Geological Technics Inc.

Feasibility Study Work Plan

Dual Phase Extraction & Air Sparging Pilot Test

Arrow Rentals Service
187 North L St.
Livermore, CA 94550

Project No. 1262.2
June 28, 2006

Prepared for:
Tony & Rita Sullins
Arrow Rentals Service
187 North L St.
Livermore, CA 94550

Prepared by:
Geological Technics Inc.
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June 28, 2006

Project No.: 1262.2
Project Name: Sullins (L St.)

Tony & Rita Sullins
Arrow Rentals Service
187 North L Street
Livermore, CA 94550

RE: Work Plan: Feasibility Study -- Dual Phase Extraction/Air Sparging Pilot Test
Location: 187 North L Street, Livermore, CA 94550.
(ACEH Fuel Leak Case No. RO0000394)

Dear Mr. & Ms. Sullins:

Geological Technics Inc. is pleased to present the following feasibility study work plan for a dual phase extraction/air sparging pilot test at the 187 North L Street, Livermore, California. Although Woodward Clyde Consultants performed an extraction test in March 1994 the groundwater level exceeded the screened intervals of the site's wells and the test results were limited. Installing a single extraction well and performing this work will enable a corrective action plan to be developed and begin the process of remediating the contamination rather than just monitoring it.

The dual phase extraction testing is intended to evaluate the feasibility of utilizing both soil vapor and groundwater extraction technologies to treat the gasoline plume at the site. Additional data will be obtained for air sparging technology that consists of blowing air beneath the water table to volatilize the gasoline to the surface so it can be extracted by vacuum extraction as above.

Respectfully Submitted,

Raynold I. Kablanow II, Ph.D.
Vice President

cc: Jerry Wickham - ACEH
USTCUF
Chris Davidson - City of Livermore

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Geological Technics Inc.

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Feasibility Study Work Plan

Dual Phase Soil Vapor and Groundwater Extraction/Air Sparging Pilot Test

Arrow Rentals Services
187 North L St.
Livermore, CA

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1.0 INTRODUCTION

Gasoline range petroleum hydrocarbons associated with underground storage tank (UST) systems have been documented in soil and groundwater at the above subject site (see Figures 1 and 2 for vicinity and site maps). The site also experienced an environmental impact when a gasoline delivery was introduced into a subsurface vapor/monitoring well rather than the UST fill pipe ("Petcock Release").

The work performed to date is summarized below*:

- 1972 – Three 1500 gallon USTs removed.
- 1984 – Two USTs removed (4000 & 6000 gallon); a single 1,000 gallon gasoline UST installed.
- June 1985 – Petcock Petroleum dispenses ~600 gallons into a vapor monitoring well adjacent to the 1,000 gasoline UST (Petcock Release).
- September 1988 – Three monitoring wells installed (W-1, W-2 and W-3).
- March 1989 – Five soil borings advanced (B-1 through B-5).
- July 1990 – Five monitoring wells installed (W-A through W-E), three soil borings advanced (B-7, B-8 and B-1A), and a soil gas survey was completed.
- March 1991 – A single soil boring advanced (B-F).
- January 1992 - UST pipeline soil excavation and sampling, two soil borings advanced (B-G and B-H).
- March 1994 – Dual Phase Extraction pilot test performed.
- March 1996- Four monitoring wells installed (W-1s, W-Bs, W-3s and W-Es).
- 1988 to present – intermittent monitoring/sampling of select wells.

* Data from Woodward Clyde Consultants and ACEH documentation.

As noted above, a Dual Phase Pilot Test was performed by Woodward Clyde Consultants (WCC) in March 1994. Geological Technics Inc. (GTI) performed a limited file review of the Alameda County Environmental Health's (ACEH) files on April 27, 2006 and copied relevant data from the WCC 1994 pilot test report (December 20, 1995 - portions included as Appendix B). As discussed below, they encountered a problem while performing the test in 1994.

Dual phase extraction involves the use of soil vapor extraction and groundwater extraction simultaneously from one well - extracting groundwater induces a cone of depression that exposes more impacted soil to vapor extraction. The problem encountered by WCC was that groundwater elevation exceeded the screened intervals of the site's wells and therefore soil vapor extraction was not evaluated during the pilot test.

WCC did report the following data:

- An extraction rate of 1.7 to 2.0 gallons per minute (gpm) was developed in well W-1.
- An extraction rate of 4 cubic feet per minute (cfm) was developed for vapor extraction in W-1.
- Based on extraction rate and measured drawdown in W-1 they estimated conductivity at $6x10^{-4}$ cm/sec (as a sand aquifer material).
- Potential capture zone as 50 feet from well W-1.

GTI has developed the following plan to evaluate the feasibility of using dual phase extraction to achieve clean up of the soil and groundwater plumes. This will necessitate installing a new shallow extraction well screened above the water table. Air sparging technology will also be evaluated using the existing wells. This work can proceed concurrently with the continued plume definition efforts underway. Several new monitoring wells, MW-4 through MW-7, are proposed and tentatively approved by ACEH for the locations shown in Figure 3.

2.0 PILOT TEST OBJECTIVES

In our March 29, 2006 "Report of Findings" GTI presented cross section diagrams illustrating the documented soil contamination at the site. Figures 4: Cross Section A – A' with Soil TPH-G and Figures 5: Cross Section B – B' with Soil TPH-G show the subsurface contaminant distribution (see Figure 2 for cross section location). The highest levels of TPH-G (total petroleum hydrocarbons as gasoline) were detected in borings W-1 and B-G located near former UST system piping trenches. The soil contamination is present starting at depths of 5 feet below grade and extends to as deep as 55 feet below grade surface (bgs). The historical groundwater elevation at the site has ranged from approximately 20 - 40 feet bgs and the gasoline has become entrained in the soil within this vertical range.

The performance of a dual phase extraction test will determine if the residual contamination in soils above the water table at the site can be removed utilizing high vacuum soil vapor extraction technology. This is a standard technology for remediation of gasoline release sites due to the high volatility of gasoline petroleum compounds.

Air sparging is a remedial technology that involves injecting air beneath the groundwater table. The injected air enables a phase transfer of gasoline from liquid (dissolved in groundwater) to vapor phase. Once in vapor phase the gasoline can be removed by soil vapor extraction technology. Air sparging also increases oxygen content of the soil and groundwater which promotes biodegradation. Performing an air sparging test in a monitoring well that has a submerged screen will determine if the TPH-G beneath the water table can be addressed using this method.

Details of the pilot test(s) are provided in the following sections.

3.0 DUAL PHASE EXTRACTION TEST

Soil vapor extraction and groundwater extraction are two proven technologies for the remediation of gasoline impacted sites. Dual phase extraction involves the use of both technologies simultaneously from one well - extracting groundwater induces a cone of depression that exposes more impacted soil to vapor extraction. For the purpose of this pilot test, GTI proposes to utilize a mobile treatment unit for a period of one week. Extracted vapors will be treated with a thermal oxidizer and groundwater will be temporarily stored in a tank trailer and hauled off for disposal at periodic intervals.

3.1 Extraction Wells

A single extraction well, EW-1, will be installed near the W-1 location to use for the extraction test. See Figure 6 for the proposed well location. The well will be constructed of four-inch PVC casing to facilitate greater air flow capacity. The existing monitoring wells will be used as observation points for the vapor and groundwater extraction tests.

The extraction well is proposed with the following construction:

Well	Dia./TD	Screen	Slot	Sand Pack	Trans. Seal	Grout Seal
EW-1	4"/20'	10-25'	0.020"	#12 sand 8-25'	6-8'	6'-surface

This construction is proposed for the following reasons:

- The groundwater elevation was determined to be approximately 27.5 feet in W-1 on June 22, 2006 and any deeper would submerge the well screen as in the 1994 pilot test.
- If the screen is any shallower the extraction vacuum influence could short circuit to the surface.

3.2 Dual Phase Extraction System

The general process for dual phase extraction is as follows:

- Extract vapors and water using a liquid ring vacuum pump.
- Separate the influent vapors and water in a portable vacuum tank.
- The contaminated vapor is then oxidized in a thermal oxidizer.
- The captured contaminated groundwater is transferred to a tanker truck trailer via a high vacuum pump. The tank trailer will be emptied at regulator intervals by a licensed hauler for transportation to a waste disposal facility.
- Collect data for actual vacuum flow and contaminant concentrations.
- Delineate the area of influence from the applied vacuum and groundwater draw down through use of observation wells.

3.3 Equipment

- A self contained trailer unit will be procured with liquid ring blower, water transfer tank, thermal oxidizer and control panel.
- A temporary propane tank will be used as fuel for the thermal oxidizer unit.
- Hoses will be used to connect the well heads to a manifold on the trailer input pipe.
- A 4,000 gallon tank trailer will be used to hold the extracted water and then it will be hauled off at periodic intervals to a licensed disposal facility.

3.4 Dual Phase Extraction Testing

GTI proposes conducting a 5-day pilot test utilizing proposed new well EW-1.

The test will start with extraction from new well EW-1. GTI will attempt to minimize groundwater extraction initially by not lowering the vacuum hose stinger down into the well but rather by just attaching it to the sealed top of the well. Vacuum influence will be measured at regular intervals in nearby monitoring wells screened across the water table (W-1s and W-Bs). This test will continue until the system reaches asymptotic conditions or 24 hours elapses.

A second test (24 hours) will then be conducted by slowly lowering the vacuum hose (stinger) by increments into well W-1s to prevent loss of vacuum (dead heading). Vapor/water extraction will continue from this well with vacuum measurements from EW-1

and W-Bs. Depth to groundwater measurements will also be taken at periodic intervals in wells W-1, W-Bs, W-B and W-A to determine response to groundwater extraction.

A third test will then be conducted by extracting from both EW-1 and W-1s with vacuum influence measured in W-Bs. This test will continue until the system reaches asymptotic conditions or 24 hours elapses.

For the remainder of the week (exclusive of the air sparge test outlined below) the system will be configured to extract vapors and groundwater from the most heavily impacted wells W-1s, W-1, W-A and new well EW-1. The purpose of this last effort will be to remove as much contamination as possible while consuming the remaining propane in the portable tank.

3.5 Effectiveness Evaluation

Radius of Influence

The amount of pressure necessary for demonstrating vacuum influence in soil vapor extraction technology is generally regarded as at least 0.1 inches of water ("*How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites*", USEPA, May, 1995). The radius of influence of the air injection will be estimated by comparing the changes in vacuum at the monitoring wells that are located at varying distances from the active extraction well(s).

Groundwater Extraction

The data obtained by WCC in 1994 is sufficient for estimating aquifer parameters if a pump and treat remedial system should become necessary. However, given the demonstrated contaminant reduction over time at the site and the proposed air sparging process outlined in Section 4.0 below, GTI proposes that groundwater extraction system may not be necessary to mitigate this site.

Note: If a groundwater response is measured during the pilot test within the constraint that extraction does not exceed the storage capacity of the trailer then the following will apply: The data that will be collected after the aquifer test has concluded will be analyzed by the appropriate aquifer equations for the type of aquifer determined to characterize this interval. The test results and calculations will be presented to estimate a capture zone for aquifer pumping.

4.0 AIR SPARGING TEST

Air sparging is a remedial technology that involves injecting air beneath the groundwater table. The injected air enables a phase transfer of gasoline from liquid (dissolved in groundwater) to vapor phase. Once in vapor phase the gasoline can be removed by soil vapor extraction technology.

4.1 Sparging Wells

No additional wells are proposed for this air sparging test. Existing well W-1s is screened from 20 – 45 feet bgs and it will be used for the single sparge point during the test. The well will be fitted with an air tight cap and a temporary ½ inch PVC casing with a four (4) foot screened section will be lowered to the bottom of the well. Air will be introduced into the ½" casing and the air will exit the screened section to fill the W-1s casing. The air will bubble upward to the screened section of W-1s and then enter the formation where it will be extracted by vacuum applied to EW-1 and described in section 3.4 above.

4.2 Air Sparging Equipment

The equipment to be utilized for the air sparging test includes:

- A blower for injecting air into the well.
- Hoses and/or PVC piping for connecting blower to the well.
- Magnehelic gauges for measuring well head pressure/vacuum.
- Manual meter or in-line device for measuring air speed.

4.3 Air Sparging Testing

The soil vapor extraction from EW-1 will be in progress as air injection in W-1s commences. The following system parameters will be monitored:

- The extraction air speed/volume will be measured in EW-1 at periodic intervals.
- The injected air volume will be monitored in W-1s.
- A pressure cap will be fitted to well W-Bs and monitored for changes in pressure/vacuum as air sparging commences.
- Periodic vapor sampling by photo-ionization detector (PID) will be obtained from EW-1 to see if and when concentrations go up to reflect air sparging in W-1s.
    - 4 hour sampling intervals to start, then 8 hours after 12 hours elapsed time.

4.4 Effectiveness Evaluation

Radius of Influence

The amount of pressure necessary for demonstrating vacuum influence in soil vapor extraction technology is generally regarded as at least 0.1 inches of water ("*How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites*", USEPA, May, 1995). This value may also be used as a measure of positive pressure influence with lower positive pressures expected in silty/clayey soils (0.01 inches H_2O). The radius of influence of the air injection will be estimated by comparing the changes in vacuum/positive pressure at well W-Bs. Little to no change is expected at the well W-Bs location due to the extraction from EW-1 that is located adjacent to W-1s. The purpose of monitoring is in case a large (~35') radius of influence is present that impacts W-Bs.

Contaminant Levels
The concentrations of soil vapors extracted from EW-1 should increase as air sparging progresses in W-1s. This will be a direct indicator that the gasoline is volatilizing from the injected air influence and that the technology is feasible at the site.

5.0 LABORATORY ANALYSES

Groundwater samples will be obtained to estimate mass removed during the test and for water disposal purposes. Vapor samples will also be obtained to estimate calculate mass removed during the week long test.

5.1 Groundwater

Groundwater Sample Analysis
Groundwater samples from W-1s (and other wells as applicable) will be submitted to a state certified laboratory for the analysis of:

- Benzene, toluene, ethyl benzene and xylene (BTEX) by EPA method 602/5030 or 8260
- Gasoline range petroleum hydrocarbons (TPH-G) by EPA method 5030/8015(m) or 8260

The detection limits for these compounds are listed below. A Chain of Custody will be completed for all samples collected and tracked to ensure sample integrity.

Detection Limits:	BTEX	TPH-G
Water (µg/L)	0.3-0.6	50

5.2 Soil Vapor

Soil vapor influent samples from EW-1 and system effluent samples will be submitted to Air Toxics Ltd. of Folsom, California (State Certified Laboratory #02110) for the following analysis by EPA Method TO-3:

- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Gasoline range petroleum hydrocarbons (TPH-Gas)

The detection limits for these compounds are listed below. A Chain of Custody will be completed for all samples collected and tracked to ensure sample integrity.

Detection Limits:	BTEX	TPH-G
(ppmv)	0.001	0.025

Proposed Project Flow

Monday	Mob & Setup	Start 1st 24hr test		
Tuesday		Conclude 1st test	Start 2nd 24h test	
Wednesday			Conclude 2nd test	
Thursday				Start Air Sparge test
Friday				Concl AS test, Demob

6.0 SCHEDULE & REPORTING

Upon work plan approval and cost pre-approval from the Fund, we will immediately proceed with scheduling this project. The information gathered during this phase of work will be presented in a report, which will include a summary of the extraction data and recommendations. Dr. Ray Kablanow, a registered professional geologist, will supervise the project. Copies of the report will be forwarded to the appropriate regulatory agencies (ACEH).

Our proposed schedule for performing the work proposed above is:

Feasibility Study

- Submit work plan — July 2006
- Receive work plan approval from ACEH — August 2006
- Submit Cost Pre-approval to the Fund — August 2006
- Receive Approval of Costs from the Fund — September 2006
- Perform pilot test — October 2006
- Submit the dual phase test report — November 2006

7.0 SIGNATURES & CERTIFICATION

Geological Technics Inc. will perform this project in accordance with accepted geologic and hydrologic standards of the State of California accepted and in effect at the time of this investigation. Geological Technics Inc. is not responsible for undisclosed conditions.

This work plan was prepared by:

Joseph D. Angulo
Geologist

Raynold Kablanow II, Ph.D.
California Professional Geologist #5234
Certified Hydrogeologist #442

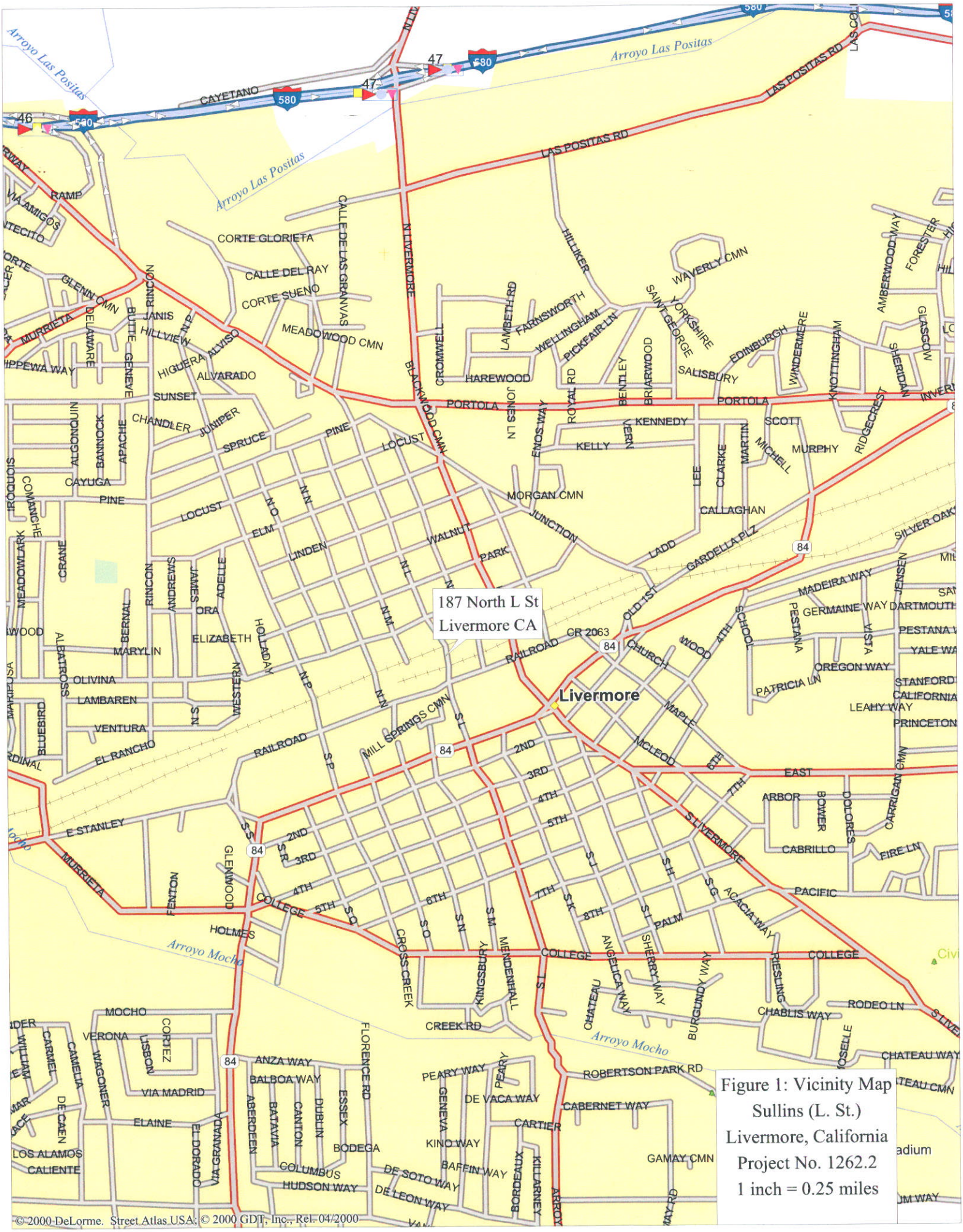

Figure 1: Vicinity Map
Sullins (L. St.)
Livermore, California
Project No. 1262.2
1 inch = 0.25 miles

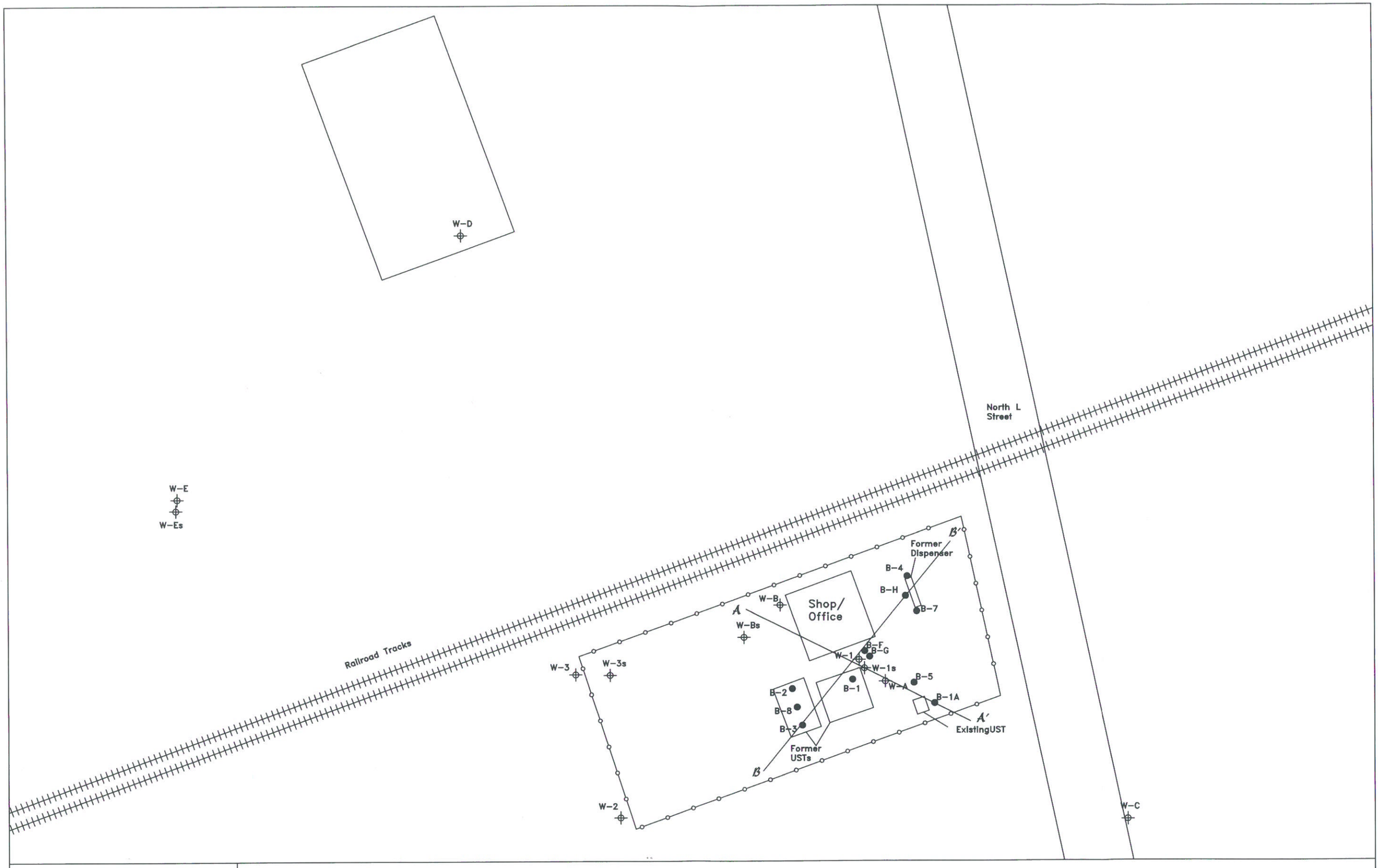

Fig 2: Site Map

Arrow Rentals
187 North L Street
Livermore, CA

Geological Technics Inc. 3/16/06

Legend

A - A' Cross Section Location

Monitoring Well

Soil Boring

N

0 50'

Scale

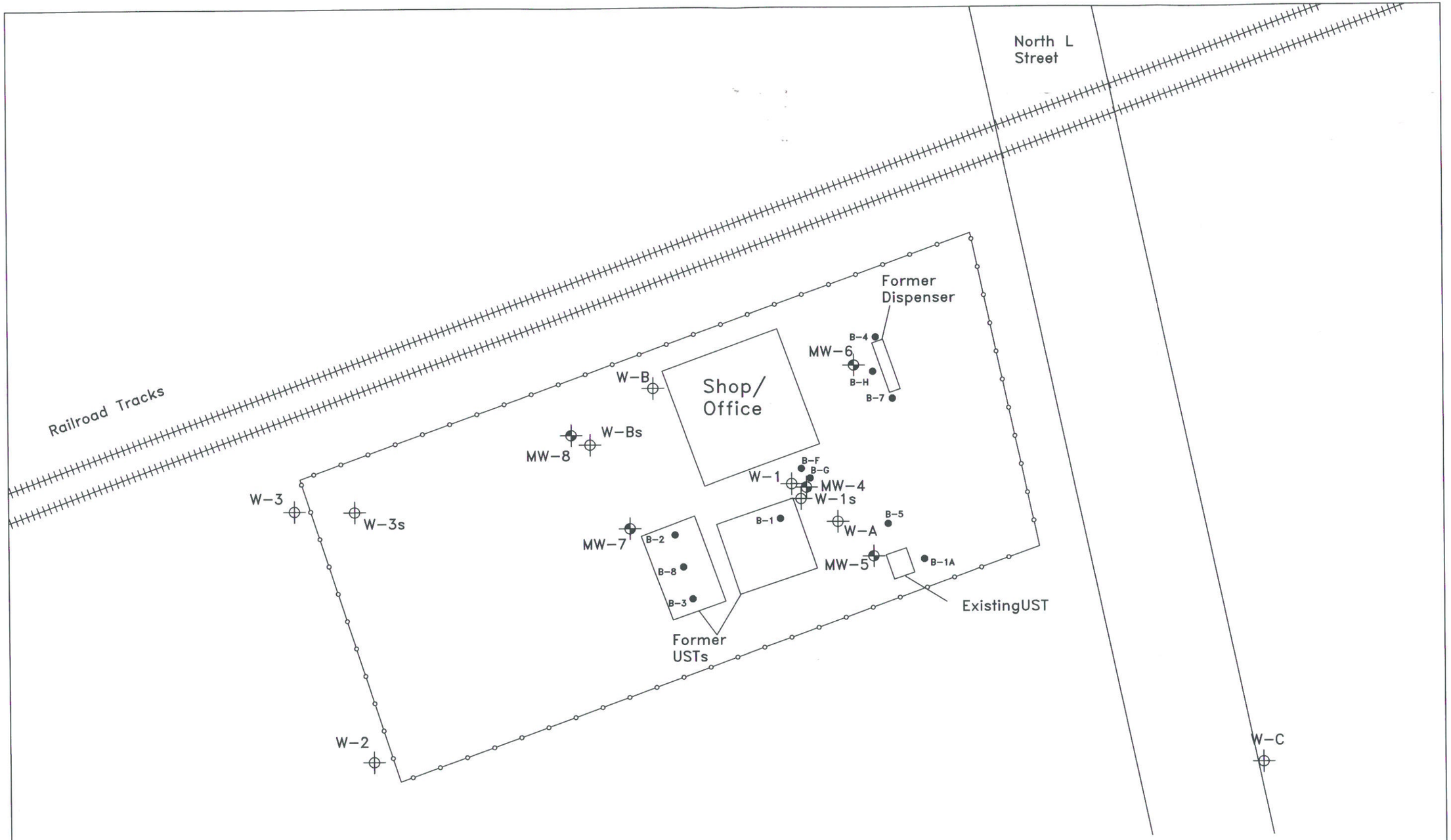

Fig 3: Site Detail Map

Arrow Rentals
187 North L Street
Livermore, CA

Geological Technics Inc. 5/18/06

Legend

- Monitoring Well
- Soil Boring
- Proposed Monitoring Well

N

0 30'

Scale

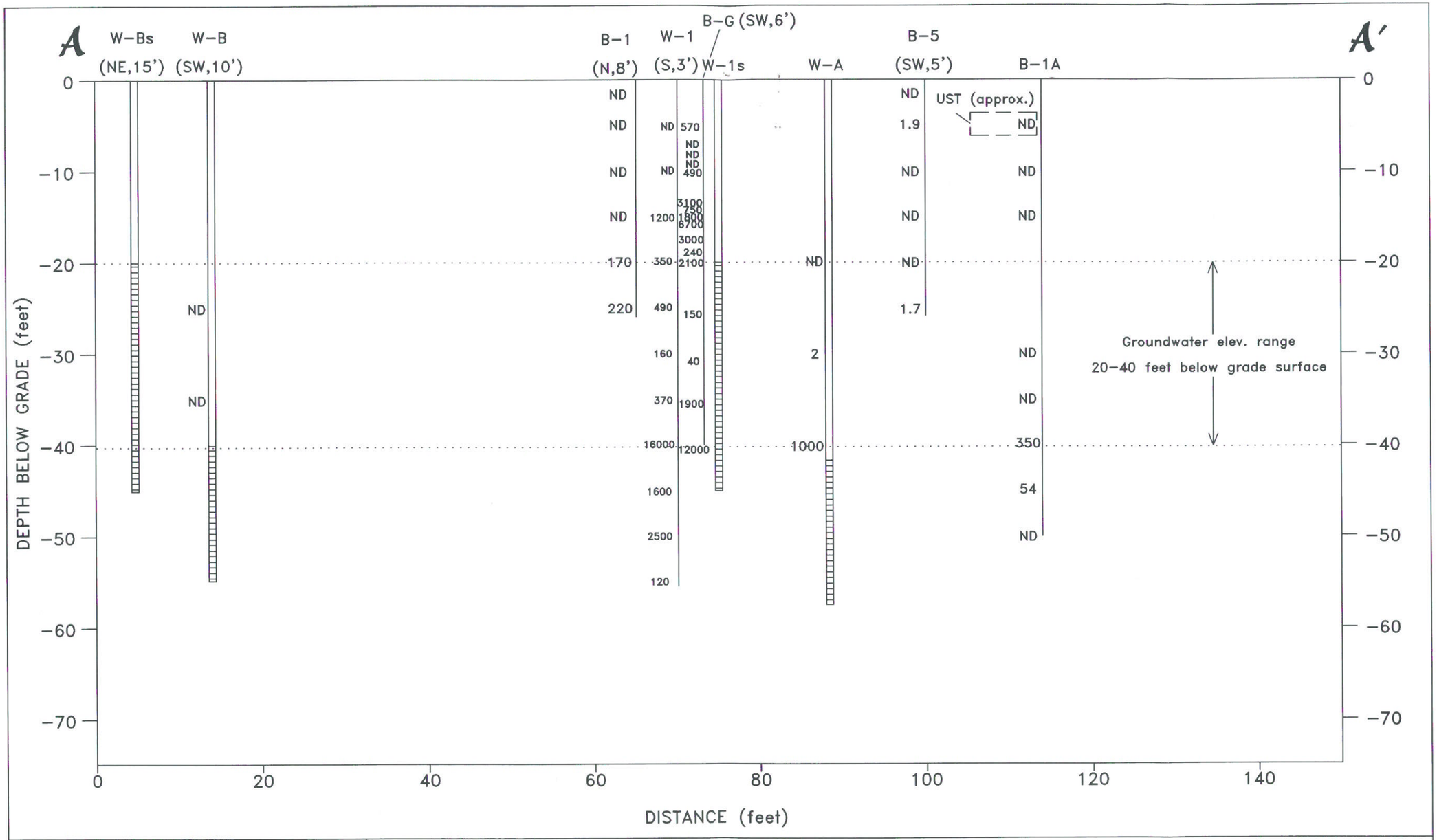

Figure 4
Cross Section A – A'
With Soil TPH-Gasoline

Arrow Rentals
187 N L Street
Livermore, CA

Project No.: 1262.2

Geological Technics Inc. 3/16/06

LEGEND

2300 = Soil TPH-G Concentration (mg/kg)
ND = Soil TPH-G non-detect

Soil Plume

Scale as Indicated.

(N,5') = Boring projection onto section (direction, distance)

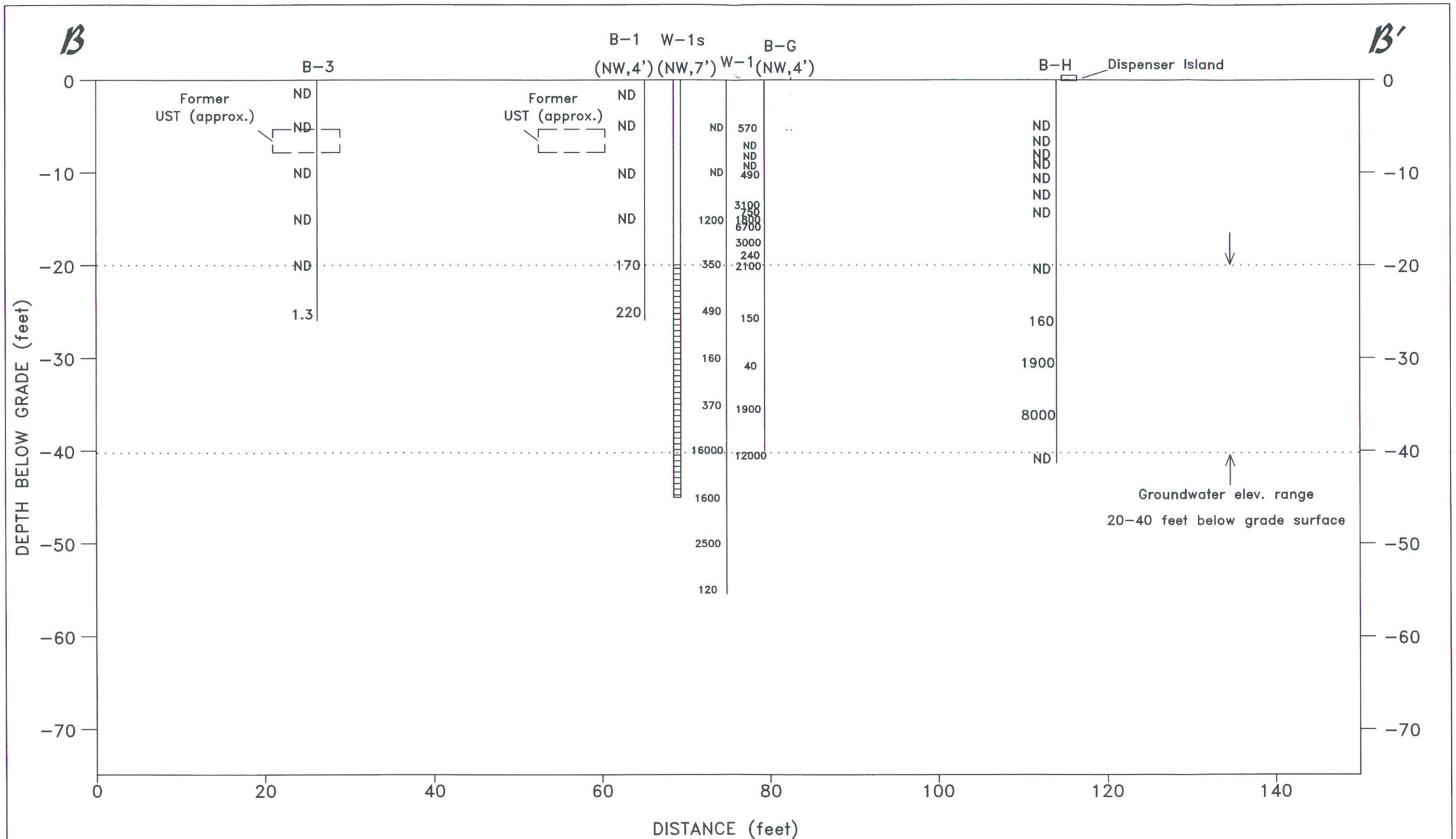

Figure 5
Cross Section B – B'
With Soil TPH-gasoline

Arrow Rentals
187 N L Street
Livermore, CA

Project No.: 1262.2

Geological Technics Inc. *3/16/06*

LEGEND

2300 = Soil TPH-G Concentration (mg/kg)
ND = Soil TPH-G non-detect

Soil Plume

Scale as Indicated.

(N,5') = Boring projection onto section (direction, distance)

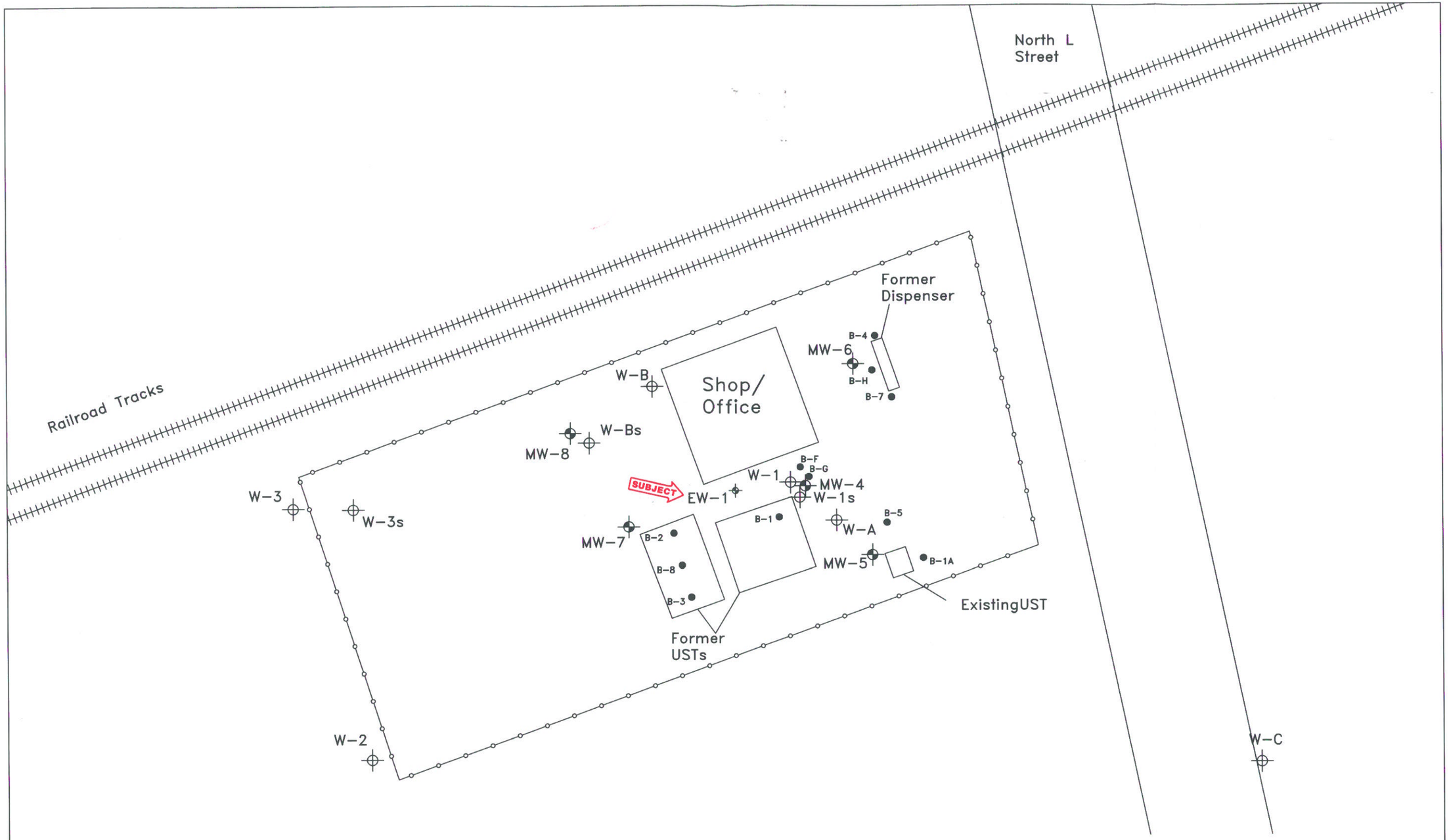

Fig 6: Site Detail Map
w/proposed well

Arrow Rentals
187 North L Street
Livermore, CA

Geological Technics Inc. 6/26/06

Legend

- Monitoring Well
- Soil Boring
- Proposed Monitoring Well

N

0 30'

Scale

Appendix A

Health & Safety Plan

1.0 HEALTH AND SAFETY PROGRAM

Geological Technics has incorporated the following health and safety precautions while working on sites containing unidentified hazardous waste. Once the nature and extent of contamination has been determined, additional work on site will be met with the proper precautions.

1.1 Workers Health and Safety

1.1.1 Work Space Safety

The perimeter of the workspace should, if possible, be 20 feet from the drilling rig or excavation site. Brightly colored delineators will mark the working perimeter. All unauthorized personnel will not be allowed access into the workspace.

The project supervisor will coordinate all field activities and maintain the safest possible working environment at all times. If an emergency occurs, the supervisor will immediately contact the proper authorities.

1.1.2 Skin and Head Protection

Disposable suits, boots, and gloves will be worn when the working conditions require such precautions.

Disposable plastic gloves will be worn at all times during soil and groundwater sampling. The gloves will be changed after each sample has been collected.

Used disposable clothing will be properly discarded at the end of each working day.

Hard hats will be worn during drilling, excavation, and other activities in which potentially dangerous equipment is being operated within the workspace.

1.1.3 Face and Respiratory Protection

During drilling and excavation activities, the working air space will be periodically monitored with either a Photo Ionization Detector (PID) for gas and vapor content. The PID measures the total organic compounds (VOC) vapor concentration. Monitoring of the working air space shall be concentrated around the drilling rig and in the down wind direction.

If working air space concentrations exceed the Permissible Exposure Limits, the workers will wear respirators with organic vapor cartridges. If working air space at the perimeter of the working space has levels that exceed the Permissible Exposure Limits for more then 15 minutes, then the drilling or excavation activity will halt until the concentrations can be maintained below the Permissible Exposure Limits.

1.2 Health and Safety Agencies

1. Alameda County Environmental Health
   Name: Jerry Wickham
   Phone No: (510) 567-6791
2. Fire Department
   Name: Livermore Fire Department
   Phone No: 911
3. Company Health and Safety Coordinator
   Name: Ray Kablanow
   Phone No: (209) 522-4119

Appendix B

Woodward Clyde Consultants Data

Woodward-Clyde
Engineering & sciences applied to the earth & its environment

December 20, 1995
93C0276A

② add'l new dg of well W-3 noted (~60' dg) Dear well W-E

Ms. Rita Sullins
Don-Sul, Inc.
187 North L Street
Livermore, CA 94550

Subject: Report of Remedial Activities since January 1994, 187 North L Street, Livermore, California

Dear Ms. Sullins:

This report is in response to a request by Ms. Eva Chu, of the Alameda County Health Care Services Agency (ACHCSA), in a letter dated June 29, 1995. Ms. Chu requested that the results of a Dual-Phase Pilot Test be presented in a report, along with groundwater monitoring results. The following report presents the results of the work performed by WCC as outlined in our proposal to you dated August 17, 1995.

SCOPE OF WORK

The scope of work included sampling groundwater from existing monitoring wells W-1, W-2, W-3 and W-E, and performing laboratory analyses on groundwater samples for TPH as gasoline and for BTEX. The work scope also included presentation of the results of the Dual Phase Pilot Test performed on March 15-16, 1994. Following the installation of new groundwater monitoring wells and analyses of groundwater samples, the site could be evaluated for closure using the ASTM Risk Based Corrective Action method (RCBA).

GROUNDWATER MONITORING

Groundwater levels were measured and groundwater samples were collected from wells W-1, W-2, W-3 and W-E on September 13, 1995. The results of laboratory analyses were presented in a report to you dated October 6, 1995. Table 1 presents the groundwater depths and the laboratory analysis results. The depth to the top of the screened section in these wells is about 40 feet. The depth to the groundwater level in these wells ranged from about 28.7 feet in well W-1 to 30.7 feet in well W-2. Since the groundwater levels are about 10 feet higher than the screened section these wells have a low potential for sampling floating product.

Woodward-Clyde Consultants • A subsidiary of Woodward Clyde Group, Inc.
500 12th Street, Suite 100 • Oakland, California 94607-4014
510-893-3600 Fax 510-874-3268

8/31/95

The highest concentration of benzene (65,000 ug/L) and TPH as gasoline (660,000 ug/L) were detected in groundwater from well W-1. This has been the location historically where the highest concentrations of these compounds were found. BTEX was not detected above the laboratory detection limit in groundwater from well W-2. Only 90 ug/L TPH as gasoline was detected in the groundwater sample from well W-2. The laboratory reported 5,600 ug/L benzene, 290 ug/L toluene, 460 ug/L ethylbenzene, and 280 ug/L total xylenes, and 27,000 ug/L TPH gasoline for groundwater from well W-3. Only 4 ug/L benzene and 95 ug/L TPH gasoline were reported in groundwater from well W-E. MTBE was not detected in groundwater from wells W-1, W-2, and W-3, but was detected at 18 ug/L in groundwater from well W-E. Copies of the laboratory reports are attached for your reference.

Groundwater elevations were calculated using the top of casing elevations shown on Figure 2 of our June 12, 1991 report. The groundwater gradient is towards the west northwest and ranges from an elevation of 70.44 feet in well W-1, to 64.62 feet in well W-E. Calculated elevations of groundwater are 67.45 in well W-2 and 68.31 in well W-3. Figure 2 is attached, and has been modified to show the current groundwater elevations and estimated groundwater elevation contours.

DUAL-PHASE PILOT TEST RESULTS

The Dual-Phase pilot test was conducted on the 14th and 15th of March 1994. A WCC portable trailer unit (see attached description) was used to perform the pilot test. The blower unit was attached to a small pipe that was inserted into well W-1 and about 24 inches of mercury vacuum and about 4 cfm soil gas flow was developed. About 1.7 to 2.0 gpm groundwater extraction rate was developed. Because the groundwater levels were above the top of the well screens in the observation wells, W-A, W-B, W-C, and W-2 no vacuum could be observed in the casing for those wells.

After about 17 hours of extraction a stabilized drawdown of about 1.87 feet was measured in well W-A, and about 0.67 feet was measured in well W-B. Using this information and the approximate extraction rate of 1.7 gpm the estimated conductivity was calculated at about 6 x 10^{-4} cm/sec, which is consistent with a sand aquifer material. Since well W-B is about 50 feet north of the pumping well (W-1) the radius of groundwater elevation influence, and potential capture zone, appears to be at least 50 feet. The approximate total volume of groundwater removed was 3,600 gallons. This water was temporarily stored in Baker Tanks, and later disposed of properly at Gibson Environmental in Redwood City, California. A copy of the disposal invoice is attached.

The effectiveness of this method for soil vapor extraction could not be evaluated since the groundwater level in the extraction well, and the observation wells was above the screened section of the well casings.

OPTIONAL CORRECTIVE MEASURES

Construction of New Wells

As shown on Figure 2, we recommend construction of four new groundwater wells with screened sections located above the current groundwater level. One new 6-inch diameter well could be constructed between W-A and W-1. This well should be constructed with sufficient well screen to continue to function with vertical variations of groundwater elevation of at least ten feet. The top of the new well screen should extend at least 10 feet above the current groundwater level. A second 6-inch diameter well should be constructed just south of well W-B.

Because of the rise in groundwater elevations above the screened interval, existing monitoring wells W-2 and W-3 need to be replaced. Adjacent to existing well W-3, a groundwater extraction well with a 6-inch diameter well casing should be constructed. Adjacent to well W-2 a new 4-inch diameter well should be constructed with a screened section set at elevation at least 10 feet above the current groundwater level and extending down below the top of the existing monitoring well screens, at a depth of about 40 feet. The existing 2-inch diameter wells W-2 and W-3 would remain in place to provide for monitoring groundwater levels.

We recommend that each of the four new groundwater wells be properly developed and groundwater samples collected for analysis. Laboratory results of analytes for TPH gasoline and BTEX from these new wells should be compared to previous results of analyses of groundwater from adjacent monitoring wells.

Re-Evaluation of Dual-Phase Extraction

We recommend that a dual-phase extraction pilot test be conducted on the newly constructed 6-inch well between W-1 and W-A. The radius of influence of a vacuum applied to this well could be evaluated by measuring pressure changes in the new well near W-B. If the pilot test shows that the method could be effective, these two new wells, along with the new wells near W-2 and W-3 could be utilized as dual-phase extraction wells.

RBCA Evaluation

Following the construction of new monitoring wells and evaluation of the results of laboratory analyses of groundwater samples from these new wells, this site can be evaluated for closure using the ASTM Risk Based Corrective Action method. This method is supported by a recent study Rice et al., 1995 (see references).

DISCUSSION

We can provide a schedule and cost for installation of the four new wells, and sampling and analysis of groundwater from the wells. We assume that you will forward a copy of this report to Ms. Eva Chu, at the Alameda County Health Care Services Agency.

Sincerely,

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Analytical Laboratory Reports

References: Rice et al., 1995, Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks (LUFTs), Lawrence Livermore National Laboratory, University of California, Livermore, California, October 16, UCRL-AR-121762.

TABLE 1

LABORATORY ANALYSIS RESULTS AND GROUNDWATER DEPTHS

Wells	Date sampled	Groundwater depths (feet)	Compounds (µg/L)					
			MtBE	Benzene	Toluene	Ethylbenzene	Total Xylenes	Gasoline
W-1	9/13/95	28.78	ND	65,000	78,000	6,400	36,000	660,000
W-2	9/13/95	30.76	ND	ND	ND	ND	ND	90
W-3	9/13/95	30.58	ND	5,600	290	460	280	27,000
W-E	9/13/95	29.67	18	4	ND	ND	ND	95

ND Not Detected at or above the reporting limit for the method.

TABLE 2
DUAL-PHASE EXTRACTION UNIT PILOT TEST DATA
MW-1 EXTRACTION TEST
ARROW RENTALS, LIVERMORE, CALIFORNIA

Date	Time	Enlapsed Time (hrs)	Applied Vacuum (In. Hg)	Inlet Temp. (Deg F)	Out Temp. (Deg F)	Vapor Flow (CFM)	Average Groundwater Extraction Rate (GPM)	Cumulative Volume Extracted Groundwater (gal)	Comments
3/15/94	10:45	0.00	25.50	64	82		0.00	88.8	System Startup
3/15/94	11:00	0.15	25.80	67	84		2.61	128.0	
3/15/94	11:15	0.30	26.00	70	86		NA	NA	
3/15/94	11:30	0.45	26.20	71	87		NA	NA	
3/15/94	11:43	0.58	26.50	72	88	4	2.65	226.0	
3/15/94	12:00	1.15	26.50	74	88		NA	NA	Well closed
3/15/94	12:15	1.30	26.50	73	89		1.84	285.0	Well open
3/15/94	12:45	2.00	26.50	72	90		2.47	359.0	
3/15/94	13:00	2.15	26.50	72	91		2.40	395.0	
3/15/94	13:40	2.55	26.00	70	91		2.38	490.0	
3/15/94	14:09	3.24	26.00	69	90		2.04	549.3	
3/15/94	14:31	3.46	26.00	68	90		2.15	596.5	
3/15/94	15:05	4.20	25.50	65	87		1.93	662.2	
3/15/94	16:04	5.19	25.50	64	87		2.04	782.6	
3/15/94	17:02	6.17	24.75	62	85		2.00	898.8	
3/15/94	18:03	7.18	24.60	61	82		1.89	1014.0	
3/15/94	19:03	8.18	24.50	61	80		1.91	1128.5	
3/15/94	20:01	9.16	24.25	60	86		1.97	1242.7	
3/16/94	7:29	11.28	24.00	59	77		1.85	2515.3	
3/16/94	8:30	12.29	24.00	59	78		1.79	2624.4	
3/16/94	9:32	13.31	24.20	60	80		1.77	2733.9	
3/16/94	10:35	14.34	24.30	60	80		1.75	2844.0	
3/16/94	11:32	15.31	24.30	61	80		1.73	2942.4	
3/16/94	12:37	16.36	24.30	60	80		1.67	3050.7	
3/16/94	13:31	17.30	24.30	60	80		1.81	3148.6	
3/16/94	14:46	18.45	24.40	61	81		1.73	3278.4	
3/16/94	15:50	19.49	24.40	61	81		1.69	3386.7	
3/16/94	16:40	20.39	NA	NA	NA		NA	NA	Switched to 1/2" straw
3/16/94	17:06	21.05	24.70	63	81		1.54	3504.1	
3/16/94	17:50	21.49	24.70	62	79		1.39	3565.3	
3/16/94	18:16	22.15	NA	NA	NA		NA	NA	
3/16/94	18:21	22.20	NA	NA	NA		NA	NA	
3/16/94	18:25	22.24	24.50	60	77		1.46	3616.5	
3/16/94	18:26	22.25	NA	NA	NA		NA	NA	End pilot DPE test

Legend

NA Not Available
GPM Gallons per minute
CFM Cubic feet per minute

TABLE 3
WATER LEVELS IN WELLS MEASURED DURING DPE PILOT TEST
MW-1 EXTRACTION TEST
ARROW RENTALS, LIVERMORE, CALIFORNIA

Date	Time	Elapsed Time (hr)	Extraction Well	Groundwater Elevation (feet from mean sea level)							Comments
				W-A	W-B	W-C	W-D	W-E	W-2	W-3	
3/15/94	9:23	0.00	MW1	67.17	65.91	68.66	64.80	62.62	65.53	64.99	
3/15/94	10:45	1.22	MW1	67.03	65.91						Start
3/15/94	11:00	1.37	MW1	66.84	65.89				65.55	64.99	
3/15/94	11:15	1.52	MW1	66.59	65.88						
3/15/94	11:30	2.07	MW1	66.44	65.86						
3/15/94	11:45	2.22	MW1	66.32	65.84						
3/15/94	12:00	2.37	MW1	66.23	65.83						
3/15/94	12:15	2.52	MW1	66.19	65.82						
3/15/94	12:30	3.07	MW1	66.13	65.81						
3/15/94	12:45	3.22	MW1	NA	65.80						
3/15/94	13:00	3.37	MW1	65.99	65.79						
3/15/94	13:42	4.19	MW1	65.92	65.76						
3/15/94	14:07	4.44	MW1	65.88	65.74						
3/15/94	14:30	5.07	MW1	65.86	65.73						
3/15/94	15:00	5.37	MW1	65.83	65.71	68.81			65.62		
3/15/94	16:00	6.37	MW1	65.80	65.69						
3/15/94	17:00	7.37	MW1	65.76	65.65						
3/15/94	18:00	8.37	MW1	65.69	65.62	68.79			65.61		
3/15/94	19:00	9.37	MW1	65.65	65.58						
3/15/94	20:00	10.37	MW1	65.60	65.56						
3/16/95	7:48	22.25	MW1	65.39	65.39						
3/16/95	8:45	23.22	MW1	65.36	65.36						
3/16/95	9:45	24.22	MW1	65.33	65.33						
3/16/95	10:35	25.12	MW1	65.31	65.32						
3/16/95	11:35	26.12	MW1	65.30	65.31						
3/16/95	12:30	27.07	MW1	65.30	65.30	68.69			65.48		
3/16/95	13:30	28.07	MW1	65.24	65.30						
3/16/95	14:43	29.20	MW1	65.32	65.30						
3/16/95	15:49	30.26	MW1	NA	65.30						
3/16/95	17:09	31.46	MW1	NA	65.28						
3/16/95	18:02	32.39	MW1	NA	65.24	68.69			65.49		