

SUBJECT: Final Results of Hydrogeologic Modeling for Remediation Site in Oakland, California

Dear Mr. Katin:

Hydrologic Consultants, Inc. (HCI) has completed a hydrogeologic analysis of a treatment system for the Dongary site in Oakland, California. The analysis included use of a ground-water model to locate injection and extraction wells.

BACKGROUND

You have described the problem to us in several recent telephone conversations. We understand that underground storage tanks on the site leaked contaminants into the subsurface. The tanks have been removed. It appears that all contamination resides within the backfill material associated with the tanks. The extent of contamination and hydrogeologic properties of the backfill have been previously characterized. It appears that the backfill is a sandy material underlain by a relatively impermeable clay layer.

Your remediation plan calls for in-situ biological treatment. A set of injection and extraction wells will expose the contaminated backfill to nutrient-enriched, oxygenated water. The injection-extraction system will create a circulation cell that will contain and remediate the contaminants.

ANALYSIS

Review of Previous Data Analyses

HCI reviewed the geologic data previously collected from the site in order to determine whether previous estimates of permeability and lithology are reasonable. Materials that comprise the data base for our analysis were sent to us by your office on April 15, 1993. The data include geologic logs from 16 bore holes, sketches of the site in plan view and cross-section, chemical analyses of soil borings and ground water, and a sieve analysis of a sand sample. We have used these data in the modeling analysis described below.

143 Union Boulevard • Suite 525 • Lakewood, CO 80228
Tel: (303) 969-8033 • FAX: (303) 969-8357

1947 Galileo Court • Suite 101 • Davis, CA 95616
Tel: (916) 756-0925 • FAX: (916) 756-9230

HCI HYDROLOGIC CONSULTANTS, INC.

The data appear to be reasonable and consistent. However, the data introduce two areas of uncertainty. First, the presence of a lateral permeability boundary on the north side of the site is not clearly demonstrated by the boring logs. The presence or absence of a permeability boundary, however, is not expected to affect the ability to conduct in-situ biological treatment. Second, the permeability of the sand may vary from the estimate of 1.0×10^{-2} cm/sec, which was based on a sieve analysis using the Hazen method. The sieve analysis is an approximate method for estimating permeability, and the use of a single sample may not account for possible spatial variation.

These uncertainties may affect the time required to operate the remediation system. The modeling analysis computes a target time of about six to twelve months. The actual time needed may be less than or greater than the target time, depending on actual hydrogeologic conditions. The remediation plan recommended below accounts for data uncertainty by calling for water-level monitoring after remediation begins. Injection and extraction rates should be adjusted in accordance with monitored water levels.

Ground-Water Modeling of Injection and Extraction

HCI incorporated the available data into an analytic computer model of the site. The model simulates the movement of the nutrient-enriched water that you plan to introduce to the subsurface in order to promote in-situ biological treatment. The nutrients are injected using a single well located near the center of the site. The injected nutrients are contained and withdrawn by several extraction wells located near the site perimeter.

The model is named RESSQ, which is a public-domain computer code that is widely available and documented (Javandel, Doughty, and Tsang, 1984). It accounts for steady-state, two-dimensional advective transport under homogeneous and isotropic conditions. The model does not account for hydrodynamic dispersion or for chemical or biological reactions.

Modeling Assumptions

The modeling analysis includes the following assumptions:

- The tank pit and waste oil pit that are currently open will be filled with sandy material that is hydrologically similar to the backfill that is now present at the site. The pits will be filled before operation of the injection-extraction system.

- Building foundations will not interfere with the operation of the system by creating a barrier to subsurface flow. This assumption is reasonable, since the foundations of the car wash and auto loader are not expected to extend to depths beyond five feet.

- There will be no significant biological consumption or adsorption of the injected nutrients onto the sand grains that comprise the backfill, which means that the nutrients are a "conservative" constituent. This assumption is justified if the nutrient concentration is large relative to the biological consumption rate and the adsorptive capacity of the backfill.

- There will be no significant subsurface flow in the vertical direction. This assumption is supported by the presence of the clay layer, the screened intervals of the wells, and the injection and extraction rates.

- Heterogeneities in the backfilled material are not significant.

- The effective porosity of the backfill is 25 percent. This is a typical value for unconsolidated sands.

- The regional hydraulic gradient is small, as reported in the database.

- This modeling effort is not designed to treat off-site contamination, which may migrate onto the site.

- During operation of the system, injection and extraction rates will be modified in response to water-level monitoring.

Simulated System Design

The simulated remediation system consists of one injection well and five extraction wells (Drawing B-9152.00-02). All wells are installed down to the underlying clay bed at a depth of approximately 10 feet. Well screens run throughout the saturated sand, from about one foot above the water table down to the clay. All well diameters are six inches.

The injection well is located near the northwest corner of the diesel tank pit. The simulated injection rate is 1.5 gallons per minute (gpm). The extraction wells are located as shown in Drawing B-9152.00-02. Total extraction at all five wells equals the injection volume at the center well. The extraction rate at each well is about 0.3 gpm.

Model results indicate that this design will contain the nutrient mixture from offsite migration, disperse it throughout the contaminated backfill material, and extract it. Drawing B-9152.00-03 shows the computed position of the nutrient front at various elapsed times since the start of injection and extraction. The nutrient front shows that the soil is enriched by the nutrients throughout the area encompassed by the front. The drawing also shows selected flow paths (direction of flow) from the injection well.

The nutrient front is expected to reach the estimated limit of contamination after about six months. Injection of nutrients and recirculation of ground water will be continued until clean-up levels have been achieved. After this point in time, injection will be discontinued.

The positions of the flow paths (Drawing B-9152.00-03) are independent of the permeability of the subsurface materials, assuming that no significant heterogeneities occur. Uncertainties regarding the true permeability does not affect the ability of the remediation system to spread the injected nutrients. However, uncertainty regarding permeability does produce uncertainties in the time required to spread the nutrients. Remediation time is affected by constraints on acceptable water-level changes, which limit the range of feasible injection and extraction rates.

Adjustments to Injection and Extraction Rates

The modeling results assume that the permeability of the backfill material is uniform and is 1.0×10^{-2} cm/sec. This is the numerical value reported from the sieve analysis. Injection at a rate of 1.5 gpm should produce a water-level increase of about two feet within the central well. Likewise, the extraction rate of 0.3 gpm should produce a water-level decline of about one quarter of a foot in each of the perimeter wells.

If the field permeability is substantially less than the estimated value, the water level in the injection well will tend to rise above the land surface. Unless pressurized injection is feasible, it will be necessary to reduce the injection rate. Injection should be reduced to the point that the in-well water level is acceptable. A similar situation may be encountered in the extraction wells, where low permeability may produce water-level declines that de-water the wells. However, since the initial

HCI HYDROLOGIC CONSULTANTS, INC.

extraction rate for each well is much lower than the injection rate, reduced extraction may not be necessary.

If it is necessary to reduce the injection rate, more time may be needed to completely disperse the nutrient mixture throughout the contaminated area. Upon your request, we can provide you with revised estimates of completion time once the final injection rate is known.

REFERENCES

Javandel, I., C. Doughty, and C.F. Tsang, 1984, Groundwater Transport: Handbook of Mathematical Models, American Geophysical Union.

CLOSURE

If you have any questions or comments regarding this analysis, please do not hesitate to contact us.

Sincerely,

HYDROLOGIC CONSULTANTS, INC.

L. Jeffrey Lefkoff, Ph.D.
Vice President

Linda D. Bond, R.G.
Senior Project Hydrogeologist

REGISTERED GEOLOGIST
LINDA D. BOND
No. 4656
REGISTERED GEOLOGIST
STATE OF CALIFORNIA

ATTACHMENT B

SUMMARY OF LABORATORY BENCH SCALE TESTING

Environmental
Resources
Management, Inc.

855 Springdale Drive
Exton, Pennsylvania 19341
(215) 524-3500
(215) 524-7335 (Fax)

24 June 1993 (Sent via Fed Ex)

File Number: M0052.00.01

Mr. Robert Katin, P.E., REA
Senior Associate
ERM EnviroClean West
1777 Botelho Drive
Suite 260
Walnut Creek, CA 94596

ERM

Re: Final Report of Test Results Evaluating Biological Treatability of Diesel Contaminated Ground Water from the Dongary Investment Site in Oakland, California.

Dear Bob:

Environmental Resources Management Inc., (ERM) is pleased to submit this letter report detailing the results of the testing performed to evaluate the biological treatability of diesel contaminated ground water at the Dongary Investment Site in Oakland, California. This report presents the background, testing methodology, results and conclusions for the testing performed the week of 24 May 1993.

Background

This biological treatability investigation involves evaluating the feasibility of in-situ bioremediation of contaminated ground water. The ground water is suspected to be contaminated with diesel fuel from leaking storage tanks, which have since been removed. Analytical results of the ground water sample delivered to our laboratories were reported as non-detect, with the detection limit being 0.4 mg/L (See Attachment 1 - Lancaster Laboratories Analysis Report), however, a distinct hydrocarbon odor was noticeable in the sample.

Under the present scope of work, ERM was asked to make recommendations concerning the feasibility of in-situ bioremediation, the type and amount of nutrients to use, and the oxygen demand required to biologically treat the ground water.

Test Methodology

The biological testing procedure involved the use of respirometric techniques to monitor the oxygen uptake of the indigenous site organisms found in the ground water sample to verify biological activity within the system.

One gallon samples collected from two different monitoring wells (MW-1 and MW-2) respectively, were received at our laboratory on 21 May 1993. A wastewater characterization was performed on each sample which analyzed the ground water for pH, total COD (TCOD), soluble COD (SCOD), total suspended solids (TSS), volatile suspended solids (VSS), ammonia nitrogen (NH_3-N), and phosphate (PO_4). The results of the analyses showed that there were nutrients present in the ground water (2.5 mg/L NH_3-N; 0.9 mg/L PO_4), but limited COD concentrations (40 mg/L TCOD; 16 mg/L SCOD). The solids concentrations of the ground water were 107 mg/L TSS and 13 mg/L VSS. Upon completion of the wastewater characterization, a composite sample from the two monitoring wells was collected and sent to Lancaster Laboratories for TPH analysis for diesel, gasoline and kerosene (See Attachment 1 for results of initial samples).

Treatability testing was initiated on 21 May by preparing six test reactors using only the ground water and varying concentrations of nutrients. As shown in Table 1, a blank reactor (ground water only) along with reactors with two and three times the normal amount of nutrients were set-up. Duplicates of all three reactors were prepared in an effort to ensure that sufficient data was collected in the event that leaks developed in the respirometer units. As the data shows in Table 2, leaks did develop in reactors 3 and 5 and no oxygen uptake data was collected.

Table 1
Reactor Contents for PROACT Test

Reactor	Reactor Description	Nutrients DAP (ml)	UREA (ml)	Groundwater (ml)
1	Blank	0	0	400
2	Blank (duplicate)	0	0	400
3	Double nutrients	0.1	0.1	399.8
4	Double nutrients (duplicate)	0.1	0.1	399.8
5	Triple nutrients	0.2	0.2	398.6
6	Triple nutrients (duplicate)	0.2	0.2	398.6

Notes:

1. Diammonium Phosphate (DAP) stock solution was 36 g/L.
2. Urea stock solution was 73.8 g/L.

Table 2
Summary of PROACT Test Results

Reactor	pH		TCOD (mg/L)		SCOD (mg/L)		TSS (mg/L)		VSS (mg/L)		O2 Uptake (mg O2/L)
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
1	7.05	9.21	20	0	25	1	60	455	5	140	5
2	7.05	9.2	15	0	37	0	75	375	10	135	0.7
3	6.98	9.09	33	6	36	10	40	355	15	105	0
4	7.02	9.1	20	0	39	24	55	380	5	110	11.3
5	7.04	9.08	37	12	33	15	80	410	10	115	0
6	7.03	9.07	31	17	44	8	70	315	15	100	11.4

Note:
Leaks developed in reactors 3 and 5 and thus no oxygen uptake data was collected.

Cumulative oxygen uptake was monitored for Reactors 1 thru 6 using an N-Con Systems, constant pressure respirometer. The temperature of each respirometer reactor was maintained at 24 ^{o}C using a circulating water bath.

ERM

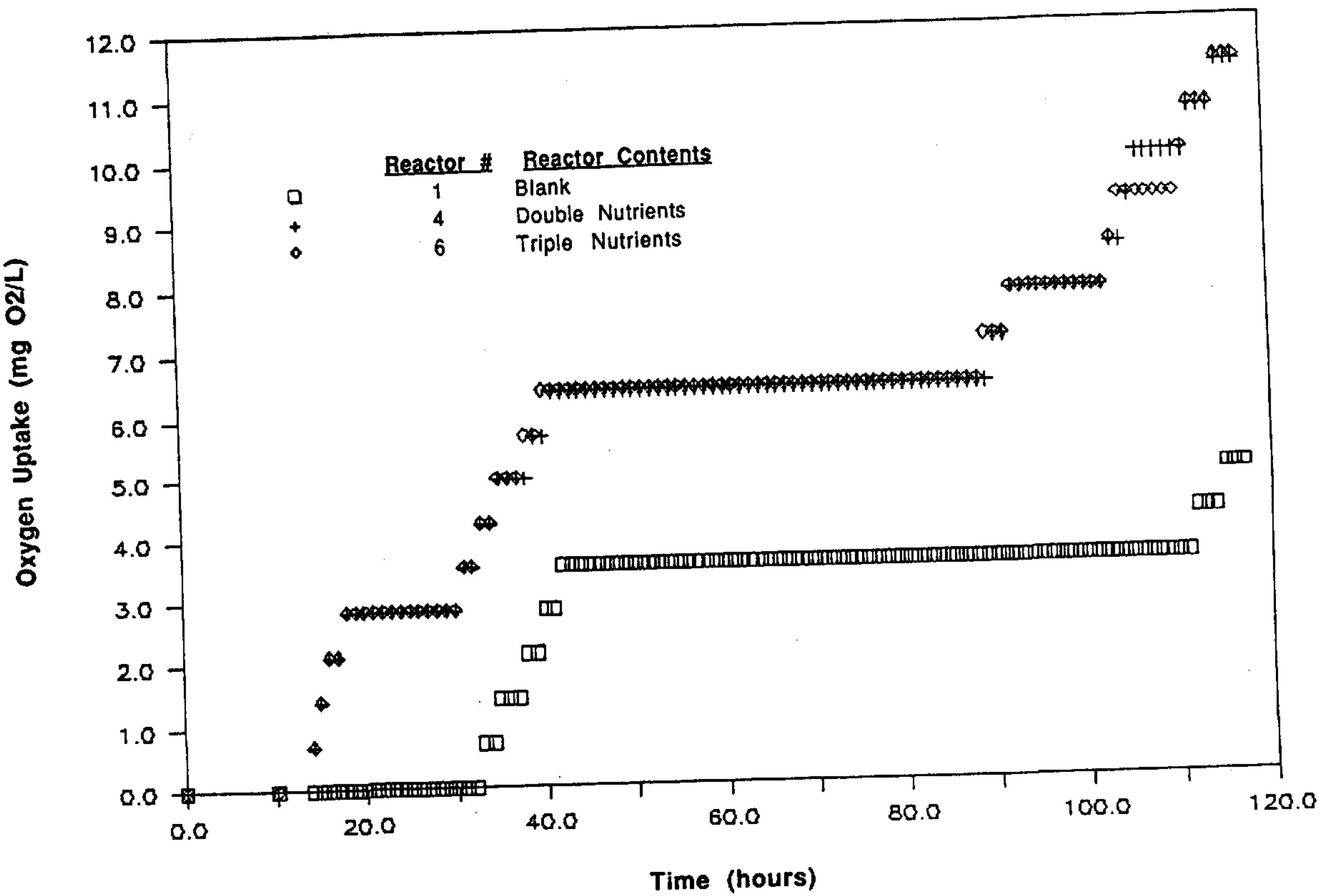
Test Results

Oxygen uptake results for all the reactors were very low as expected since the COD of the ground water is also very low. Cumulative oxygen uptake data for reactors 1, 4 and 6 are shown in Figure 1. As can be seen, Reactor 1 (ground water only) did show some activity with cumulative oxygen uptake reaching 5 mg O_2/L. The nutrient levels were doubled in Reactor 4, and Figure 1 shows that the cumulative oxygen uptake more than doubled, reaching a maximum oxygen uptake of 11.3 mg O_2/L. The oxygen uptake of Reactor 6 was almost identical to that of Reactor 4, despite nutrient levels at approximately three times the normal concentration. The optimum dosage of nutrients should thus be in the range of 7-8 mg NH_3-N/L and 3-4 mg PO_4/L, as indicated by the results generated from Reactor 4.

Table 2 shows that although COD concentrations were low and difficult to accurately measure in this range, COD reduction did take place in each of the reactors, another strong indicator that biodegradation took place. At the completion of the respirometry test, Reactors 4 and 6 were combined and sent to Lancaster Labs for TPH analyses (See Attachment 1). These two reactors were chosen based on the fact that they displayed the most activity during the test. Again the results showed no detectable concentrations. No noticeable hydrocarbon odor was observed after testing, indicating that treatment had occurred during testing.

Table 2 also shows the noticeable increase in both the pH and the suspended solids in the final samples. Note that the pH rose substantially in Reactors 1 thru 6 due to the fact that no buffer solution was added to the reactors before start-up. Each of the six reactors also showed substantial increases in final TSS and VSS

Figure 1
Cumulative Oxygen Uptake Data for PROACT Test Performed on 21 May 1993



readings believed to be caused by the precipitation of dissolved solids due to the increasing pH.

Conclusions

ERM

The following is a list of conclusions and recommendations as a result of this work and our bioremediation experience.

- The reduction of COD noticed in all 6 reactors, coupled with the elimination of all hydrocarbon odors indicates that the ground water is capable of being treated biologically with the addition of nutrients and oxygen.

- The optimum nutrient levels were determined through our respirometry testing to be in the range of 7-8 mg NH_3-N/L and 3-4 mg/L PO_4. It is recommended that stock solutions of 74 g Urea/L and 36 g DAP/L be prepared for injection into the recirculated ground water. Based on a 100 gpm flow of contaminated ground water, these stock solutions should be injected at a rate of 0.5 gallons per hour to ensure that the optimum nutrient dosage is achieved.

- A conservative estimate of the oxygen demand required to biologically treat the ground water based on a flow rate of 100 gpm and a biodegradable COD concentration of 20 mg/L is 25 lb O_2/day.

We appreciate the opportunity to work with you on this project and look forward to providing continued support on this project and any future projects requiring our treatability and engineering services. Please contact me at (215) 524-4849 or Rich Colvin at (215) 524-3941 should you have any questions or comments regarding this report.

Sincerely,

Christian D. Hahn
Project Engineer

ERM

Richard J. Colvin, P.E.
Project Manager

CDH/cdh
attachments (1):
cc: Al Rozich

Analysis Report

Lancaster Laboratories
Where quality is a science.

11:15:24 379571
ASR000 D 2 1
00767 0

ERM, Inc. - PA
855 Springdale Drive
Exton, PA 19341-2843

LLI Sample No. WW 1972861
Date Reported 5/26/93
Date Submitted 5/24/93
Discard Date 6/ 3/93
Collected 5/24/93 by CH
Time Collected 1000
P.O. M0052.00.01/CH
Rel.

MW-1 & MW-2 Composite Water Sample
ERM West

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
Petroleum Fuels by GC-FID H2O	attached		483418100S*

2 COPIES TO ERM, Inc. ATTN: Ms. Shawne Rodgers

RECEIVED
MAY 27 1993
By______________

Questions? Contact Environmental
Client Services at (717) 656-2301
052 00767 38.00 021900

Respectfully Submitted
Lancaster Laboratories, Inc.

Delwyn K. Schumacher, B.S.
Group Leader, ExpressLAB

Lancaster Laboratories
Where quality is a science.

11:15:26 379571
ASR000 D 2 1
00767 0

LLI Sample No. WW 1972861
Date Reported 5/26/93
Date Submitted 5/24/93
Discard Date 6/ 3/93
Collected 5/24/93 by CH
Time Collected 1000
P.O. M0052.00.01/CH
Rel.

ERM, Inc. - PA
855 Springdale Drive
Exton, PA 19341-2843

MW-1 & MW-2 Composite Water Sample
ERM West

	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Petroleum Fuels by GC-FID H20				
Gasoline	< 0.4	mg/l	0.4	482900000S
Kerosene	< 0.4	mg/l	0.4	483000000S
Diesel/#2 Fuel	< 0.4	mg/l	0.4	483100000S

This analysis will report the presence of fuel hydrocarbons in a range not exceeding C-30 normal hydrocarbons. Non-fuel hydrocarbons such as mineral oils or lubricating oils will not be reported.

2 COPIES TO ERM, Inc. ATTN: Ms. Shawne Rodgers

Questions? Contact Environmental Client Services at (717) 656-2301

Respectfully Submitted
Lancaster Laboratories, Inc.

Delwyn K. Schumacher, B.S.
Group Leader, ExpressLAB

Lancaster Laboratories
Where quality is a science.

RM, Inc. - PA
MW-1 & MW-2 Composite Water Sample
ERM West

LLI Sample No. 1972861
Group No. 379571
Page No. 1

LOQ	UNITS		BLANK		MS or D RPD	MS % REC	MSD % REC	LCS	LCS LIMITS LOW	LCS LIMITS HIGH
834 Petroleum Fuels by GC-FID H20										
4829 Gasoline										
.4	mg/l		< 0.4	mg/l						
4830 Kerosene										
.4	mg/l		< 0.4	mg/l						
4831 Diesel/#2 Fuel										
.4	mg/l		< 0.4	mg/l	3.2	91.0	94.0			

Lancaster Laboratories
Where quality is a science.

ERM, Inc. - PA
MW-1 & MW-2 Composite Water Sample
ERM West

LLI Sample No. 1972861
Group No. 379571

SURROGATE SUMMARY

	SURROGATE	RECOVERY %	SURROGATE LIMITS LOW	HIGH
4834 Petroleum Fuels by GC-FID H2O	Chlorobenz	96.0	50.0	135.0
	o-Terpheny	98.0	75.0	135.0

Lancaster Laboratories, Inc.
2425 New Holland Pike
Lancaster, PA 17601-5994
717-656-2301

@

Lancaster Laboratories Inc.

Interim Analytical Reports

For

Mr. Richard Colvin

with

ERM, Inc. - PA

from

M. Del Stoltzfus

with Lancaster Laboratories, Inc.

If you experience transmission problems please call M. Del Stoltzfus at 717-656-2301

For any other questions please call Donald E. Wyand
Your Client Service Representative at 717-656-2301

The number of pages including the cover sheet are 2

LLI FAX NO 717-656-2681

COMMENTS:

All analytical results should be considered preliminary and are subject to further review until the final report is issued.

***** Lancaster Laboratories, Inc. Analytical Report *****
2425 New Holland Pike, Lancaster, PA 17601

Sample Number: EL 1974058 Account: 00767 ERM, Inc. - PA
Date Submitted: 05/26/93 Date Reported: NOT REP
Date Collected: 05/26/93

12517 Reactor 4 and Reactor 6 Composite
Groundwater Sample
West

Analysis Name	As Received	Units
4828 TPH by GC-FID (Waters)		attached

The limits of quantitation for TPH by GC-FID were increased due to insufficient sample volume.
The GC Fingerprint for this sample doesn't contain a pattern of peaks that would indicate the presence of petroleum distillates.
==========

4829 Gasoline	< 0.8	mg/l
4830 Kerosene	< 0.8	mg/l
4831 Diesel/#2 Fuel	< 0.8	mg/l