ARCTOS

Arctos Environmental
☑ 1332 Peralta Avenue
Berkeley, CA 94702
510 525-2180 PHONE
510 525-2392 FAX

Main Office
○ 3450 E. Spring St., Suite 212
Long Beach, CA 90806
562 988-2755 PHONE
562 988-2759 FAX

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2:15 pm, Mar 21, 2008

Alameda County
Environmental Health

Interim Remedial Action Plan for Groundwater

1619 1st Street
Livermore, California
Tesoro No. 67076 (Former Beacon 3604)
ACEH Case No. RO0000434

prepared for:

Tesoro Companies, Inc.
3450 South 344th Way, Suite 201
Federal Way, Washington 98001

March 2008

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1332 Peralta Avenue, Berkeley, CA 94702
510 525-2180 PHONE
510 525-2392 FAX

Main Office
3450 E. Spring St., Suite 212, Long Beach, CA 90806
562 988-2755 PHONE
562 988-2759 FAX

21 March 2008
Project No. 01LV

Jerry Wickham
Hazardous Materials Specialist
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

Subject: Interim Remedial Action Plan for Groundwater
1619 1st Street, Livermore, California
Tesoro No. 67076 (Former Beacon 3604); ACEH Case No. RO0000434

Dear Mr. Wickham:

Arctos Environmental (Arctos), on behalf of Tesoro Companies, Inc., is submitting this interim remedial action plan (IRAP) for review and approval by Alameda County Environmental Health. The IRAP responds to your letter dated 28 December 2007 and includes the consensus reached at our meeting on 12 March 2008. The IRAP describes the installation of deep monitoring wells and operation of an in situ groundwater remediation system at the subject site.

Arctos appreciates your review and approval of this IRAP. If you have any questions or comments, please call us at 510/525-2180.

Very truly yours,

ARCTOS ENVIRONMENTAL

Matthew Nelson
Senior Staff Engineer

Michael P. Purchase, P.E.
Senior Project Manager

REGISTERED PROFESSIONAL ENGINEER
MICHAEL P. PURCHASE
No. C71230
Exp. 6/30/09
CIVIL
STATE OF CALIFORNIA

Copy: Jeffrey M. Baker, P.E. – Tesoro Companies, Inc.
Colleen Winey – Zone 7 Water Agency

EXECUTIVE SUMMARY

Arctos Environmental (Arctos), on behalf of Tesoro Companies, Inc. (Tesoro), has prepared this interim remedial action plan (IRAP) for the active automobile service station at 1619 First Street, Livermore, California (the site; Figure 1). The IRAP was prepared in response to the Alameda County Environmental Health (ACEH) letter to Tesoro dated 28 December 2007 requesting additional remediation and groundwater assessment activities at the site. The IRAP proposes (1) additional groundwater assessment and (2) a two-phase remedial program for impacted groundwater at the site.

The additional groundwater assessment will include installation of deep monitoring wells to monitor water quality in the lower intervals of the aquifer at and downgradient of the site. One onsite and three downgradient deep monitoring wells are proposed. The four proposed monitoring wells will be included in future monitoring events and quarterly status reports.

Arctos will install an in situ remediation system consisting of an oxygen injection system and a soil vapor extraction (SVE) system. Oxygen will be injected into seven wells installed in the source area to enhance the biodegradation of petroleum hydrocarbons. The wells will be screened in a saturated sand layer that is roughly 40 feet thick.

Groundwater elevations at the site vary approximately 6 to 17 feet each year. The SVE system will be installed to remediate hydrocarbon-impacted saturated soils exposed during periods of low groundwater levels. The SVE system will assist in groundwater remediation by removing vapor- and sorbed-phase hydrocarbons that contribute to groundwater impact.

After completing the proposed field program and system start-up period (1 to 3 months), Arctos will include data and evaluations of the systems in the quarterly status reports.

TABLE OF CONTENTS

Section **Page**

ARCTOS

TABLE OF CONTENTS (continued)

List of Figures

List of Appendices

1.0 INTRODUCTION

Arctos Environmental (Arctos), on behalf of Tesoro Companies, Inc. (Tesoro), has prepared this interim remedial action plan (IRAP) for the active automobile service station at 1619 First Street, Livermore, California (the site; Figure 1). The IRAP was prepared in response to the Alameda County Environmental Health (ACEH) letter to Tesoro dated 28 December 2007 requesting additional remediation and groundwater assessment activities at the site. The IRAP proposes (1) additional groundwater assessment and (2) in situ groundwater remediation system including an oxygen injection system and a soil vapor extraction (SVE) system.

1.1 Background

The site is located on the southeast corner of the intersection of First Street and South P Street at an active automobile service station. Adjacent properties include an office building to the east, Fosters Freeze restaurant to the west, Safeway supermarket and Hollywood Video to the north, and apartments to the south (Figure 2).

Previous investigations indicate that the groundwater beneath the site is impacted by petroleum hydrocarbons including total petroleum hydrocarbons as gasoline (TPHg); benzene, toluene, ethylbenzene, and total xylenes (BTEX); methyl tert-butyl ether (MTBE); and tert-butyl alcohol (TBA). Current groundwater monitoring and analytical results indicate that the highest TPHg and benzene concentrations of 37,000 and 4,200 micrograms per liter (µg/l), respectively, were reported at onsite well MW-2 during the third quarter 2007 monitoring event. The highest MTBE and TBA concentrations of 14,000 and 16,000 µg/l, respectively, were reported at onsite well TP-2. Elevated benzene and MTBE concentrations in groundwater (1,800 and 310 µg/l, respectively) were also reported approximately 140 feet downgradient of the site at well MW-6. Figures 3 and 4 show the most recent isoconcentration contours for benzene and MTBE, respectively. Historical groundwater elevations and analytical results are in Appendix A.

A site background, which summarizes regional and site geology and hydrogeology and previous investigation and remediation, is in Appendix B.

1.2 Objectives and Scope of Work

The objectives of this IRAP are to perform additional groundwater assessment and install an in situ remedial technology to (1) develop aerobic groundwater conditions in the hydrocarbon-impacted groundwater, (2) promote the growth of microorganisms that metabolize petroleum hydrocarbons, (3) mitigate the downgradient migration of petroleum hydrocarbons, and (4) vapor-extract hydrocarbons from portions of the saturated zone exposed during low groundwater levels. To meet these objectives, Arctos will perform the following scope of work:

- Obtain ACEH approval of this IRAP and well permits from the Zone 7 Water Agency
- Mobilize for well installation including marking for underground service alert (USA) and preparing a site-specific health and safety plan (HSP)
- Install seven injection wells designated as IP-1 to IP-7 and four deep monitoring wells designated as DW-1 to DW-4 (Figure 2)
- Collect baseline groundwater samples and background groundwater quality data
- Survey the new wells
- Install oxygen injection equipment and new conduits for tubing that will convey oxygen to the injection points
- Install SVE equipment and subsurface piping to existing vapor extraction wells
- Start up the injection and extraction systems
- Incorporate the results of the deep monitoring wells, oxygen injection system, and SVE system into the site quarterly status reports

2.0 GROUNDWATER ASSESSMENT

Arctos will install four deep monitoring wells on site and downgradient of the site to assess the vertical extent of impacted groundwater. The objective of installing the deep wells is to monitor water quality in the lower zones of the aquifer (beneath the existing monitoring well screen intervals and above the regional aquitard).

2.1 Field Program

Based on results of previous groundwater grab samples, Arctos will install monitoring wells at the following locations (Figure 2):

- Well DW-1 on site northwest (downgradient) of the dispenser islands and adjacent to existing well TP-2
- Wells DW-2, DW-3, and DW-4 off site northwest (downgradient) adjacent to previous borings DB-5, DB-6, and DB-7, respectively.

Soil samples will be collected at 5-foot intervals to total depth to confirm cone penetrometer testing logs from previous borings. Groundwater is expected at approximately 40 to 45 feet below grade. Proposed screened intervals for the deep wells are shown on Figures 5 and 6 with geologic cross sections for downgradient area and the site, respectively.

Arctos's proposed field and quality assurance/quality control (QA/QC) procedures are in Appendix C. The scope of work will be conducted under the supervision of a California registered geologist or civil engineer.

2.2 Data Evaluation and Report Preparation

Arctos will evaluate the field and analytical data and incorporate the results into the next quarterly status report after completing the field program. The report will include the following:

- Field and sampling procedures (including boring/well construction logs, development logs, sampling logs, and a figure showing the well locations)

- ☐ Laboratory analytical results presented in tables
- ☐ Conclusions regarding the vertical extent of impacted groundwater.

3.0 IN SITU GROUNDWATER REMEDIATION

The objectives of the in situ groundwater remediation system are to (1) develop aerobic groundwater conditions in the hydrocarbon-impacted groundwater, (2) promote the growth of microorganisms that metabolize petroleum hydrocarbons, (3) mitigate the downgradient migration of petroleum hydrocarbons, and (4) vapor-extract hydrocarbons from portions of the saturated zone exposed during low groundwater levels.

Arctos will install the following in situ remediation equipment:

- Oxygen Injection System – Oxygen will be injected using the following components:
  - Seven oxygen injection wells
  - Subsurface conveyance tubing
  - Treatment compound containing the air compressor, oxygen generator, injection pump, manifold, regulators, control panel, and accessories.
- SVE System – Vapor extraction will be conducted using the following components:
  - Blower with thermal / catalytic oxidizer
  - Subsurface conveyance piping to existing extraction wells.

3.1 Oxygen Injection System

The injection of oxygen into hydrocarbon-impacted groundwater can stimulate the growth of naturally occurring petroleum-degrading aerobic microorganisms. Enhanced in situ bioremediation is a proven remediation technique for sites where physical remediation processes (such as groundwater pumping and aboveground treatment) may not be efficient, and conditions for biological processes are more favorable. Oxygen injection enhances the biodegradation of organic contaminants that are aerobically biodegradable, such as petroleum hydrocarbons. Biodegradation of gasoline oxygenates, including MTBE and TBA, has been observed at numerous sites.

The proposed oxygen generation system will purify ambient air to produce greater than 90 percent oxygen with variable delivery flows from 0.5 to 10 standard cubic feet per minute (scfm). The primary mechanisms of oxygen transport are advection and dispersion, the same mechanisms that facilitate contaminant migration. The system will deliver oxygen at high concentrations and low flow rates to maximize oxygen transfer to groundwater without volatilizing dissolved hydrocarbons. The high solubility of oxygen gas overcomes the mass transfer limitation of air injection and other oxygen-supplying techniques. The dissolution of nearly pure oxygen at a controlled rate can result in measured dissolved oxygen concentrations up to 40 milligrams per liter (mg/l). This technology will produce dissolved oxygen concentrations significantly higher than the total oxygen demand observed within the impacted groundwater plume resulting in oxygen transport and geochemical conditions that are ideal for biodegradation (Matrix, 2005).

3.1.1 Oxygen Injection Wells

Five injection wells will be installed on approximately 20-foot centers extending northeast to southwest in the driveway along the northwestern portion of the site to target the source area. Two additional injection wells will be installed in the northwest corner of the site and angled at approximately 25 degrees from vertical, which will place the screen roughly 28 feet downgradient of the site (Figure 7). The injection wells are designed to target saturated sands and sandy silts between approximately 45 to 60 feet below grade.

The injection wells will be installed using a hollow-stem auger rig and will be blind-drilled to total depth. The five source area injection wells will be constructed as dual-casing injection/monitoring wells using 1-inch Schedule 40 polyvinyl chloride (PVC) pipe for the injection well and 2-inch Schedule 40 PVC pipe for the monitoring well. The wells shall be screened from approximately 60 to 65 feet below grade using 0.020-inch slotted screen. The two downgradient angled injection wells will be constructed using 2-inch-diameter Schedule 40 PVC casing with 5 feet of 0.02-inch slotted well screen placed at a 25 degree angle from vertical at approximately 60 to 65 feet below grade.

A Monterey #2/12 or equivalent sand pack will be installed from approximately 1 foot below to approximately 1 foot above each screened interval. A 3- to 5-foot thick bentonite seal will be placed on top of the sand pack. The remaining annular space will be filled with Portland cement slurry. Each injection well will be completed at the surface with a 12-inch-diameter traffic-rated vault set in concrete. Figure 8 shows a typical dual-casing injection/monitoring well construction diagram. Details of Arctos's field procedures for the proposed field program are described in Appendix C.

3.1.2 Subsurface Conveyance Tubing

Oxygen will be delivered to each injection well through 1/2-inch-diameter high-density polyethylene (HDPE) tubing. All conveyance tubing will be run within 4-inch-diameter Schedule 40 PVC conduit. The conduit will be installed from the wellhead to the oxygen injection system in a treatment compound. The tubing and conduit will be buried in a trench and backfilled with native soil or imported material. The backfill material will be compacted to at least 90 percent of the material's maximum dry density following American Society for Testing and Materials (ASTM) Method D1557-78. The backfilled trenches will be repaved with asphalt to match existing site conditions. The conveyance tubing will be connected to a manifold located in the treatment compound and connected to an oxygen generator.

3.1.3 Oxygen Generation System Description

The oxygen generation system is an existing ozone sparge system that has a programmable option to produce only high-concentration oxygen. The system is manufactured by H_2O Engineering Inc. (H_2O) of San Luis Obispo, California. The system will be placed in a secured treatment compound. The major components of the oxygen injection system are described below:

1. Equipment Enclosure – The unit will be enclosed in a ventilated trailer-mounted enclosure. A lock-down feature will be provided to secure the system. A distribution manifold will be located inside the enclosure.

2. Oxygen Generator – A pressure swing adsorption (PSA) system will be used generate oxygen from ambient air. This unit will deliver up to 15 standard cubic feet per hour (scfh) at over 90 percent by volume oxygen concentration. The main components of the oxygen generator are an oilless air compressor and a SeQual ATF Oxygen Concentrator Module.

3. Distribution Subsystem – The oxygen system contains a 20-port manifold with solenoid valves, a high pressure safety switch, and ½-inch Kynar compression fittings for pulsing oxygen into the injection wells.

4. Integrated Control System – The system contains a programmable logic controller (PLC) with a human machine interface (HMI). The system controller is an electronic logic timer that controls the sparge system. The controller provides independent time duration control for each sparge point from 1 to 99 minutes.

5. Wellhead Equipment - Each wellhead will include an access port for sampling or routine injection, operation, and maintenance, and a pressure gage to measure pressure in the casing (Figure 8).

3.1.4 Oxygen Injection System Operation

The oxygen injection system will initially be operated at the five source area injection wells (IP-1 to IP-5). The remaining two injection wells (IP-6 and IP-7) will be used to treat a portion of the contaminant plume roughly 40 feet downgradient of the source area.

The combined area of influence of the five source area injection wells is anticipated to be approximately 85 feet wide and extend approximately 10 feet upgradient and downgradient of the injection points under static groundwater conditions. The two downgradient injection wells will have an anticipated area of influence of approximately 40 feet wide and extend approximately 10 feet upgradient and downgradient of the injection points. The maximum thickness of saturated sand targeted by the injection points will be approximately 40 feet. The volume of the saturated zone within the source area oxygen injection zone will be approximately 85 feet by 20 feet by 40 feet. The following table summarizes the system design data including initial estimated concentrations and mass loading values.

Design Parameters	Units	Value
Area of influence	ft^2	1,700
Average benzene concentration	μg/l	2,500
Average MTBE concentration	μg/l	6,300
Depth to water	feet	41
Total saturated thickness affected by source area oxygen injection	feet	40
Volume of soil within source area treatment zone	ft^3	68,000
Mass of benzene within source area treatment zone	pounds	~3
Mass of MTBE within source area treatment zone	pounds	~7
Oxygen demand within source area treatment zone, due to benzene and MTBE	pounds	~22

The injection system will deliver oxygen to the subsurface in pulsed intervals through its manifold. The benefits to the pulsed injection cycle will include: (1) the increased potential for mixing of the oxygen with groundwater and (2) decreased potential for "pushing" dissolved hydrocarbons away from the injection wells.

3.2 SVE System

An SVE system is proposed to assist in groundwater remediation through the removal and treatment of hydrocarbon-impacted soil vapors from the saturated soil exposed during periods of low groundwater levels. Groundwater elevations at the site vary by approximately 6 to 17 feet each year with historically low levels occurring in July to December.

3.2.1 SVE Pilot Test

A soil vapor extraction pilot test was conducted by Arctos on 5 December 2007. The objectives of the pilot test were to (1) assess the applicability of SVE technology to remediate the exposed saturated zone soil and (2) collect site-specific data to establish design parameters for a full-scale SVE system. To accomplish these objectives, Arctos performed an 8-hour, single well pilot test to monitor mass removal rate, flow, vacuum, and radius of influence. SVE pilot test procedures and logs are in Appendix D.

3.2.2 SVE System Description

An SVE system will be installed to extract and treat impacted soil vapor from existing source area wells. A blower will be used to maintain a partial vacuum on the extraction wells. Because pressure differentials will exist between the extraction wells and the surrounding soil, air will flow through the impacted soil toward the extraction wells. Compounds with adequate vapor pressure will be stripped from the soil by the moving air. This air will be collected at the extraction wells, piped through a manifold to a vapor treatment unit, and discharged to the atmosphere in accordance with a Bay Area Air Quality Management District (BAAQMD) permit.

Soil vapor will be extracted using a positive displacement blower and treated with a thermal or catalytic oxidizer. The soil vapor lines from each well casing will be individually connected to a pipe manifold located in the treatment compound. Each soil vapor line will have a shut-off valve and sample port. The system will operate at a total extraction rate of 75 to 150 scfm. The following table summarizes the SVE design parameters developed from the pilot test:

SVE Design Parameters	Units	Value
No. of extraction wells		3
No. of casings per extraction well		1
Radius of vacuum influence	feet	26
Well spacing	feet	10 to 15
Extraction flow rate	scfm	75 to 150
Applied vacuum	in. Hg	6 to 12
Minimum pore-gas velocity	cm/s	0.01
Expected TPHg concentration at start-up	µg/l	11,000
Expected benzene concentration at start-up	µg/l	21
VOC mass removal rate at 75 to 150 scfm	lbs/day	15 to 18

3.2.3 Vapor Extraction Well Locations and Design

Three existing wells (TP-1, TP-2, and VW-2) are proposed for vapor extraction based on their location within the former source area and screen interval through the lower portion of the vadose zone. The screen intervals of these wells will be exposed during periods of low groundwater levels. The layout of the SVE wells with overlaying 50-foot-diameter circles indicating the anticipated radius of influence is shown on Figure 9.

Wells TP-1 and TP-2 were previously installed for groundwater monitoring and well VW-2 was previously installed for vapor extraction. The following table summarizes the well construction for each SVE well:

Well ID	Diameter (inches)	Screen Interval (depth in feet)
TP-1	2	28 to 43
TP-2	2	28 to 43
VW-2	2	22 to 37

4.0 MONITORING AND ANALYTICAL PROGRAM

The effects of in situ remediation will be monitored at the following wells:

Location	Monitoring Well
Upgradient of the oxygen injection system	Wells MW-1 and MW-3
Downgradient of the oxygen injection system	Wells MW-6, MW-9, and DW-2, DW-3, and DW-4
Source area injection zone	Wells MW-2, TP-1, TP-2, VW-2, and DW-1

Monitoring data will be collected to (1) measure the change in hydrocarbon concentrations, (2) measure the general groundwater quality compared to baseline conditions, and (3) track the changes in groundwater quality with time and observe rebound in dissolved benzene and MTBE concentrations.

Pressure will also be monitored at each injection wellhead to ensure that enough pressure is being applied to keep the well casing evacuated.

4.1 Groundwater Monitoring Plan

Groundwater monitoring will be conducted at the above-referenced monitoring wells to establish baseline groundwater conditions before start-up of the injection system and during scheduled quarterly sampling events during operation. Groundwater samples will be collected following sampling procedures presented in Appendix C and analyzed for the following parameters:

- Field parameters including pH, temperature, conductivity, dissolved oxygen (DO), oxidation reduction potential (ORP), and ferrous iron
- TPHg, BTEX, MTBE, and TBA
- Inorganic compounds from selected wells including alkalinity, biochemical oxygen demand (BOD), chemical oxygen demand (COD), chloride, nitrate, nitrite, phosphate, and sulfate
- Light gases (dissolved carbon dioxide and methane).

In addition to the chemical parameters, microbiological samples will be collected and analyzed from selected wells. The analyses will include testing for (1) universal bacteria,

(2) PM-1 (an indicator of MTBE-degrading bacteria), and (3) toluene dioxygenase by polymerase chain reaction (PCR) methods. Toluene dioxygenase is an enzyme produced by bacteria containing a specific gene that triggers its production. Detection of the enzyme is an indirect method of determining the presence of bacteria capable of degrading dissolved hydrocarbons.

Biotraps baited with carbon-13-enriched MTBE, TBA, and benzene will be installed in wells MW-2, MW-6, and MW-9 to evaluate whether target contaminant degradation is occurring under baseline conditions. The baited biotraps will be analyzed for the baited compound degradation rates and phospholipid fatty acids (PLFA). The PLFA analysis will be used to describe the active biological community with information obtained about viable biomass concentrations, community composition, and metabolic status.

Once oxygen injection has begun, field parameters and hydrocarbon concentrations will be monitored quarterly to monitor the presence and effectiveness of injected oxygen. Inorganic compounds and light gases will be analyzed semiannually to measure the long-term effects of injection. Microbiologic sampling will also be conducted semiannually at wells MW-2, MW-4, MW-6, and TP-1. Semiannual sampling will occur during the first and third quarters because of the high and low groundwater levels seen in those quarters, respectively.

The following table summarizes the parameters, monitoring wells, sampling frequency, and anticipated results during monitoring to determine the remediation effectiveness.

Parameter	Monitoring Wells	Sampling Frequency	Anticipated Result
Petroleum hydrocarbons	MW-1, -2, -3, -6, -9, TP-1, -2, VW-2, DW-1, -2, -3, and -4	Baseline and quarterly thereafter	Decrease in target compounds (TPHg, BTEX, MTBE, TBA)
DO and ORP			Increase due to influence of oxygen injection
Conductivity			Increase due to mobilization of inorganic constituents responding to the change from an anaerobic to aerobic environment and to increased biological activity
pH and temperature			Slight increases from biological processes possible; would normally remain within range described by baseline conditions

Parameter	Monitoring Wells	Sampling Frequency	Anticipated Result
Inorganic compounds	MW-2, -3, -6, -9, TP-1, -2, and VW-2	Baseline and semiannually thereafter	Changes in geochemistry due to oxygen-enhanced biological processes
Light gases			Changes in geochemistry due to oxygen-enhanced biological processes
Microbiological testing	MW-2, -4, -6, and TP-1	Baseline and semiannually thereafter	Increase in aerobic populations in response to oxygen injection; temporary increase in population of MTBE- and hydrocarbon-degrading bacteria (until MTBE and other dissolved hydrocarbons degrade)
Stable isotope probing (baited biotrap, benzene, MTBE, and TBA)	MW-2, -6, and -9	Baseline and semiannually thereafter	Increase in rate of petroleum hydrocarbon degradation when injection begins, then decrease over time

Note – Monitoring wells and sampling frequency may be adjusted based on results.

Samples will be collected using the groundwater sampling procedures described in Appendix C and will be analyzed following the program described in Section 4.1.2.

4.1.1 Groundwater Analytical Laboratories

The following laboratories will analyze the groundwater samples:

Kiff Analytical LLC
2795 2nd Street, Suite 300
Davis, California 95616
Phone: 530/297-4800
Fax: 530/297-4808

Microbial Insights, Inc.
2340 Stock Creek Boulevard
Rockford, Tennessee 37853
Phone: 865/573-8188
Fax: 865/573-8133

4.1.2 Groundwater Sample Analyses

Groundwater samples will be analyzed using the following test methods within the appropriate holding times following U.S. Environmental Protection Agency (EPA) methods, as appropriate:

- TPHg, BTEX, MTBE, and TBA by EPA Method 8260
- DO, ORP, conductivity, pH, and temperature using a YSI Model 556 MPS field meter
- Ferrous iron using a Hach field test kit
- Water quality parameters including alkalinity, BOD, and COD by EPA Methods 310.1, 405.1, and 410.4, respectively
- Ammonia, chloride, nitrate, nitrite, sulfate, and phosphate using EPA Method 300
- Dissolved carbon dioxide and methane using EPA Methods D1945 or equivalent
- Biotraps analyzed at the laboratory for total bacteria, MTBE-degrading bacteria, and dissolved hydrocarbon-degrading bacteria by PCR methods.
- MTBE-, TBA-, and benzene-baited biotraps analyzed at the laboratory for the baited compound, carbon-13, and PLFA.

4.2 Soil Gas Monitoring Plan

SVE system monitoring will be conducted to evaluate system performance and compliance with BAAQMD permit conditions. Soil gas samples will be collected following sampling procedures presented in Appendix C and analyzed for the following parameters:

- TPHg, BTEX, MTBE, and TBA
- Fixed gases (oxygen, nitrogen, methane, and carbon dioxide).

During SVE operation, extraction well influent samples will be collected from the system manifold monthly to monitor the effectiveness of the system. SVE system influent and effluent samples will be collected per BAAQMD permit requirements.

4.2.1 Soil Gas Analytical Laboratories

The following laboratories will analyze the soil gas samples:

Kiff Analytical LLC
2795 2nd Street, Suite 300
Davis, California 95616
Phone: 530/297-4800
Fax: 530/297-4808

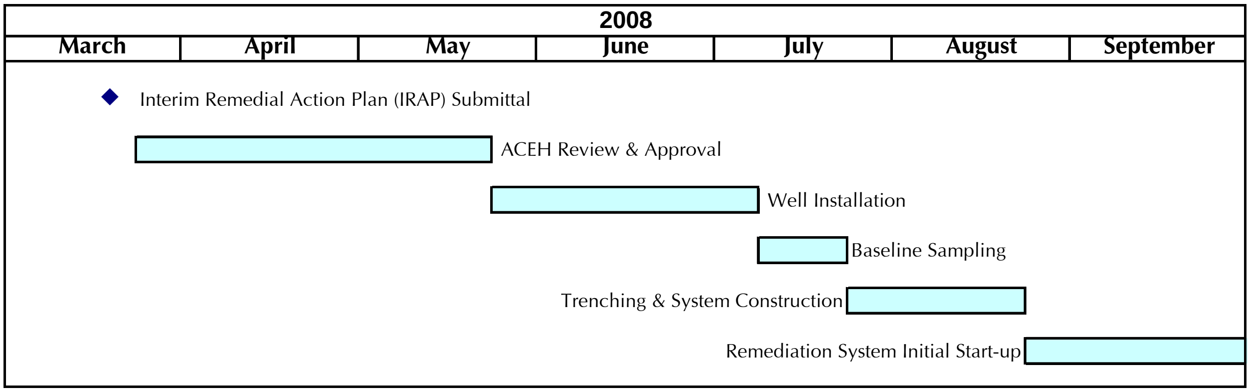
4.1.2 Soil Gas Sample Analyses

Soil gas samples will be analyzed using the following test methods within the appropriate holding times following U.S. EPA and American Society for Testing and Materials (ASTM) methods, as appropriate:

- ☐ TPHg, BTEX, MTBE, and TBA by EPA Method 8260
- ☐ Fixed gases (oxygen, nitrogen, methane, and carbon dioxide) by ASTM Method D1946 or equivalent.

5.0 IN SITU REMEDIATION SYSTEM INSTALLATION SCHEDULE

IRAP implementation will occur as shown on the following schedule including regulatory approval, installation, and remediation system initial start-up.



6.0 DATA EVALUATION AND REPORTING PROGRAM

While the oxygen injection and/or SVE systems are active, Arctos will include progress updates in the quarterly status reports submitted to the ACEH. After completing the initial system start-up period (1 to 3 months), Arctos will review the analytical data to evaluate the effectiveness of the oxygen injection and SVE systems. The start-up results (and subsequent system operating data) will be incorporated into the quarterly status reports, which will summarize the following:

- Field program
- Groundwater and soil gas samples and sampling procedures
- Field and laboratory analytical results
- Conclusions and recommendations regarding the effectiveness of the oxygen injection and SVE systems.

The report will also contain the following documentation:

- Figures showing the site location, site plan, and locations of monitoring wells, extraction wells, and injection points
- Chain-of-custody forms
- Laboratory analytical reports.

7.0 REFERENCES

Arctos Environmental (Arctos), 2005. *Initial Site Conceptual Model, Tesoro Livermore Site, No. 67076*, September.

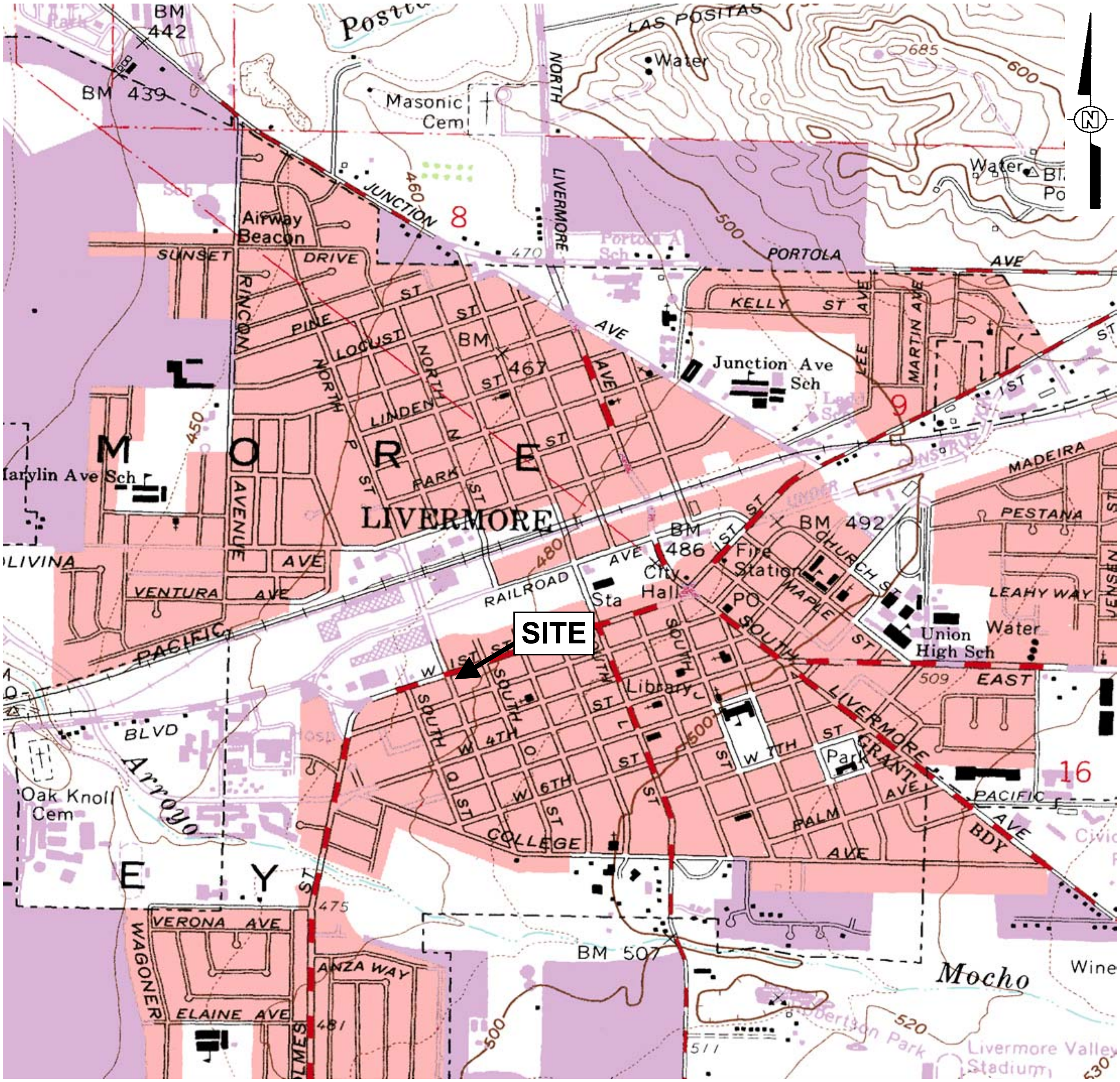
California Department of Water Resources (CDWR), 1974. *Bulletin 118-2, Evaluation of Groundwater Resources : Livermore and Sunol Valleys*, June.

Matrix Environmental Technologies, Inc., 2005. *Proposal to Install an Oxygen Injection System*, 2 March.

8.0 LIMITATIONS

Arctos has prepared this document as it pertains to the subject property located at 1619 First Street, Livermore, California. Any use of or reliance on this document by a third party shall be at such party's sole risk. Arctos will perform a limited scope of work as described in this interim remedial action plan, the client contract, proposal, and addenda. The remediation activities will be performed at specific areas of environmental concern and other impacted media may be present at other areas of the site. Therefore, despite the use of reasonable care, Arctos may not detect such hazardous substances.

No warranty or guarantee concerning the findings or conclusions of this remedial program will be offered or intended. Rather, Arctos's proposed scope and performance of the professional services will be rendered in accordance with the current state of practice as conducted in the site region by similarly qualified practitioners.



SCALE

0 2000 4000 FEET

REFERENCE

7.5 MINUTE USGS TOPOGRAPHIC MAP OF
LIVERMORE, CALIFORNIA QUADRANGLE
DATE: 1961, PHOTOREVISED 1980
SCALE = 1:24,000

ARCTOS ENVIRONMENTAL			
TESORO - LIVERMORE			
SITE LOCATION MAP			
PROJECT NO. 01LV	DRAWN BY MP	CHECKED BY MP	APPROVED BY JG
FILE NO. Site Map.xls		FIGURE 1	

Legend

MW-7 Groundwater Monitoring Well

DW-1 Proposed Deep Groundwater Monitoring Well

DB-5 Soil Boring and Grab Groundwater Sampling Location

IP-1 Proposed Injection Well

VW-2 Vapor Extraction Well

TP-2 Temporary Monitoring Well

A A' Geologic Cross Section

0 30' 60'
SCALE

REVISION	NO.	BY	DATE	DESCRIPTION
0	0	MY	3/21/08	IRAP

ARCTOS ENVIRONMENTAL

TESORO - LIVERMORE

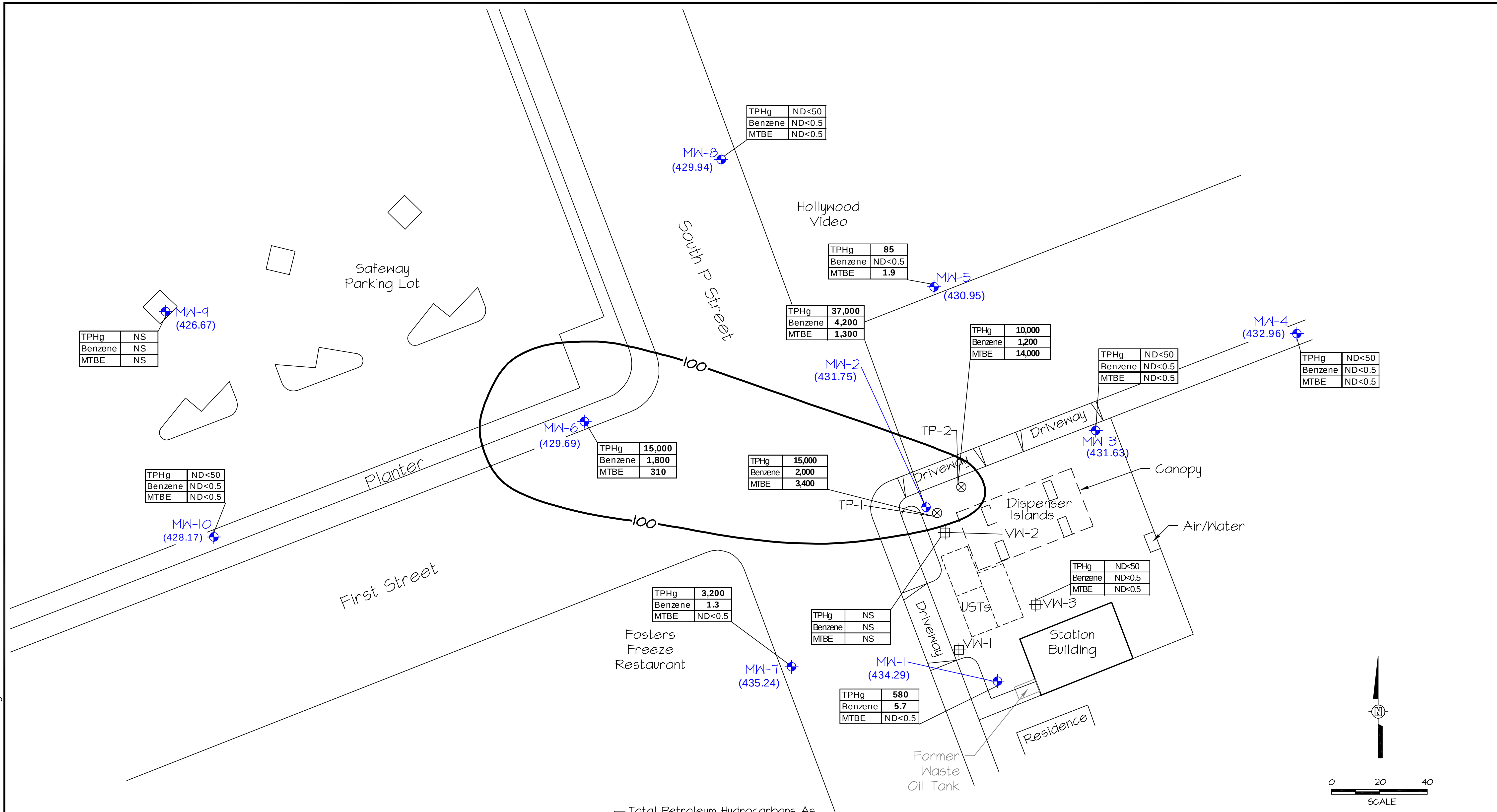
SITE PLAN

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	MP	JPG

FILE NO. 01LV11B-20200.DWG

FIGURE 2

3/20/2008 3:07PM 01LV11B-20200.dwg



Legend

MW-7 (435.24)	Groundwater Monitoring Well with Groundwater Elevation (Feet, MSL) and 2 August 2007 Results
VW-2	Vapor Extraction Well
TP-2	Temporary Monitoring Well
ND	Not Detected at Reporting Limit Listed

TPHg	580	Total Petroleum Hydrocarbons As Gasoline (THPg) (µg/l)
Benzene	5.7	Benzene (µg/l)
MTBE	ND<0.5	Methyl Tert-Butyl Ether (MTBE) (µg/l)

100 — Benzene Concentration Contour (µg/l)

REVISION 0

REVISIONS

NO.	BY	DATE	DESCRIPTION
0	MY	3/21/08	IRAP

ARCTOS ENVIRONMENTAL

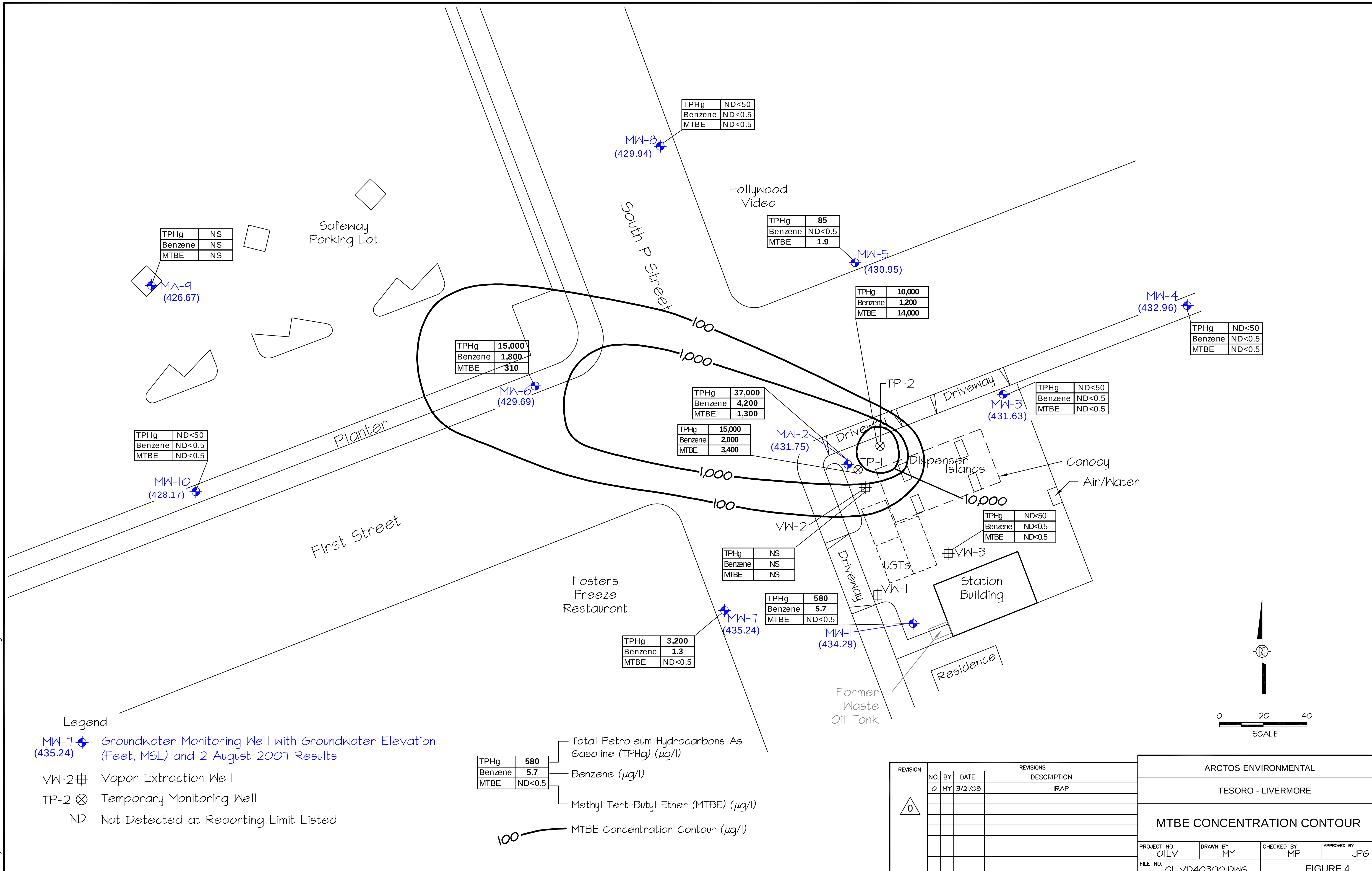
TESORO - LIVERMORE

BENZENE CONCENTRATION CONTOUR

PROJECT NO. OILV | DRAWN BY MY | CHECKED BY MP | APPROVED BY JPG

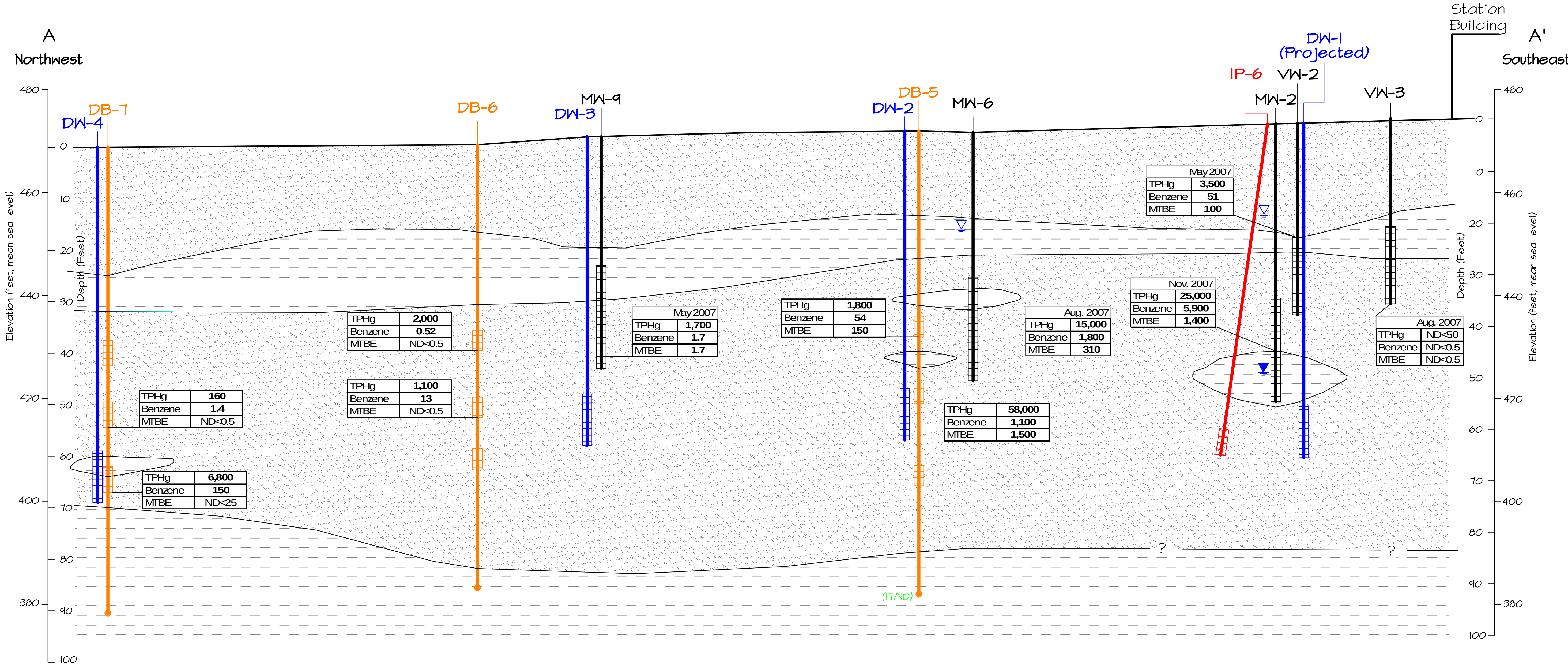
FILE NO. OILVD40400.DWG | FIGURE 3

3/20/2008 4:14PM 01LVD40400.dwg



01LVD40300.dwg

3/20/2008 4:20PM



Legend

Soil Classification

- Clayey and silty gravels, and gravelly sands with clay
- Silty clays, clayey sands, and silty clays with gravel
- MW-9 — Well Identification
- DW-1 — Proposed Deep Groundwater Monitoring Well
- IP-6 — Proposed Injection Well
- Groundwater elevation on 12 November 2007
- Historical high groundwater elevation reported in March 1996
- Screened interval groundwater wells sampled on 17 May, 2 August, and 12 November 2007
- DB-5 (1/ND) — Soil sample location with Benzene/MTBE results in micrograms per kilogram (µg/kg)
- Grab groundwater sample location sampled on 3 February 2006 and 4 January 2007

Groundwater Results

TPHg	ND<50
Benzene	ND<0.5
MTBE	ND<0.5

- TPHg — Total Petroleum Hydrocarbons As Gasoline (µg/l)
- Benzene (µg/l)
- MTBE — Methyl Tert-Butyl Ether (MTBE) (µg/l)

Horizontal Scale: 0 25' 50'

Vertical Scale: 0 10' 20'

REVISION	NO.	BY	DATE	DESCRIPTION
0	0	MY	3/21/08	IRAP

ARCTOS ENVIRONMENTAL

TESORO - LIVERMORE

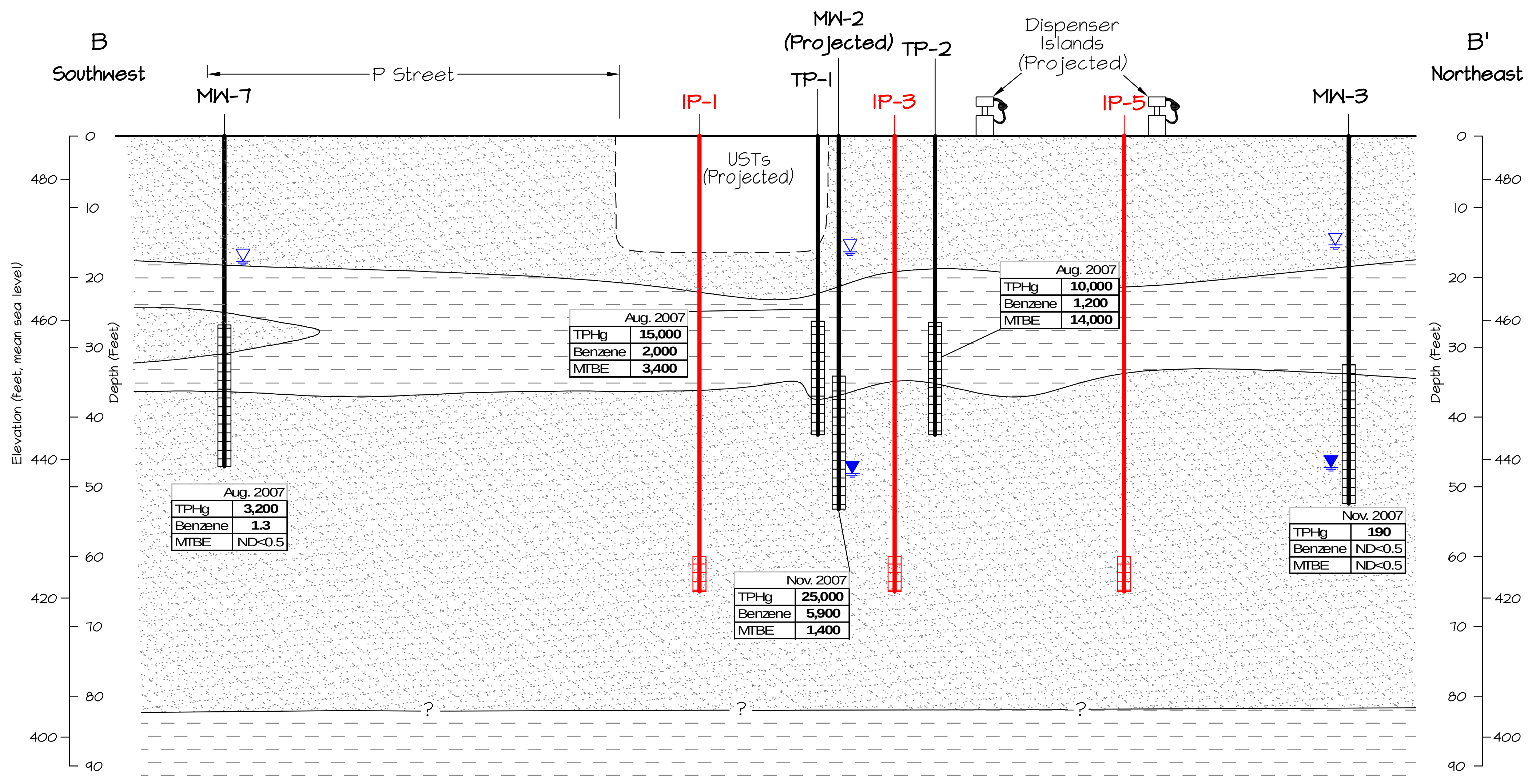
GEOLOGIC CROSS SECTION A-A'

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	MP	JPG

FILE NO. 01LV11B-20300.DWG

FIGURE 5

3/20/2008 4:25PM 01LV11B-20300.dwg



Legend

Soil Classification

- Clayey and silty gravels, and gravelly sands with clay
- Silty clays, clayey sands, and silty clays with gravel

MW-3 Well identification

IP-1 Proposed Injection Well

Groundwater elevation on 12 November 2007

Historical high groundwater elevation reported in March 1996

Screened interval groundwater wells sampled on 2 August, 12 November 2007

Groundwater Results

TPHg	ND<50	Total Petroleum Hydrocarbons As Gasoline (µg/l)
Benzene	ND<0.5	Benzene (µg/l)
MTBE	ND<0.5	Methyl Tert-Butyl Ether (MTBE) (µg/l)

0 10' 20'
Horizontal Scale

0 10' 20'
Vertical Scale

Note:
Depth of clay aquitard is estimated from soil lithology at the Livermore Arcade Shopping Center to the northwest.

REVISION	NO.	BY	DATE	DESCRIPTION
0	0	MY	3/21/08	IRAP

ARCTOS ENVIRONMENTAL

TESORO - LIVERMORE

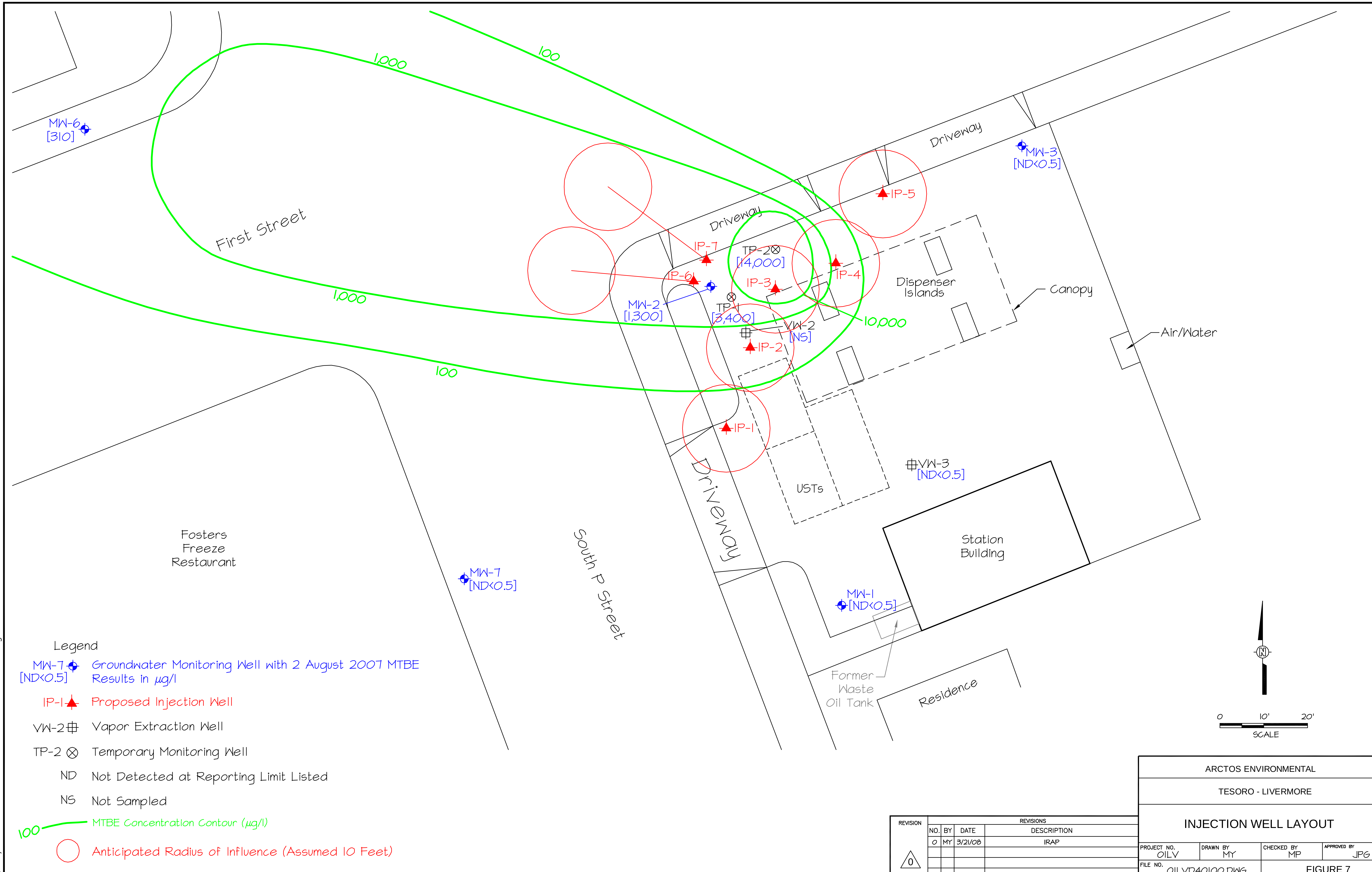
GEOLOGIC CROSS SECTION B-B'

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	MP	JPG

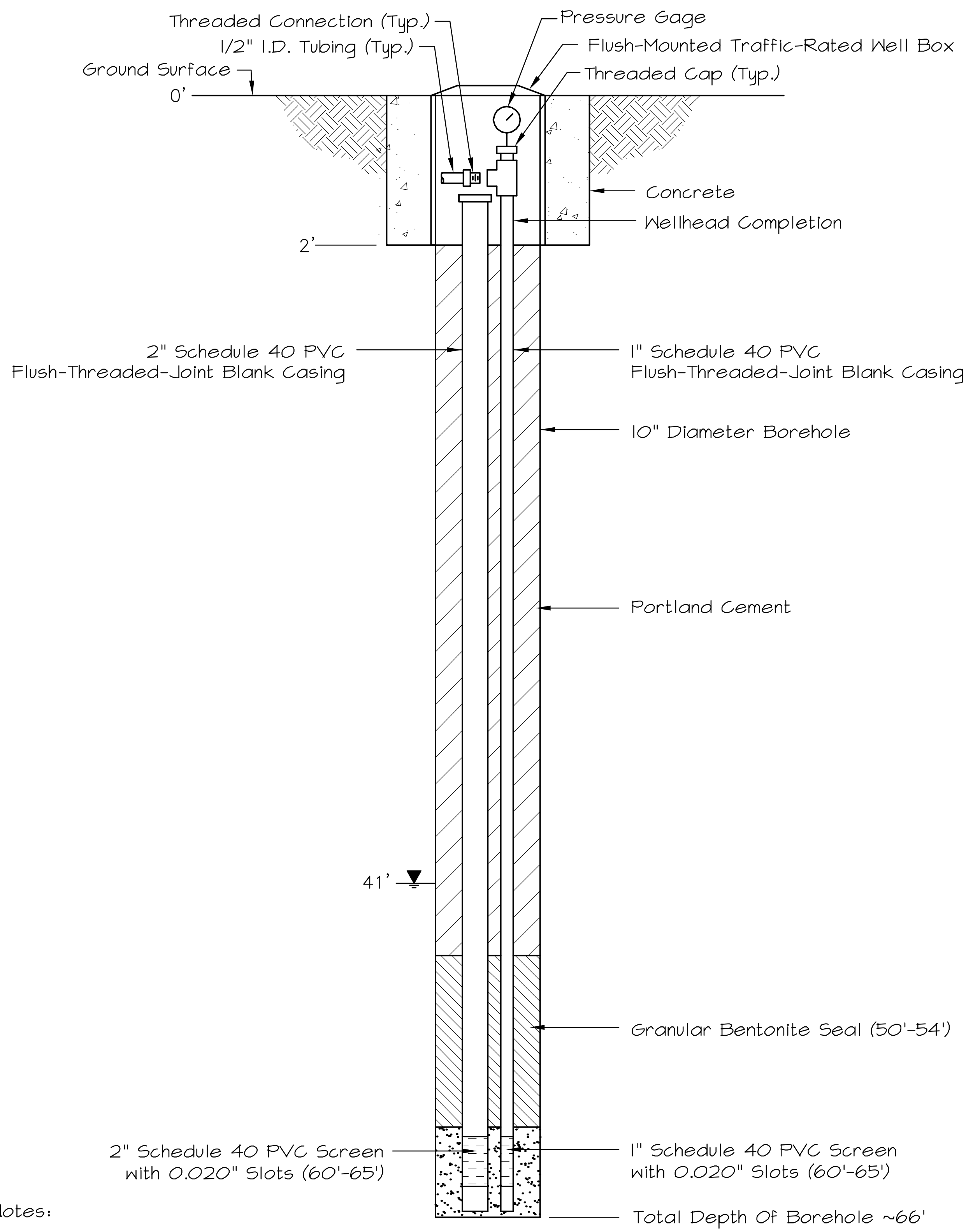
FILE NO. 01LVD40700.DWG

FIGURE 6

01LVD40700.dwg 3/20/2008 4:31PM



3/20/2008 4:33PM 01LVD40100.dwg



Notes:

1. Drawing not to scale.

2. Actual well construction may vary based on field investigation.

REVISION	REVISIONS			
	NO.	BY	DATE	DESCRIPTION
0	0	MY	3/21/08	IRAP

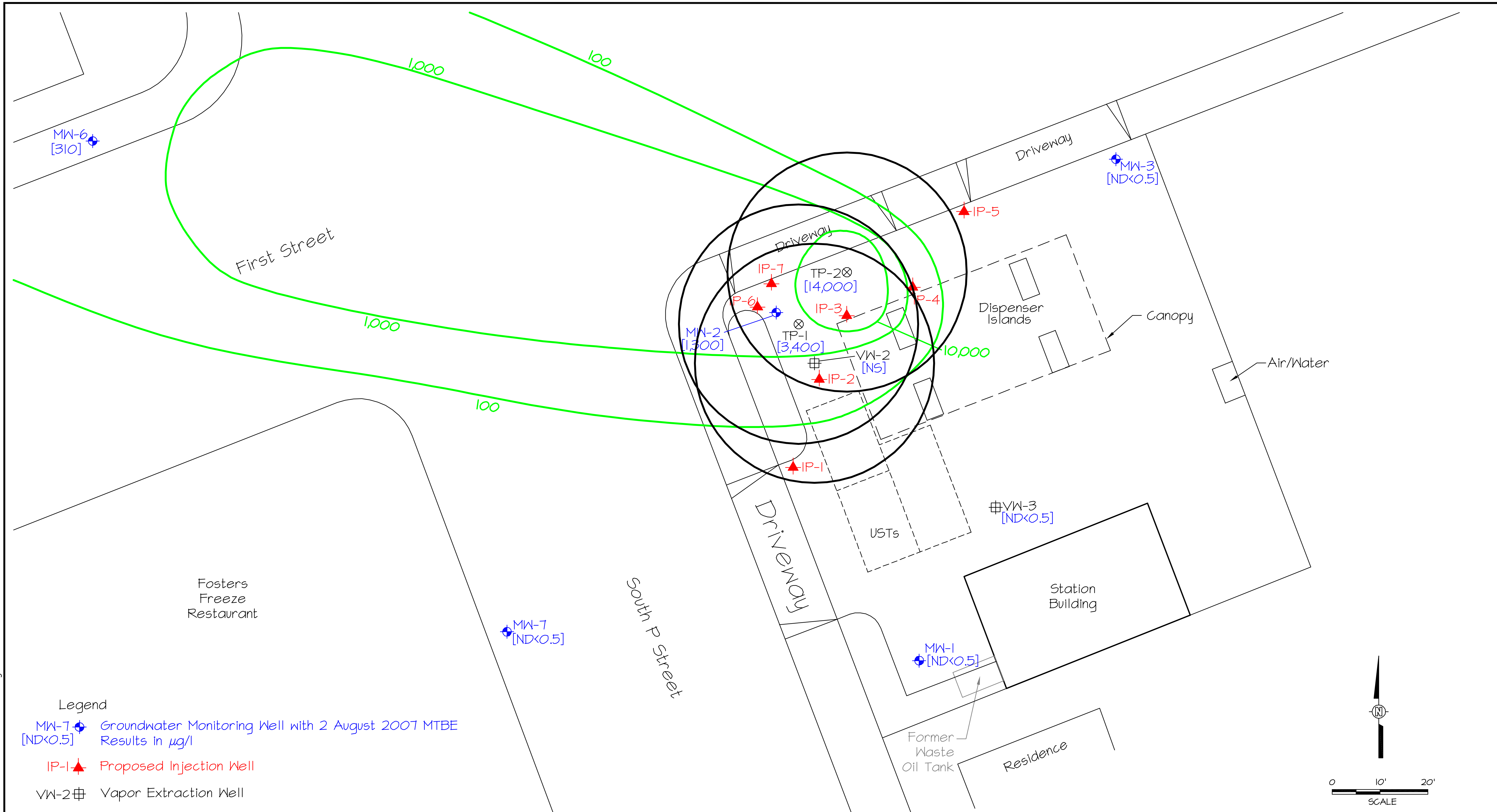
ORION ENVIRONMENTAL INC.

TESORO - LIVERMORE

INJECTION WELL
CONSTRUCTION DIAGRAM

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	MP	JPG
FILE NO. 01LVD40200.DWG		FIGURE 8	

3/20/2008 4:50PM 01LVD40200.dwg



Legend

MW-7 [ND<0.5]	Groundwater Monitoring Well with 2 August 2007 MTBE Results in µg/l
IP-1	Proposed Injection Well
VW-2	Vapor Extraction Well
TP-2	Temporary Monitoring Well
ND	Not Detected at Reporting Limit Listed
NS	Not Sampled
100	MTBE Concentration Contour (µg/l)
◯	Anticipated Radius of Influence (Assumed 25 Feet)

REVISION	NO.	BY	DATE	DESCRIPTION
0	0	MY	3/21/08	IRAP

ARCTOS ENVIRONMENTAL

TESORO - LIVERMORE

SOIL VAPOR EXTRACTION COVERAGE MAP

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	MP	JPG

FILE NO. 01LV11B-20100.DWG — FIGURE 9

01LV11B-20100.dwg 4:35PM 3/20/2008

ARCTOS

APPENDIX A

HISTORICAL GROUNDWATER ELEVATIONS AND ANALYTICAL RESULTS

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-1	6/1/1993	37.50	474.29	436.79
	6/22/1993	38.46		435.83
	10/6/1993	42.22		432.07
	1/13/1994	34.52		439.77
	3/30/1994	31.93		442.36
	4/25/1994	33.49		440.80
	8/12/1994	41.03		433.26
	12/14/1994	38.63		435.66
	2/10/1995	30.80		443.49
	6/15/1995	25.46		448.83
	9/26/1995	31.05		443.24
	12/15/1995	28.11		446.18
	3/21/1996	17.67		456.62
	6/13/1996	22.86		451.43
	9/16/1996	30.04		444.25
	12/2/1996	26.74		447.55
	3/7/1997	20.84		453.45
	6/12/1997	28.71		445.58
	9/29/1997	33.91		440.38
	12/1/1997	34.88		439.41
	3/19/1998	19.83		454.46
	5/29/1998	21.57		452.72
	9/15/1998	31.68		442.61
	11/30/1998	36.80		437.49
	1/17/1999	30.02		444.27
	6/10/1999	29.30		444.99
	9/7/1999	31.41		442.88
	12/13/1999	32.95		441.34
	3/13/2000	25.74		448.55
	6/12/2000	28.24		446.05
	11/10/2000	30.56		443.73
	12/31/2000	31.71		442.58
	3/27/2001	30.43		443.86
	6/30/2001	36.61		437.68
	9/26/2001	45.10		429.19

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-1	12/18/2001	39.39	474.29	434.90
(cont.)	3/18/2002	38.24		436.05
	8/21/2002	36.71		437.58
	12/3/2002	36.85		437.44
	3/4/2003	33.72		440.57
	6/10/2003	31.31		442.98
	9/9/2003	35.05		439.24
	12/23/2003	30.15		444.14
	3/23/2004	26.61		447.68
	5/10/2004	30.31		443.98
	8/4/2004	34.77		439.52
	11/4/2004	33.93		440.36
	1/12/2005	27.82		446.47
	5/2/2005	24.87		449.42
	7/19/2005	29.26		445.03
	11/21/2005	31.15		443.14
	2/9/2006	26.24		448.05
	5/16/2006	24.87		449.42
	8/9/2006	31.64		442.65
	11/8/2006	31.16		443.13
	2/14/2007	30.00		444.29
	5/17/2007	33.75		440.54
	8/2/2007	40.00		434.29
	11/12/2007	48.55		425.74
MW-2	6/1/1993	38.02	472.98	434.96
	6/22/1993	39.07		433.91
	10/6/1993	43.72		429.26
	1/13/1994	35.85		437.13
	3/30/1994	32.82		440.16
	4/25/1994	34.76		438.22
	8/12/1994	44.33		428.65
	12/14/1994	40.00		432.98
	2/10/1995	32.16		440.82
	6/15/1995	25.93		447.05

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation(b) (feet MSL)	Water Table Elevation(c) (feet MSL)
MW-2	9/26/1995	32.42	472.98	440.56
(cont.)	12/15/1995	29.41	472.98	443.57
	3/21/1996	17.47	472.98	455.51
	6/13/1996	23.69		449.29
	9/16/1996	31.24		441.74
	12/2/1996	26.90		446.08
	3/7/1997	21.33		451.65
	6/12/1997	29.94		443.04
	9/29/1997	34.22		438.76
	12/1/1997	35.94		437.04
	3/19/1998	20.34		452.64
	5/29/1998	22.63		450.35
	9/15/1998	32.30		440.68
	11/30/1998	36.90		436.08
	1/17/1999	30.17		442.81
	6/10/1999	29.98		443.00
	9/7/1999	31.85		441.13
	12/13/1999	33.72		439.26
	3/13/2000	26.54		446.44
	6/12/2000	28.44		444.54
	11/10/2000	31.31		441.67
	12/31/2000	32.68		440.30
	3/27/2001	30.81		442.17
	6/30/2001	37.58		435.40
	9/26/2001	44.97		428.01
	12/18/2001	40.67		432.31
	3/18/2002	38.94		434.04
	6/5/2002	36.45		436.53
	8/21/2002	37.15		435.83
	12/3/2002	36.76		436.22
	3/4/2003	33.60		439.38
	6/10/2003	32.89		440.09
	9/9/2003	35.45		437.53
	12/23/2003	31.79		441.19
	3/23/2004	28.25		444.73

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-2	5/10/2004	30.91	472.98	442.07
(cont.)	8/4/2004	35.36		437.62
	11/4/2004	34.92		438.06
	1/12/2005	29.46		443.52
	5/2/2005	25.61		447.37
	7/19/2005	30.11		442.87
	11/21/2005	32.04		440.94
	2/9/2006	27.11		445.87
	5/17/2006	25.18		447.80
	8/9/2006	32.69		440.29
	11/8/2006	33.21		439.77
	2/14/2007	31.27		441.71
	5/17/2007	34.40		438.58
	8/2/2007	41.23		431.75
	11/12/2007	48.22		424.76
MW-3	6/1/1993	36.18	473.37	437.19
	6/22/1993	37.11		436.26
	10/6/1993	41.15		432.22
	1/13/1994	33.95		439.42
	3/30/1994	30.97		442.40
	4/25/1994	32.46		440.91
	8/12/1994	41.72		431.65
	12/14/1994	37.62		435.75
	2/10/1995	29.96		443.41
	6/15/1995	23.66		449.71
	9/26/1995	29.62		443.75
	12/15/1995	27.10		446.27
	3/21/1996	15.85		457.52
	6/13/1996	21.31		452.06
	9/16/1996	28.62		444.75
	12/2/1996	25.55		447.82
	3/7/1997	19.77		453.60
	6/12/1997	27.67		445.70
	9/29/1997	29.60		443.77
	12/1/1997	33.37		440.00

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-3	3/19/1998	18.76	473.37	454.61
(cont.)	5/29/1998	20.64		452.73
	9/15/1998	30.70		442.67
	11/30/1998	34.96		438.41
	1/17/1999	28.81		444.56
	6/10/1999	28.10		445.27
	9/7/1999	30.38		442.99
	12/13/1999	31.46		441.91
	3/13/2000	24.28		449.09
	6/12/2000	26.80		446.57
	11/10/2000	29.47		443.90
	12/31/2000	31.38		441.99
	3/27/2001	29.94		443.43
	6/30/2001	37.54		435.83
	9/26/2001	45.17		428.20
	12/18/2001	39.41		433.96
	3/18/2002	37.73		435.64
	6/5/2002	35.35		438.02
	8/21/2002	36.21		437.16
	12/3/2002	35.92		437.45
	3/4/2003	32.75		440.62
	6/10/2003	31.26		442.11
	9/9/2003	34.72		438.65
	12/23/2003	30.47		442.90
	3/23/2004	26.67		446.70
	5/10/2004	30.25		443.12
	8/4/2004	34.70		438.67
	11/4/2004	33.94		439.43
	1/12/2005	28.21		445.16
	5/2/2005	24.56		448.81
	7/19/2005	29.39		443.98
	11/21/2005	31.30		442.07
	2/9/2006	26.21		447.16
	5/16/2006	24.36		449.01
	8/9/2006	31.90		441.47

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-3	11/8/2006	31.30	473.37	442.07
(cont.)	2/14/2007	30.20		443.17
	5/17/2007	33.64		439.73
	8/2/2007	41.74		431.63
	11/12/2007	47.41		425.96
MW-4	3/30/1994	31.56	473.64	442.08
	4/25/1994	32.73		440.91
	8/12/1994	41.61		432.03
	12/14/1994	38.11		435.53
	2/10/1995	30.50		443.14
	6/15/1995	23.63		450.01
	9/26/1995	29.70		443.94
	12/15/1995	27.56		446.08
	3/21/1996	15.63		458.01
	6/13/1996	21.07		452.57
	9/16/1996	28.99		444.65
	12/2/1996	26.04		447.60
	3/7/1997	19.69		453.95
	6/12/1997	28.04		445.60
	9/29/1997	29.91		443.73
	12/1/1997	33.88		439.76
	3/19/1998	18.67		454.97
	5/29/1998	20.16		453.48
	9/15/1998	30.46		443.18
	11/30/1998	34.50		439.14
	1/17/1999	28.30		445.34
	6/10/1999	27.60		446.04
	9/7/1999	30.79		442.85
	12/13/1999	31.60		442.04
	3/13/2000	24.35		449.29
	6/12/2000	26.91		446.73
	11/10/2000	29.71		443.93
	12/31/2000	31.79		441.85
	3/27/2001	29.98		443.66
	6/30/2001	36.88		436.76

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-4	9/26/2001	43.87	473.64	429.77
(cont.)	12/18/2001	39.30		434.34
	3/18/2002	37.75		435.89
	6/5/2002	35.68		437.96
	8/21/2002	36.58		437.06
	12/3/2002	35.90		437.74
	3/4/2003	32.73		440.91
	6/10/2003	31.20		442.44
	9/9/2003	34.64		439.00
	12/23/2003	31.30		442.34
	3/23/2004	26.71		446.93
	5/10/2004	30.33		443.31
	8/4/2004	34.87		438.77
	11/4/2004	34.28		439.36
	1/12/2005	28.67		444.97
	5/2/2005	24.46		449.18
	7/19/2005	29.36		444.28
	11/21/2005	31.80		441.84
	2/9/2006	26.34		447.30
	5/16/2006	24.30		449.34
	8/9/2006	32.05		441.59
	11/8/2006	32.85		440.79
	2/14/2007	30.46		443.18
	5/17/2007	33.92		439.72
	8/2/2007	40.68		432.96
	11/12/2007	46.34		427.30
MW-5	3/30/1994	32.07	472.67	440.60
	4/25/1994	33.65		439.02
	8/12/1994	42.73		429.94
	12/14/1994	38.89		433.78
	2/10/1995	31.44		441.23
	6/15/1995	24.99		447.68
	9/26/1995	30.20		442.47
	12/15/1995	28.56		444.11
	3/21/1996	16.82		455.85

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-5	6/13/1996	22.61	472.67	450.06
(cont.)	9/16/1996	29.78		442.89
	12/2/1996	26.51		446.16
	3/7/1997	21.91		450.76
	9/29/1997	31.74		440.93
	12/1/1997	34.05		438.62
	3/19/1998	20.93		451.74
	5/29/1998	21.30		451.37
	9/15/1998	31.32		441.35
	11/30/1998	35.44		437.23
	1/17/1999	29.59		443.08
	6/10/1999	28.05		444.62
	9/7/1999	31.11		441.56
	12/13/1999	32.66		440.01
	3/13/2000	25.87		446.80
	6/12/2000	28.15		444.52
	11/10/2000	30.05		442.62
	12/31/2000	31.81		440.86
	3/27/2001	30.57		442.10
	6/30/2001	37.24		435.43
	9/26/2001	44.53		428.14
	12/18/2001	40.65		432.02
	3/18/2002	38.75		433.92
	6/5/2002	36.21		436.46
	8/21/2002	36.76		435.91
	12/3/2002	36.12		436.55
	3/4/2003	32.90		439.77
	6/10/2003	33.04		439.63
	9/9/2003	34.20		438.47
	12/23/2003	31.38		441.29
	3/23/2004	27.51		445.16
	5/10/2004	31.12		441.55
	8/4/2004	35.09		437.58
	11/4/2004	34.34		438.33
	1/12/2005	29.19		443.48

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-5	5/2/2005	25.31	472.67	447.36
(cont.)	7/19/2005	30.49		442.18
	11/21/2005	32.35		440.32
	2/9/2006	27.19		445.48
	5/16/2006	25.30		447.37
	8/9/2006	32.68		439.99
	11/8/2006	32.22		440.45
	2/14/2007	34.00		438.67
	5/17/2007	34.29		438.38
	8/2/2007	41.72		430.95
	11/12/2007	Dry		--
MW-6	3/30/1994	33.38	471.93	438.55
	4/25/1994	35.49		436.44
	8/12/1994	45.14		426.79
	12/14/1994	40.99		430.94
	2/10/1995	33.34		438.59
	6/15/1995	26.88		445.05
	9/26/1995	33.55		438.38
	12/15/1995	30.32		441.61
	3/21/1996	18.89		453.04
	6/13/1996	24.62		447.31
	9/16/1996	32.64		439.29
	12/2/1996	27.42		444.51
	3/7/1997	22.13		449.80
	6/12/1997	31.02		440.91
	9/29/1997	35.77		436.16
	12/1/1997	37.14		434.79
	3/19/1998	21.10		450.83
	5/29/1998	23.26		448.67
	9/15/1998	33.50		438.43
	11/30/1998	38.73		433.20
	1/17/1999	32.05		439.88
	6/10/1999	31.44		440.49
	9/7/1999	33.94		437.99
	12/13/1999	35.84		436.09

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-6	3/13/2000	28.45	471.93	443.48
(cont.)	6/12/2000	30.52		441.41
	11/10/2000	32.99		438.94
	12/31/2000	34.95		436.98
	3/27/2001	32.72		439.21
	6/30/2001	39.86		432.07
	9/26/2001	Dry		Dry
	12/18/2001	43.36		428.57
	3/18/2002	41.29		430.64
	6/5/2002	38.35		433.58
	8/21/2002	39.02		432.91
	12/3/2002	38.76		433.17
	3/4/2003	35.13		436.80
	6/10/2003	34.15		437.78
	9/9/2003	37.66		434.27
	12/23/2003	33.43		438.50
	3/23/2004	29.96		441.97
	5/10/2004	32.98		438.95
	8/4/2004	37.02		434.91
	11/4/2004	37.03		434.90
	1/12/2005	32.01		439.92
	5/2/2005	27.30		444.63
	7/19/2005	32.27		439.66
	11/21/2005	33.23		438.70
	2/9/2006	29.07		442.86
	5/17/2006	27.23		444.70
	8/9/2006	35.22		436.71
	11/8/2006	33.41		438.52
	2/14/2007	33.43		438.50
	5/17/2007	36.50		435.43
	8/2/2007	42.24		429.69
	11/12/2007	Dry		--
MW-7	3/30/1994	31.98	472.33	440.35
	4/25/1994	33.56		438.77
	8/12/1994	43.35		428.98

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-7	12/14/1994	39.34	472.33	432.99
(cont.)	2/10/1995	32.11		440.22
	6/15/1995	25.51		446.82
	9/26/1995	31.43		440.90
	12/15/1995	28.97		443.36
	3/21/1996	17.36		454.97
	6/13/1996	23.47		448.86
	9/16/1996	31.35		440.98
	12/2/1996	27.11		445.22
	3/7/1997	21.33		451.00
	6/12/1997	29.90		442.43
	9/29/1997	34.37		437.96
	12/1/1997	36.46		435.87
	3/19/1998	20.33		452.00
	5/29/1998	22.30		450.03
	9/15/1998	32.54		439.79
	11/30/1998	37.96		434.37
	1/17/1999	31.04		441.29
	6/10/1999	29.89		442.44
	9/7/1999	32.38		439.95
	12/13/1999	33.98		438.35
	3/13/2000	27.09		445.24
	6/12/2000	28.76		443.57
	11/10/2000	31.54		440.79
	12/31/2000	32.76		439.57
	3/27/2001	30.97		441.36
	6/30/2001	37.50		434.83
	9/26/2001	45.11		427.22
	12/18/2001	41.13		431.20
	3/18/2002	39.22		433.11
	6/5/2002	36.55		435.78
	8/21/2002	36.81		435.52
	12/3/2002	36.52		435.81
	3/4/2003	32.60		439.73
	6/10/2003	31.33		441.00

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-7	9/9/2003	34.71	472.33	437.62
(cont.)	12/23/2003	30.80		441.53
	3/23/2004	26.41		445.92
	5/10/2004	29.86		442.47
	8/4/2004	34.06		438.27
	11/4/2004	34.12		438.21
	1/12/2005	28.83		443.50
	5/2/2005	24.66		447.67
	7/19/2005	29.07		443.26
	11/21/2005	30.42		441.91
	2/9/2006	26.15		446.18
	5/16/2006	24.44		447.89
	8/9/2006	31.77		440.56
	11/8/2006	31.14		441.19
	2/14/2007	30.39		441.94
	5/17/2007	33.31		439.02
	8/2/2007	37.09		435.24
	11/12/2007	Dry		--
MW-8	12/23/2003	32.01	471.18	439.17
	3/23/2004	28.50		442.68
	5/10/2004	31.44		439.74
	8/4/2004	35.11		436.07
	11/4/2004	34.77		436.41
	1/12/2005	29.66		441.52
	5/2/2005	25.91		445.27
	7/19/2005	30.56		440.62
	11/21/2005	32.48		438.70
	2/9/2006	27.40		443.78
	5/16/2006	25.60		445.58
	8/9/2006	32.77		438.41
	11/8/2006	32.10		439.08
	2/14/2007	30.94		440.24
	5/17/2007	34.14		437.04
	8/2/2007	41.24		429.94
	11/12/2007	44.03		427.15

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
MW-9	12/23/2003	34.03	470.78	436.75
	3/23/2004	30.01		440.77
	5/10/2004	33.61		437.17
	8/4/2004	37.47		433.31
	11/4/2004	37.44		433.34
	5/2/2005	27.73		443.05
	7/19/2005	32.90		437.88
	11/21/2005	34.15		436.63
	2/9/2006	29.44		441.34
	5/16/2006	27.50		443.28
	8/9/2006	35.85		434.93
	11/8/2006	34.18		436.60
	2/14/2007	34.00		436.78
	5/17/2007	36.88		433.90
	8/2/2007	44.11		426.67
	11/12/2007	Dry		--
MW-10	12/23/2003	33.80	471.63	437.83
	3/23/2004	28.68		442.95
	5/10/2004	32.15		439.48
	8/4/2004	36.40		435.23
	11/4/2004	36.21		435.42
	1/12/2005	31.64		439.99
	5/2/2005	27.01		444.62
	7/19/2005	31.59		440.04
	11/21/2005	32.96		438.67
	2/9/2006	28.36		443.27
	5/16/2006	26.83		444.80
	8/9/2006	34.37		437.26
	11/8/2006	33.41		438.22
	2/14/2007	32.81		438.82
	5/17/2007	35.85		435.78
	8/2/2007	43.46		428.17
	11/12/2007	44.80		426.83
VW-2	8/4/2004	34.13	473.28	439.15
	11/4/2004	34.75		438.53

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
VW-2	1/12/2005	29.35	473.28	443.93
(cont.)	5/2/2005	25.34		447.94
	7/19/2005	29.76		443.52
	11/21/2005	31.81		441.47
	2/9/2006	27.21		446.07
	5/17/2006	25.26		448.02
	8/9/2006	31.74		441.54
	11/8/2006	33.52		439.76
	2/14/2007	30.77		442.51
	5/17/2007	33.17		440.11
	8/2/2007	36.33		436.95
	11/12/2007	Dry		
VW-3	8/4/2004	32.89	474.38	441.49
	11/4/2004	34.78		439.60
	1/12/2005	29.51		444.87
	5/2/2005	24.79		449.59
	7/19/2005	28.91		445.47
	11/21/2005	31.07		443.31
	2/9/2006	26.60		447.78
	5/16/2006	24.19		450.19
	8/9/2006	30.53		443.85
	11/8/2006	31.62		442.76
	2/14/2007	30.48		443.90
	5/17/2007	31.70		442.68
	8/2/2007	35.55		438.83
	11/12/2007	Dry		--
TP-1	7/19/2005	29.91	472.82	442.91
	11/21/2005	32.28		440.54
	2/9/2006	28.02		444.80
	5/17/2006	25.18		447.64
	8/9/2006	32.81		440.01
	11/8/2006	32.02		440.80
	2/14/2007	33.59		439.23
	5/17/2007	33.52		439.30

TABLE A-1

HISTORICAL WELL AND GROUNDWATER ELEVATIONS
TESORO - LIVERMORE, 67076

Monitoring Well	Date of Measurement	Depth to Water (feet below casing)	PVC Casing Elevation[b] (feet MSL)	Water Table Elevation[c] (feet MSL)
TP-1	8/2/2007	40.30		432.52
(cont.)	11/12/2007	42.85		429.97
TP-2	7/19/2005	29.67	472.93	443.26
	11/21/2005	31.43		441.50
	2/9/2006	27.27		445.66
	5/17/2006	25.00		447.93
	8/9/2006	31.74		441.19
	11/8/2006	32.80		440.13
	2/14/2007	30.32		442.61
	5/17/2007	33.28		439.65
	8/2/2007	39.35		433.58
	11/12/2007	Dry		--
MW-A	1/17/1999	30.13	NM[d]	NM
MW-B	1/17/1999	30.29	NM	NM
MW-C	1/17/1999	30.60	NM	NM
MW-D	1/17/1999	31.32	NM	NM
MW-E	1/17/1999	31.36	NM	NM
MW-W	1/17/1999	30.91	NM	NM

(a) Difference between Depth to Water and Depth to Free Product.
(b) Elevation of PVC well casing (north edge) surveyed relative to mean sea level (MSL).
Wells were surveyed by Cross Land Surveying, Inc., per AB 2886 requirements on 31 August 2005.
Benchmark K2-741, elevation is 467.835 feet above MSL.
(c) Potentiometric Surface Elevation = (Casing Elevation - Depth to Water) + (0.89)(Free Product Thickness)
assuming a free product specific gravity of 0.89.
(d) NM = Well not surveyed.

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (µg/l)	Benzene[b] (µg/l)	Toluene[b] (µg/l)	Ethylbenzene[b] (µg/l)	Xylenes[b] (µg/l)	MTBE[b] (µg/l)	DIPE[b] (µg/l)	ETBE[b] (µg/l)	TAME[b] (µg/l)	TBA[b] (µg/l)	Methanol[b] (µg/l)	Ethanol[b] (µg/l)	1,2-DCA[b] (µg/l)	EDB[b] (µg/l)
MW-1	6/1/1993	27,000	2,200	400	ND<0.5[d]	4,900	-[e]	-	-	-	-	-	-	-	-
	6/22/1993	87,000	8,000	10,000	260	10,000	-	-	-	-	-	-	-	-	-
	10/6/1993	40,000	4,700	6,500	740	5,300	-	-	-	-	-	-	-	-	-
	1/13/1994	9,400	1,300	9,500	110	850	-	-	-	-	-	-	-	-	-
	3/30/1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4/25/1994	11,000	1,500	1,800	290	1,700	-	-	-	-	-	-	-	-	-
	8/12/1994	11,000	550	330	260	1,400	-	-	-	-	-	-	-	-	-
	12/14/1994	11,000	1,000	1,200	320	1,500	-	-	-	-	-	-	-	-	-
	2/10/1995	9,300	1,200	1,500	280	1,500	-	-	-	-	-	-	-	-	-
	6/15/1995	140	5.6	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	9/26/1995	410	140	ND<0.5	ND<0.5	43	-	-	-	-	-	-	-	-	-
	12/15/1995	740	250	ND<1.3	ND<1.3	87	-	-	-	-	-	-	-	-	-
	3/21/1996	ND<50	0.52	ND<0.5	ND<0.5	0.51	-	-	-	-	-	-	-	-	-
	6/13/1996	240	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	9/16/1996	720	70	ND<0.5	1.0	5.1	ND<5	-	-	-	-	-	-	-	-
	12/2/1996	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	3/7/1997	600	6.7	ND<0.5	1.2	1.8	ND<5	-	-	-	-	-	-	-	-
	6/12/1997	18,000	180	800	410	1,800	ND<5	-	-	-	-	-	-	-	-
	9/29/1997	350	120	1.5	ND<0.5	12	ND<5	-	-	-	-	-	-	-	-
	12/1/1997	ND<50	7.0	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	3/19/1998	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	5/29/1998	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	9/15/1998	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	11/30/1998	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	1/17/1999	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	6/10/1999	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	9/7/1999	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	12/13/1999	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	3/13/2000	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	6/12/2000	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	11/10/2000	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-
	12/31/2000	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (μg/l)	Benzene[b] (μg/l)	Toluene[b] (μg/l)	Ethylbenzene[b] (μg/l)	Xylenes[b] (μg/l)	MTBE[b] (μg/l)	DIPE[b] (μg/l)	ETBE[b] (μg/l)	TAME[b] (μg/l)	TBA[b] (μg/l)	Methanol[b] (μg/l)	Ethanol[b] (μg/l)	1,2-DCA[b] (μg/l)	EDB[b] (μg/l)
MW-1	3/27/2001	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-
(cont.)	6/30/2001	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-
	9/26/2001	90	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-
	12/18/2001	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-
	11/4/2004	4,500	2.5	5.8	79	140	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	78	0.80	0.70	0.86	2.4	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<40	ND<5	ND<0.5	ND<0.5
	7/19/2005	290	ND<0.5	ND<0.5	4.0	4.1	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	370	ND<0.5	ND<0.5	0.75	1.3	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	140	ND<0.5	ND<0.5	0.67	1.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/16/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/9/2006	100	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/8/2006	400	ND<0.5	ND<0.5	1.7	1.9	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/14/2007	410	ND<0.5	ND<0.5	2.2	2.2	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/17/2007	2,300	ND<0.5	0.66	17	21	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<8	--	--
	8/2/2007	580	5.7	0.64	6.8	12	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/12/2007	750	0.85	2.7	4.2	9.3	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<20	ND<0.5	ND<0.5
MW-2	6/1/1993	170,000	20,000	21,000	3,300	18,000	-	-	-	-	-	-	-	-	-
	6/22/1993	160,000	19,000	22,000	3,500	18,000	-	-	-	-	-	-	-	-	-
	10/6/1993	110,000	17,000	17,000	3,000	15,000	-	-	-	-	-	-	-	-	-
	1/13/1994	93,000	20,000	19,000	2,300	14,000	-	-	-	-	-	-	-	-	-
	3/30/1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4/25/1994	41,000	9,600	7,300	840	7,800	-	-	-	-	-	-	-	-	-
	8/12/1994	59,000	11,000	11,000	2,300	11,000	-	-	-	-	-	-	-	-	-
	12/14/1994	63,000	13,000	13,000	2,200	12,000	-	-	-	-	-	-	-	-	-
	2/10/1995	63,000	12,000	12,000	2,200	11,000	-	-	-	-	-	-	-	-	-
	6/15/1995	61,000	11,000	12,000	1,900	11,000	-	-	-	-	-	-	-	-	-
	9/26/1995	61,000	9,400	11,000	2,300	12,000	-	-	-	-	-	-	-	-	-
	12/15/1995	48,000	8,000	8,300	2,200	12,000	-	-	-	-	-	-	-	-	-
	3/21/1996	48,000	8,000	7,700	2,400	12,000	-	-	-	-	-	-	-	-	-
	6/13/1996	33,000	7,300	8,800	1,900	12,000	ND<250	-	-	-	-	-	-	-	-
	9/16/1996	8,600	510	640	180	1,300	ND<250	-	-	-	-	-	-	-	-

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (μg/l)	Benzene[b] (μg/l)	Toluene[b] (μg/l)	Ethylbenzene[b] (μg/l)	Xylenes[b] (μg/l)	MTBE[b] (μg/l)	DIPE[b] (μg/l)	ETBE[b] (μg/l)	TAME[b] (μg/l)	TBA[b] (μg/l)	Methanol[b] (μg/l)	Ethanol[b] (μg/l)	1,2-DCA[b] (μg/l)	EDB[b] (μg/l)
MW-2	12/2/1996	29,000	4,400	4,000	1,300	6,100	ND<130	-	-	-	-	-	-	-	-
(cont.)	3/7/1997	13,000	1,800	1,100	270	2,000	ND<250	-	-	-	-	-	-	-	-
	6/12/1997	68,000	7,800	6,600	2,300	11,000	ND<500	-	-	-	-	-	-	-	-
	9/29/1997	15,000	1,500	97	740	1,800	ND<250	-	-	-	-	-	-	-	-
	12/1/1997	13,000	900	37	860	2,400	ND<250	-	-	-	-	-	-	-	-
	3/19/1998	42,000	5,000	3,600	2,000	8,300	ND<250	-	-	-	-	-	-	-	-
	5/29/1998	68,000	5,600	4,700	2,400	11,000	ND<250	-	-	-	-	-	-	-	-
	9/15/1998	36,000	3,900	1,200	1,400	7,800	ND<250	-	-	-	-	-	-	-	-
	11/30/1998	16,000	2,200	59	1,200	1,500	ND<250	-	-	-	-	-	-	-	-
	1/17/1999	30,000	4,000	2,200	2,100	9,500	ND<250	-	-	-	-	-	-	-	-
	6/10/1999	70,000	6,300	1,800	3,600	14,000	ND<500	-	-	-	-	-	-	-	-
	9/7/1999	42,000	3,800	840	1,900	8,000	150	-	-	-	-	-	-	-	-
	12/13/1999	14,000	1,400	87	690	110	34	-	-	-	-	-	-	-	-
	3/13/2000	38,000	2,400	2,300	1,600	6,400	2,400	-	-	-	-	-	-	-	-
	6/12/2000	56,000	4,000	950	2,300	7,200	ND<50	-	-	-	-	-	-	-	-
	11/10/2000	35,000	5,100	850	1,500	3,200	230	-	-	-	-	-	-	-	-
	12/31/2000	21,000	3,200	420	1,300	1,200	440	-	-	-	-	-	-	-	-
	3/27/2001	3,500	420	64	16	280	120	-	-	-	-	-	-	-	-
	6/30/2001	1,200	88	4.5	65	37	29	-	-	-	-	-	-	-	-
	9/26/2001	53,000	8,500	1,500	2,400	4,600	270	-	-	-	-	-	-	-	-
	12/18/2001	26,000	5,400	900	1,500	2,200	430	-	-	-	-	-	-	-	-
	1/22/2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3/18/2002	4,200	240	7.3	200	53	89	-	-	-	-	-	-	-	-
	6/5/2002	25,000	3,500	390	1,400	2,400	550	-	-	-	-	-	-	-	-
	8/21/2002	10,000	1,200	32	620	300	160	-	-	-	-	-	-	-	-
	12/3/2002	3,700	110	2.5	130	11	29	-	-	-	-	-	-	-	-
	3/4/2003	8,700	1,100	77	350	540	230	ND<0.5	ND<0.5	ND<10	21	ND<150	ND<5	ND<0.5	ND<0.5
	6/10/2003	6,300	660	35	190	120	410	ND<2.5	ND<2.5	ND<5	ND<25	ND<250	ND<25	ND<2.5	ND<2.5
	9/9/2003	6,900	500	ND<20	360	29	9,500	ND<20	ND<20	60	ND<200	ND<2,000	ND<200	ND<20	ND<20
	12/23/2003	22,000	4,900	1,300	720	2,300	1,700	ND<20	ND<20	21	ND<200	ND<2,000	ND<200	ND<20	ND<20
	3/23/2004	45,000	5,200	1,500	1,800	5,000	750	ND<20	ND<20	34	ND<200	ND<2,000	ND<200	ND<20	ND<20
	5/10/2004	7,300	1,000	51	240	290	1,800	ND<5	ND<5	14	ND<50	ND<500	ND<50	ND<5	ND<5

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (μg/l)	Benzene[b] (μg/l)	Toluene[b] (μg/l)	Ethylbenzene[b] (μg/l)	Xylenes[b] (μg/l)	MTBE[b] (μg/l)	DIPE[b] (μg/l)	ETBE[b] (μg/l)	TAME[b] (μg/l)	TBA[b] (μg/l)	Methanol[b] (μg/l)	Ethanol[b] (μg/l)	1,2-DCA[b] (μg/l)	EDB[b] (μg/l)
MW-2	8/4/2004	45,000	7,200	1,900	1,800	5,100	2,500	ND<25	ND<25	31	ND<250	ND<2,500	ND<250	ND<25	ND<25
(cont.)	11/4/2004	27,000	4,400	1,100	840	2,200	3,500	ND<9	ND<9	29	ND<50	ND<900	ND<90	ND<9	ND<9
	1/12/2005	16,000	1,900	640	570	1,500	1,900	ND<4	ND<4	19	28[f]	ND<400	ND<40	ND<4	ND<4
	5/2/2005	44,000	5,200	1,100	1,800	4,800	2,200	ND<20	ND<20	30	ND<200	ND<2,000	ND<200	ND<20	ND<20
	7/20/2005	21,000	3,000	500	1,000	1,500	4,400	ND<7	ND<7	32	74[f]	ND<700	ND<70	ND<7	ND<7
	11/22/2005	33,000	4,400	880	1,200	2,600	2,200	ND<9	ND<9	19	480	ND<900	ND<90	ND<9	ND<9
	2/9/2006	25,000	3,300	720	1,300	2,200	2,500	ND<7	ND<7	27	490	ND<700	ND<70	ND<7	ND<7
	5/17/2006	22,000	3,200	240	1,200	2,100	4,600	ND<7	ND<7	46	1000	ND<700	ND<70	ND<7	ND<7
	8/9/2006	34,000	4,200	830	1,300	2,400	2,900	ND<9	ND<9	25	1600	ND<900	ND<90	ND<9	ND<9
	11/8/2006	27,000	3,600	300	1,200	1,800	1,500	ND<9	ND<9	15	1100	ND<900	ND<90	ND<9	ND<9
	2/14/2007	36,000	4,600	740	1,600	2,100	1,800	ND<5	ND<5	20	910	ND<700	ND<50	ND<5	ND<5
	5/17/2007	37,000	7,400	680	1,900	2,400	3,000	ND<9	ND<9	24	2,600	ND<4,000	ND<90	--	--
	8/2/2007	37,000	4,200	500	1,800	2,200	1,300	ND<9	ND<9	18	1,200	ND<2,000	ND<90	ND<9	ND<9
	11/12/2007	25,000	5,900	120	1,700	820	1,400	ND<15	ND<15	16	720	ND<1,500	ND<150	ND<15	ND<15
MW-3	6/1/1993	270	4.6	ND<0.5	ND<0.5	1.9	-	-	-	-	-	-	-	-	-
	6/22/1993	160	8.2	ND<0.5	ND<0.5	0.72	-	-	-	-	-	-	-	-	-
	10/6/093	740	57	110	24	120	-	-	-	-	-	-	-	-	-
	1/13/1994	83	2.6	0.67	0.78	4.2	-	-	-	-	-	-	-	-	-
	3/30/1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4/25/1994	60	0.75	3.2	0.50	3.6	-	-	-	-	-	-	-	-	-
	8/12/1994	310	7.3	14	2.6	13	-	-	-	-	-	-	-	-	-
	12/14/1994	75	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	2/10/1995	96	1.4	ND<0.5	ND<0.5	1.8	-	-	-	-	-	-	-	-	-
	6/15/1995	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	9/26/1995	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	12/15/1995	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	11/4/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	6.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	4.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	140	ND<0.5	ND<0.5	ND<0.5	0.81	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	7/19/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.6	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	3.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	2.9	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (µg/l)	Benzene[b] (µg/l)	Toluene[b] (µg/l)	Ethylbenzene[b] (µg/l)	Xylenes[b] (µg/l)	MTBE[b] (µg/l)	DIPE[b] (µg/l)	ETBE[b] (µg/l)	TAME[b] (µg/l)	TBA[b] (µg/l)	Methanol[b] (µg/l)	Ethanol[b] (µg/l)	1,2-DCA[b] (µg/l)	EDB[b] (µg/l)
MW-3	5/16/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
(cont.)	8/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/8/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	0.71	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/14/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/17/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	0.54	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	--	--
	8/2/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/12/2007	190	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
MW-4	3/30/1994	120	4.2	15	2.5	26	-	-	-	-	-	-	-	-	-
	4/25/1994	65	ND<0.5	1.8	ND<0.5	2.1	-	-	-	-	-	-	-	-	-
	8/12/1994	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	12/14/1994	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	2/10/1995	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	6/15/1995	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	9/26/1995	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	12/15/1995	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
	11/4/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	ND<50	1.8	1.1	1.4	4.4	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	7/19/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/16/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/8/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/14/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/17/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	--	--
	8/2/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
MW-5	3/30/1994	7,500	1,300	20	ND<13	160	-	-	-	-	-	-	-	-	-
	4/25/1994	6,500	1,100	41	130	740	-	-	-	-	-	-	-	-	-
	8/12/1994	4,000	420	2.9	41	98	-	-	-	-	-	-	-	-	-
	12/14/1994	4,800	660	ND<2.5	33	13	-	-	-	-	-	-	-	-	-
	2/10/1995	5,200	490	ND<13	23	19	-	-	-	-	-	-	-	-	-

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (μg/l)	Benzene[b] (μg/l)	Toluene[b] (μg/l)	Ethylbenzene[b] (μg/l)	Xylenes[b] (μg/l)	MTBE[b] (μg/l)	DIPE[b] (μg/l)	ETBE[b] (μg/l)	TAME[b] (μg/l)	TBA[b] (μg/l)	Methanol[b] (μg/l)	Ethanol[b] (μg/l)	1,2-DCA[b] (μg/l)	EDB[b] (μg/l)
MW-5	6/15/1995	460	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-	-
(cont.)	9/26/1995	1,400	61	ND<0.5	3.1	ND<0.5	-	-	-	-	-	-	-	-	-
	12/15/1995	2,100	77	1.5	10	1.5	-	-	-	-	-	-	-	-	-
	3/21/1996	930	35	2.0	2.0	18	-	-	-	-	-	-	-	-	-
	6/13/1996	610	38	0.72	1.9	2.0	ND<5	-	-	-	-	-	-	-	-
	9/16/1996	380	29	ND<0.5	0.95	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	12/2/1996	200	1.1	0.64	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	3/7/1997	520	74	ND<0.5	0.58	1.5	ND<5	-	-	-	-	-	-	-	-
	6/12/1997	140	5.3	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	9/29/1997	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	12/1/1997	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	3/19/1998	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	5/29/1998	540	4.1	ND<0.5	ND<0.5	0.52	ND<5	-	-	-	-	-	-	-	-
	9/15/1998	67	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	11/30/1998	430	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	1/17/1999	500	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	6/10/1999	66	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	9/7/1999	820	46	1.7	10	21	ND<5	-	-	-	-	-	-	-	-
	12/13/1999	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	3/13/2000	270	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	6/12/2000	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-	-	-	-	-
	11/10/2000	2,200	42	1.1	25	30	8.6	-	-	-	-	-	-	-	-
	12/31/2000	1,300	21	ND<0.5	4.3	2.6	10	-	-	-	-	-	-	-	-
	3/27/2001	1,200	11	ND<0.5	2.6	ND<0.5	21	-	-	-	-	-	-	-	-
	6/30/2001	1,400	4.8	ND<0.5	1.5	0.56	14	-	-	-	-	-	-	-	-
	9/26/2001	660	ND<0.5	ND<0.5	ND<0.5	ND<0.5	3.0	-	-	-	-	-	-	-	-
	12/18/2001	240	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-
	1/22/2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3/18/2002	890	0.65	ND<0.5	ND<0.5	ND<0.5	3.1	-	-	-	-	-	-	-	-
	6/5/2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/21/2002	2,100	20	ND<0.5	63	4	7	-	-	-	-	-	-	-	-
	12/3/2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date(a)	TPHg(b) (μg/l)	Benzene(b) (μg/l)	Toluene(b) (μg/l)	Ethylbenzene(b) (μg/l)	Xylenes(b) (μg/l)	MTBE(b) (μg/l)	DIPE(b) (μg/l)	ETBE(b) (μg/l)	TAME(b) (μg/l)	TBA(b) (μg/l)	Methanol(b) (μg/l)	Ethanol(b) (μg/l)	1,2-DCA(b) (μg/l)	EDB(b) (μg/l)
MW-5	3/4/2003	490	10	ND<0.5	2.2	ND<0.5	1.0	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
(cont.)	6/10/2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/9/2003	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	12/23/2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3/23/2004	440	2.3	ND<0.5	1.0	5.9	2.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/10/2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/4/2004	160	ND<0.5	ND<0.5	ND<0.5	0.71	0.94	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/4/2004	290	0.74	ND<0.5	0.58	1.3	0.61	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	300	ND<0.5	ND<0.5	0.51	1.6	0.73	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	120	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	7/20/2005	330	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.1	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	210	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.2	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	ND<50	ND<0.5	ND<0.5	0.63	1.0	1.0	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/16/2006	140	ND<0.5	ND<0.5	ND<0.5	ND<0.5	0.79	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/9/2006	220	ND<0.5	ND<0.5	ND<0.5	ND<0.5	7.8	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/8/2006	120	ND<0.5	ND<0.5	ND<0.5	ND<0.5	2.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/14/2007	200	ND<0.5	ND<0.5	ND<0.5	1.1	2.1	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/17/2007	140	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	--	--
	8/2/2007	85	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.9	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
MW-6	3/30/1994	63,000	21,000	8,600	1,700	12,000	-	-	-	-	-	-	-	-	-
	4/25/1994	77,000	22,000	12,000	2,300	16,000	-	-	-	-	-	-	-	-	-
	8/12/1994	65,000	12,000	8,100	2,200	16,000	-	-	-	-	-	-	-	-	-
	12/14/1994	65,000	18,000	9,500	2,200	14,000	-	-	-	-	-	-	-	-	-
	2/10/1995	63,000	21,000	8,400	2,000	14,000	-	-	-	-	-	-	-	-	-
	6/15/1995	75,000	20,000	11,000	2,100	15,000	-	-	-	-	-	-	-	-	-
	9/26/1995	62,000	15,000	9,600	1,700	12,000	-	-	-	-	-	-	-	-	-
	12/15/1995	61,000	15,000	9,000	2,300	15,000	-	-	-	-	-	-	-	-	-
	3/21/1996	65,000	18,000	9,800	2,400	16,000	-	-	-	-	-	-	-	-	-
	6/13/1996	29,000	8,600	3,300	2,200	12,000	ND<250	-	-	-	-	-	-	-	-
	9/16/1996	42,000	6,400	1,800	2,100	11,000	ND<250	-	-	-	-	-	-	-	-
	12/2/1996	28,000	3,000	1,100	970	8,300	ND<500	-	-	-	-	-	-	-	-
	3/7/1997	12,000	2,000	190	520	2,300	ND<250	-	-	-	-	-	-	-	-

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (μg/l)	Benzene[b] (μg/l)	Toluene[b] (μg/l)	Ethylbenzene[b] (μg/l)	Xylenes[b] (μg/l)	MTBE[b] (μg/l)	DIPE[b] (μg/l)	ETBE[b] (μg/l)	TAME[b] (μg/l)	TBA[b] (μg/l)	Methanol[b] (μg/l)	Ethanol[b] (μg/l)	1,2-DCA[b] (μg/l)	EDB[b] (μg/l)
MW-6	6/12/1997	37,000	3,900	470	1,600	6,200	ND<100	-	-	-	-	-	-	-	-
(cont.)	9/29/1997	34,000	3,500	370	1,600	5,200	ND<100	-	-	-	-	-	-	-	-
	12/1/1997	20,000	2,100	ND<10	1,200	2,200	ND<100	-	-	-	-	-	-	-	-
	3/19/1998	24,000	2,900	460	1,100	3,400	ND<100	-	-	-	-	-	-	-	-
	5/29/1998	38,000	3,500	700	1,800	5,200	ND<100	-	-	-	-	-	-	-	-
	9/15/1998	22,000	1,900	110	1,400	3,000	ND<100	-	-	-	-	-	-	-	-
	11/30/1998	9,900	770	16	820	710	ND<100	-	-	-	-	-	-	-	-
	1/17/1999	14,000	2,200	160	1,700	3,600	ND<100	-	-	-	-	-	-	-	-
	6/10/1999	22,000	1,600	160	1,400	2,900	5.5	-	-	-	-	-	-	-	-
	9/7/1999	17,000	1,400	33	1,300	1,800	ND<50	-	-	-	-	-	-	-	-
	12/13/1999	16,000	790	9.2	840	780	ND<25	-	-	-	-	-	-	-	-
	3/13/2000	16,000	790	85	780	1,600	ND<25	-	-	-	-	-	-	-	-
	6/12/2000	24,000	1,100	150	1,300	2,300	5,600	-	-	-	-	-	-	-	-
	11/10/2000	13,000	440	7	760	350	1,000	-	-	-	-	-	-	-	-
	12/31/2000	12,000	680	8	820	190	1,400	-	-	-	-	-	-	-	-
	3/27/2001	14,000	330	17	940	670	380	-	-	-	-	-	-	-	-
	6/30/2001	750	45	0.93	47	14	54	-	-	-	-	-	-	-	-
	9/26/2001	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/18/2001	43,000	3,800	350	1,900	3,000	900	-	-	-	-	-	-	-	-
	1/22/2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3/18/2002	33,000	2,600	120	1,800	2,800	740	-	-	-	-	-	-	-	-
	6/5/2002	10,000	1,100	16	700	180	600	-	-	-	-	-	-	-	-
	8/21/2002	10,000	1,200	23	710	290	370	-	-	-	-	-	-	-	-
	12/3/2002	16,000	1,700	63	970	630	1,500	-	-	-	-	-	-	-	-
	3/4/2003	16,000	1,700	25	1,200	40	7,700	ND<20	ND<20	ND<70	ND<200	ND<2,000	ND<200	ND<20	ND<20
	6/10/2003	9,500	860	15	380	47	2,600	ND<5	ND<5	18	ND<50	ND<500	ND<50	ND<5	ND<5
	9/9/2003	11,000	1,000	16	630	120	2,500	ND<5	ND<5	20	52	ND<500	ND<50	ND<5	ND<5
	12/23/2003	18,000	2,100	41	1,100	390	4,900	ND<10	ND<10	42	ND<100	ND<1,000	ND<100	ND<10	ND<10
	3/23/2004	24,000	1,400	71	1,500	2,000	7,500	ND<20	ND<20	66	ND<200	ND<2,000	ND<200	ND<20	ND<20
	5/10/2004	6,500	550	<10	71	43	3,700	ND<10	ND<10	31	ND<100	ND<1,000	ND<100	ND<10	ND<10
	8/4/2004	8,200	990	19	300	120	3,300	ND<5	ND<5	23	ND<50	ND<500	ND<50	ND<5	ND<5
	11/4/2004	9,600	1,100	30	320	160	2,200	ND<4	ND<4	18	22[f]	ND<400	ND<40	ND<4	ND<4

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (µg/l)	Benzene[b] (µg/l)	Toluene[b] (µg/l)	Ethylbenzene[b] (µg/l)	Xylenes[b] (µg/l)	MTBE[b] (µg/l)	DIPE[b] (µg/l)	ETBE[b] (µg/l)	TAME[b] (µg/l)	TBA[b] (µg/l)	Methanol[b] (µg/l)	Ethanol[b] (µg/l)	1,2-DCA[b] (µg/l)	EDB[b] (µg/l)
MW-6	1/12/2005	12,000	1,100	34	600	500	3,600	ND<4	ND<4	31	30[f]	ND<400	ND<40	ND<4	ND<4
(cont.)	5/2/2005	14,000	630	22	610	920	4,000	ND<10	ND<10	32	120[f]	ND<3,000	ND<100	ND<10	ND<10
	7/20/2005	9,800	1,200	21	340	150	1,800	ND<2.5	ND<2.5	14	140	ND<500	ND<25	ND<2.5	ND<2.5
	11/21/2005	6,600	150	26	580	640	100	ND<1	ND<1	ND<1	13	ND<100	ND<10	ND<1	ND<1
	2/9/2006	7,100	340	11	370	360	910	ND<2	ND<2	9.3	120	ND<200	ND<20	ND<2	ND<2
	5/17/2006	7,100	270	5.1	320	290	930	ND<2	ND<2	8.4	260	ND<200	ND<20	ND<2	ND<2
	8/9/2006	5,800	440	7.5	120	45	670	ND<2	ND<2	7.3	380	ND<2,000	ND<50	ND<2	ND<2
	11/8/2006	9,200	990	37	390	140	310	ND<2	ND<2	3.2	110	ND<200	ND<20	ND<2	ND<2
	2/14/2007	5,900	480	10	73	23	1,600	ND<2	ND<2	14.0	1,100	ND<500	ND<20	ND<2	ND<2
	5/17/2007	3,700	240	3.4	30	10	770	ND<0.5	ND<0.5	9.2	800	ND<2,000	ND<5	--	--
	8/2/2007	15,000	1,800	120	980	510	310	ND<2.5	ND<2.5	3.0	180	ND<250	ND<25	ND<2.5	ND<2.5
MW-7	3/30/1994	43,000	7,200	2,400	1,600	11,000	-	-	-	-	-	-	-	-	-
	4/25/1994	30,000	3,900	1,000	940	6,900	-	-	-	-	-	-	-	-	-
	8/12/1994	30,000	3,800	1,400	1,300	7,500	-	-	-	-	-	-	-	-	-
	12/14/1994	31,000	3,600	1,200	900	6,400	-	-	-	-	-	-	-	-	-
	2/10/1995	27,000	4,000	900	890	5,100	-	-	-	-	-	-	-	-	-
	6/15/1995	17,000	920	680	740	4,100	-	-	-	-	-	-	-	-	-
	9/26/1995	7,000	200	150	170	810	-	-	-	-	-	-	-	-	-
	12/15/1995	11,000	350	170	540	1,900	-	-	-	-	-	-	-	-	-
	3/21/1996	12,000	320	100	730	2,500	-	-	-	-	-	-	-	-	-
	6/13/1996	5,900	98	19	370	620	ND<50	-	-	-	-	-	-	-	-
	9/16/1996	7,800	140	43	440	590	ND<25	-	-	-	-	-	-	-	-
	12/2/1996	6,300	87	29	290	430	ND<50	-	-	-	-	-	-	-	-
	3/7/1997	4,500	35	19	360	470	ND<25	-	-	-	-	-	-	-	-
	6/12/1997	3,900	29	5.2	170	48	ND<5	-	-	-	-	-	-	-	-
	9/29/1997	6,100	56	9	340	190	ND<25	-	-	-	-	-	-	-	-
	12/1/1997	6,500	24	ND<2.5	400	250	ND<25	-	-	-	-	-	-	-	-
	3/19/1998	2,000	20	ND<2.5	73	79	ND<25	-	-	-	-	-	-	-	-
	5/29/1998	5,700	22	7.3	290	350	ND<25	-	-	-	-	-	-	-	-
	9/15/1998	1,700	15	ND<2.5	44	5.1	ND<25	-	-	-	-	-	-	-	-
	11/30/1998	4,800	42	12	270	640	ND<25	-	-	-	-	-	-	-	-
	1/17/1999	3,400	33	ND<5	200	190	ND<50	-	-	-	-	-	-	-	-

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (μg/l)	Benzene[b] (μg/l)	Toluene[b] (μg/l)	Ethylbenzene[b] (μg/l)	Xylenes[b] (μg/l)	MTBE[b] (μg/l)	DIPE[b] (μg/l)	ETBE[b] (μg/l)	TAME[b] (μg/l)	TBA[b] (μg/l)	Methanol[b] (μg/l)	Ethanol[b] (μg/l)	1,2-DCA[b] (μg/l)	EDB[b] (μg/l)
MW-7	6/10/1999	1,700	7.8	1.5	23	4.1	ND<5	-	-	-	-	-	-	-	-
(cont.)	9/7/1999	1,900	9.7	2.1	70	2.9	ND<5	-	-	-	-	-	-	-	-
	12/13/1999	1,900	8.0	1.1	10	1.1	ND<5	-	-	-	-	-	-	-	-
	3/13/2000	1,500	7.5	ND<0.5	6.7	2.9	ND<5	-	-	-	-	-	-	-	-
	6/12/2000	1,200	5.4	ND<0.5	5.2	1.0	ND<5	-	-	-	-	-	-	-	-
	11/10/2000	1,000	3.9	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-
	12/31/2000	620	1.8	ND<0.5	ND<0.5	ND<0.5	ND<0.5	-	-	-	-	-	-	-	-
	3/27/2001	1,200	4.8	ND<0.5	6.7	0.94	ND<0.5	-	-	-	-	-	-	-	-
	6/30/2001	2,800	10	1.7	75	170	ND<0.5	-	-	-	-	-	-	-	-
	9/26/2001	1,900	16	0.89	2.3	25	ND<0.5	-	-	-	-	-	-	-	-
	12/18/2001	3,000	13	0.88	3.4	3.4	ND<0.5	-	-	-	-	-	-	-	-
	1/22/2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3/18/2002	3,100	7.3	1.5	38	110	ND<0.5	-	-	-	-	-	-	-	-
	6/5/2002	1,800	7.6	1.0	39	20	ND<0.5	-	-	-	-	-	-	-	-
	8/21/2002	3,300	7.6	0.7	85	36	ND<0.5	-	-	-	-	-	-	-	-
	12/3/2002	1,700	5.4	ND<0.5	15	5.5	ND<0.5	-	-	-	-	-	-	-	-
	3/4/2003	440	1.8	ND<0.5	0.54	2.9	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	6/10/2003	550	0.8	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	9/9/2003	120	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	12/23/2003	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	3/23/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/10/2004	67	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/4/2004	2,600	2.5	ND<0.5	36	31	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/4/2004	1,600	2.0	ND<0.5	16	16	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	830	1.6	ND<0.5	15	12	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	710	ND<0.5	ND<0.5	0.75	0.52	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	7/20/2005	1,400	1.1	ND<0.5	9.2	8.6	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	1,100	0.6	ND<0.5	3.4	23	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	270	ND<0.5	ND<0.5	1.2	0.98	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/16/2006	930	0.84	ND<0.5	10	7.9	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/9/2006	650	ND<0.5	ND<0.5	1.2	1.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/8/2006	800	ND<0.5	ND<0.5	1.0	0.62	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (μg/l)	Benzene[b] (μg/l)	Toluene[b] (μg/l)	Ethylbenzene[b] (μg/l)	Xylenes[b] (μg/l)	MTBE[b] (μg/l)	DIPE[b] (μg/l)	ETBE[b] (μg/l)	TAME[b] (μg/l)	TBA[b] (μg/l)	Methanol[b] (μg/l)	Ethanol[b] (μg/l)	1,2-DCA[b] (μg/l)	EDB[b] (μg/l)
MW-7	2/14/2007	800	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
(cont.)	5/17/2007	700	ND<0.5	ND<0.5	ND<0.5	0.71	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	--	--
	8/2/2007	3,200	1.3	ND<0.5	50	120	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
MW-8	9/5/2003	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-
	12/23/2003	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	7.3	ND<0.5	ND<0.5
	3/23/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/10/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/4/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	0.86	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/4/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	7/19/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	0.57	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/16/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/8/2006	ND<50	1.2	1.9	ND<0.5	0.66	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/14/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/17/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	--	--
	8/2/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
MW-9	9/5/2003	3,400	23	1.5	110	10	10	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-
	12/23/2003	1,100	2.4	ND<0.5	0.8	0.8	2.1	ND<0.5	ND<0.5	ND<0.5	5.9	ND<50	ND<5	ND<0.5	ND<0.5
	3/23/2004	760	8.5	ND<0.5	4.9	0.95	18	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/10/2004	1,100	4.4	ND<0.5	1.3	0.67	11	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/4/2004	1,200	3.4	0.59	16	7.6	6.1	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/4/2004	610	0.52	ND<0.5	1.3	ND<0.5	2.0	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	1,400	1.6	0.55	5.5	1.1	2.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	1,500	10	0.55	6.7	1.1	27	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	7/20/2005	1,800	5.5	0.69	12	1.6	10	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	1,200	0.94	ND<0.5	1.4	ND<0.5	3.3	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	1,200	2.8	0.51	6.4	0.84	4.4	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/16/2006	1,600	3.8	0.57	12	1.8	4.9	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (μg/l)	Benzene[b] (μg/l)	Toluene[b] (μg/l)	Ethylbenzene[b] (μg/l)	Xylenes[b] (μg/l)	MTBE[b] (μg/l)	DIPE[b] (μg/l)	ETBE[b] (μg/l)	TAME[b] (μg/l)	TBA[b] (μg/l)	Methanol[b] (μg/l)	Ethanol[b] (μg/l)	1,2-DCA[b] (μg/l)	EDB[b] (μg/l)
MW-9	8/9/2006	760	ND<0.5	ND<0.5	1.0	ND<0.5	2.6	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
(cont.)	11/8/2006	1,700	1.7	0.53	6.7	1.4	1.7	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/14/2007	1,000	ND<0.5	ND<0.5	0.51	ND<0.5	0.51	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/17/2007	870	ND<0.5	ND<0.5	0.54	ND<0.5	0.93	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	--	--
MW-10	9/5/2003	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	-	-	-	-
	12/23/2003	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	3/23/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/10/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/4/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	0.61	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/4/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	7/19/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/16/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/8/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/14/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/17/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	--	--
	8/2/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
VW-2	8/4/2004	5,700	480	ND<20	600	ND<20	12,000	ND<20	ND<20	110	ND<90	ND<2,000	ND<200	ND<20	ND<20
	11/4/2004	5,800	340	ND<20	38	ND<20	10,000	ND<20	ND<20	120	ND<90	ND<2,000	ND<200	ND<20	ND<20
	1/12/2005	3,800	210	ND<5	90	54	2,900	ND<5	ND<5	33	26[f]	ND<500	ND<50	ND<5	ND<5
	5/2/2005	2,600	84	ND<2	13	7.0	960	ND<2	ND<2	12	57	ND<500	ND<20	ND<2	ND<2
	7/20/2005	6,200	240	13	290	480	6,600	ND<2	ND<2	56	59[f]	ND<2,000	ND<20	ND<2	ND<2
	11/21/2005	3,100	100	ND<9	22	10	5,300	ND<9	ND<9	54	76[f]	ND<900	ND<90	ND<9	ND<9
	2/9/2006	3,500	140	ND<25	130	36	12,000	ND<25	ND<25	65	2800	ND<2,500	ND<250	ND<25	ND<25
	5/17/2006	1,800	90	2.6	39	11	1,200	ND<2.5	ND<2.5	12	700	ND<250	ND<25	ND<2.5	ND<2.5
	8/9/2006	4,300	86	3.5	200	16	2,500	ND<2.5	ND<2.5	28	2800	ND<5,000	ND<25	ND<2.5	ND<2.5
	11/8/2006	3,200	46	3.1	10	4.8	1,500	ND<3	ND<3	11	7,100	ND<800	ND<30	ND<3	ND<3

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date[a]	TPHg[b] (µg/l)	Benzene[b] (µg/l)	Toluene[b] (µg/l)	Ethylbenzene[b] (µg/l)	Xylenes[b] (µg/l)	MTBE[b] (µg/l)	DIPE[b] (µg/l)	ETBE[b] (µg/l)	TAME[b] (µg/l)	TBA[b] (µg/l)	Methanol[b] (µg/l)	Ethanol[b] (µg/l)	1,2-DCA[b] (µg/l)	EDB[b] (µg/l)
VW-2	2/14/2007	3,300	75	4.6	50	82	580	ND<2	ND<2	7.0	4,100	ND<500	ND<20	ND<2	ND<2
(cont.)	5/17/2007	3,500	51	7.3	17	24	100	ND<2.5	ND<2.5	ND<2.5	7,100	ND<250	ND<25	--	--
VW-3	8/4/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/4/2004	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	1/12/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/2/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	7/20/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/21/2005	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/16/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	8/9/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	11/8/2006	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	2/14/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
	5/17/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	--	--
	8/2/2007	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5	ND<50	ND<5	ND<0.5	ND<0.5
TP-1	7/20/2005	42,000	2,800	1,100	1,700	4,800	12,000	ND<20	ND<20	92	130[f]	ND<2,000	ND<200	ND<20	ND<20
	11/22/2005	36,000	2,100	290	1,400	2,600	11,000	ND<20	ND<20	70	810	ND<2,000	ND<200	ND<20	ND<20
	2/9/2006	19,000	1,400	230	990	1,700	8,900	ND<15	ND<15	72	2,200	ND<1,500	ND<150	ND<15	ND<15
	5/17/2006	20,000	1,400	200	920	1,800	9,200	ND<20	ND<20	37	2,500	ND<10,000	ND<200	ND<20	ND<20
	8/9/2006	28,000	1,600	150	1,200	2,200	13,000	ND<15	ND<15	84	4,900	ND<2,500	ND<150	ND<15	ND<15
	11/8/2006	20,000	1,100	78	990	1,600	6,800	ND<15	ND<15	47	4,400	ND<8,000	ND<150	ND<15	ND<15
	2/14/2007	15,000	820	37	810	1,000	8,300	ND<15	ND<15	58	8,500	ND<4,000	ND<150	ND<15	ND<15
	5/17/2007	16,000	850	35	810	1,200	6,700	ND<10	ND<10	42	12,000	ND<2,000	ND<100	--	--
	8/2/2007	15,000	2,000	100	970	630	3,400	ND<7	ND<7	25	4,000	ND<700	ND<70	ND<7	ND<7
TP-2	7/20/2005	26,000	1,800	1,100	1,100	2,500	63,000	ND<150	ND<150	400	ND<700	ND<15,000	ND<1,500	ND<150	ND<150
	11/22/2005	16,000	1,200	140	840	820	52,000	ND<90	ND<90	340	1,200[f]	ND<9,000	ND<900	ND<90	ND<90
	2/9/2006	2,700	94	2.9	28	14	1,200	ND<2.5	ND<2.5	13	1,600	ND<250	ND<25	ND<2.5	ND<2.5
	5/17/2006	31,000	2,200	1,100	1,500	3,300	87,000	ND<90	ND<90	680	4,800	ND<15,000	ND<1,500	ND<90	ND<90
	8/9/2006	14,000	1,400	86	1,200	830	56,000	ND<2.5	ND<2.5	350	2,800	ND<4,000	ND<25	ND<2.5	ND<2.5
	11/8/2006	16,000	1,300	ND<90	930	370	38,000	ND<90	ND<90	280	3,600	ND<40,000	ND<900	ND<90	ND<90
	2/14/2007	22,000	1,900	230	1,700	1,600	53,000	ND<90	ND<90	400	2,800	ND<20,000	ND<900	ND<90	ND<90

TABLE A-2

HISTORICAL GROUNDWATER MONITORING ANALYTICAL RESULTS
TESORO - LIVERMORE, 67076

Monitoring Well	Sample Date(a)	TPHg(b) (µg/l)	Benzene(b) (µg/l)	Toluene(b) (µg/l)	Ethylbenzene(b) (µg/l)	Xylenes(b) (µg/l)	MTBE(b) (µg/l)	DIPE(b) (µg/l)	ETBE(b) (µg/l)	TAME(b) (µg/l)	TBA(b) (µg/l)	Methanol(b) (µg/l)	Ethanol(b) (µg/l)	1,2-DCA(b) (µg/l)	EDB(b) (µg/l)
TP-2	5/17/2007	ND<25,000	2,400	51	1,500	510	69,000	ND<2	ND<0.5	550	4,300	ND<25,000	ND<5	--	--
(cont.)	8/2/2007	10,000	1,200	ND<25	640	140	14,000	ND<25	ND<25	110	16,000	ND<10,000	ND<250	ND<25	ND<25
MW-A	1/17/1999	5,800	1,700	85	65	320	ND<5	-	-	-	-	-	-	-	-
MW-B	1/17/1999	4,400	240	30	21	39	ND<5	-	-	-	-	-	-	-	-
MW-C	1/17/1999	1800	0.8	ND<0.5	ND<0.5	0.55	ND<5	-	-	-	-	-	-	-	-
MW-D	1/17/1999	5,600	1,600	130	66	220	ND<5	-	-	-	-	-	-	-	-
MW-E	1/17/1999	5,700	1,600	180	180	310	ND<50	-	-	-	-	-	-	-	-
	6/10/1999	5,000	1,300	130	320	450	ND<25	-	-	-	-	-	-	-	-
MW-W	1/17/1999	23,000	7,600	760	1,400	5,000	ND<50	-	-	-	-	-	-	-	-
	6/10/1999	16,000	4,100	420	1,300	4,000	ND<50	-	-	-	-	-	-	-	-

(a) Samples collected before July 2005 collected by others; data provided by Delta Environmental Consultants, Inc., Second Quarter 2005 Groundwater Monitoring Report dated 31 July 2005.

(b) Total petroleum hydrocarbons as gasoline (TPHg), benzene, toluene, ethylbenzene, xylenes, methyl tert-butyl ether (MTBE), di-isopropyl ether (DIPE), ethyl tert-butyl ether (ETBE), tert-amyl methyl ether (TAME), tert-butyl alcohol (TBA), 1,2-dichloroethane (1,2-DCA), and 1,2-dibromoethane (EDB) analyzed by EPA Method 8260; reported in micrograms per liter (µg/l).

(c) Field measurement, reported in milligrams per liter (mg/l).

(d) ND - Not detected at the reporting limit listed.

(e) "-" Not analyzed.

(f) TBA results may be biased slightly high. A fraction of MTBE (typically less than 10 percent) converts to TBA during the analysis of water samples. This conversion effect is considered to be mathematically significant in samples that contain MTBE/TBA ratios of over 20:1.

ARCTOS

APPENDIX B

SITE BACKGROUND

APPENDIX B
SITE BACKGROUND

Soil and groundwater investigation activities have been conducted at the site since 1990 (Arctos Environmental [Arctos], 2005). An understanding of the site conditions was developed from these previous phases of site assessment.

B.1 Regional and Site Geology and Hydrogeology

The site is underlain by approximately 100 feet of Quaternary alluvial fan deposits overlaying the Livermore gravels. The Tertiary aged Livermore gravels extend to 600 feet deep and consist of massive beds of rounded gravel cemented by a sandy clay and sandy silt matrix. The alluvial fan deposits consist of semiconsolidated deposits of clay, silt, sand, and gravel (California Department of Water Resources [CDWR], 1974). The north-south trending Livermore fault is mapped 0.5 mile west of the site.

The site lies in the Mocho II Subbasin of the Livermore Valley groundwater basin. This area is drained by Arroyo Mocho, which runs from the southeast toward the northwest approximately 0.5 mile southwest of the site (Figure 1). The Arroyo Mocho also provides groundwater recharge in the area (CDWR, 1974).

In the site vicinity, subsurface investigations have found a shallow, upper unconfined water-bearing zone consisting primarily of gravels with sand and clay. Underlying the gravels, an approximately 45-foot-thick, low-permeability clay unit (aquitard) is found at depths of approximately 60 to 110 feet below grade at the Livermore Arcade Shopping Center (LASC) site, 800 feet northwest of the site. Fine-grained units of clay containing sand and gravel are present across the site at varying depths. The deposits vary laterally and may include channel deposits (Figures 5 and 6). Below the clayey unit is the top of the underlying semiconfined aquifer. Groundwater extraction for municipal water supply occurs in the semiconfined aquifer and in a deeper confined aquifer.

No evidence of communication between the shallow water-bearing zone and the underlying aquifers in the site vicinity has been documented. Groundwater elevations in the shallow water-bearing zone and the semiconfined aquifer are similar and indicate that hydraulic connection at some point between these two water-bearing zones is likely. Over the last 17 years, static water levels at the site have ranged from 17 feet below grade in March 1996 to 48 feet below grade in November 2007. The groundwater flow direction generally is to the northwest with a hydraulic gradient ranging from 0.01 to 0.03 since 1993.

B.2 Previous Site Investigation and Remediation

In November 1992, three underground storage tanks (USTs) and associated product piping were removed from the site. Soil samples collected below the USTs at a depth of 14 feet below grade contained total petroleum hydrocarbon as gasoline (TPHg) concentrations of 600 and 1,400 milligrams per kilogram (mg/kg) at the west end of the unleaded plus and unleaded tanks, respectively. The UST excavation was overexcavated to a depth of 19 feet below grade for installation of the new USTs. A TPHg concentration of 4,700 mg/kg was detected at a depth 19 feet below grade at the southwest corner of the tank pit. This area was overexcavated to a depth of 27 feet to remove impacted soil until TPHg was detected at 490 mg/kg at a depth of 27 feet below grade. The only detection of benzene at the site was a concentration of 1.4 mg/kg at this depth. TPHg was also detected under the product piping at the eastern pump island at concentrations of 2.7 and 4.4 mg/kg. A total of 1,200 cubic yards of soil were excavated and disposed of off site. Soil samples were not analyzed for methyl tert-butyl ether (MTBE) (Arctos, 2005).

A soil and groundwater remediation system, including 27 dual-completion groundwater air sparing and vapor extraction wells (7 on site and 20 off site at LASC site) was installed in September and October 1995. The system operated from May 1996 through February 1997. Groundwater concentrations in onsite well MW-2 decreased by 73 and 78 percent for TPHg and benzene, respectively, and concentrations in offsite well MW-6 decreased by 77 and 60 percent for TPHg and benzene, respectively (Arctos, 2005).

Groundwater grab samples were collected from six offsite vapor extraction wells and LASC groundwater well MW-23 in March 1997. Only one well (VE-10) had detectable TPHg and benzene concentrations of 440 and 5.1 micrograms per liter (µg/l), respectively (Arctos, 2005).

APPENDIX C

FIELD AND QA/QC PROCEDURES

ARCTOS

APPENDIX C
FIELD AND QA/QC PROCEDURES

Health and Safety

Arctos will modify the site-specific Health and Safety Plan (HSP) for the field program outlined in this interim remedial action plan. The HSP presents procedures for personnel and equipment safety, medical surveillance, personal protection, air-quality monitoring, exposure control, emergency response procedures, and general work practices.

Before beginning work at the site, a site safety meeting will be conducted. Field personnel will review the HSP and sign the accompanying acknowledgment form. Field personnel will be required to comply with the HSP throughout performance of site assessment activities.

Based on the site history and potential chemicals of concern, field activities will be initiated in Level D personal protective equipment (PPE). During field activities, the breathing zone of field personnel will be monitored using a field photoionization detector (PID). If breathing zone PID readings indicate elevated levels of organic vapors, PPE will be upgraded accordingly. Breathing zone readings will be recorded on the boring logs.

The following sections provide a description of Arctos's proposed drilling, soil sampling, and well installation program.

Drilling and Soil Sampling Procedures for Monitoring Wells

Before initiating drilling activities, Arctos will mark the well locations and contact underground service alert (USA) to clear the area of subsurface lines and utilities. Arctos will also obtain boring and well permits from Zone 7 Water Agency.

The soil borings for the installation of the monitoring wells will be drilled with a 10-inch-diameter hollow-stem continuous-flight auger. Soil samples will be collected with a split-spoon sampler containing three brass tubes, each 2 inches in diameter and 6 inches in length. The sampler will be driven to the sampling depth by dropping a 140-pound hammer approximately 30 inches. Samples will be collected at 5-foot intervals, beginning at ground surface.

Immediately after the sampler is retrieved from the auger, it will be placed on a portable field stand near the boring and the brass tubes removed. The ends of one of the tubes will be covered with Teflon liners and capped with polyvinyl chloride (PVC) end caps. The sealed tubes will be labeled or marked, placed in a resealable plastic, and placed on ice in a cooler until delivery to the analytical laboratory. The information on the label or marked on the brass tube will include project identification, sample number, sample depth, date, time, and name of the person preparing the samples.

A portion of the soil from one of the tubes will be extruded and placed in a sealable plastic bag, which will then be closed and allowed to equilibrate for approximately 10 minutes. The organic vapor levels in the headspace will be measured using a field PID. The same sample will be visually examined and the results of the visual observation and headspace reading will be recorded on the boring or well installation log. The soil type will be classified using the Unified Soil Classification System (USCS) as described in American Society for Testing and Materials (ASTM) Standards D2487 and D2488.

Monitoring Well Installation

The wells will be constructed using new 4-inch-diameter, flush-threaded, Schedule 40 PVC casing. As in the previous well constructions, a 0.020-inch slot size and #2/12 Monterey sand filter pack will be used for the new well. The annular space around the well will be filled with filter pack to about 2 feet above the top of the screen.

An approximately 2-foot-thick layer of bentonite will be placed above the filter pack to provide an annular seal. The wells will be surged before placing the annular seal to allow for filter pack settlement. After placement, the seal will be hydrated with potable water. The remainder of the annulus to near ground surface will be filled with cement. A locking cap and traffic-rated cover will be installed at the surface.

Screen intervals for the monitoring wells will be from 55 to 65 feet below grade for well DW-1, 50 to 60 feet below grade for wells DW-2 and DW-3, and 59 to 69 feet below grade for well DW-4. Well construction diagrams are shown on Figures C-1 to C-3. Field personnel may adjust actual well depths and screen placements as required by the field conditions encountered. A drawing showing the as-built well construction will be included on the boring/well installation log. A registered geologist or registered civil engineer will supervise or direct the well construction and installation.

The wells will be developed at least 72 hours after well installation by surging and bailing to remove fines from the filter pack and well screen to reduce sediment in the groundwater. Development will be considered complete when at least 10 to 12 casing volumes are removed or until the pH, temperature, and specific conductivity measurements of the evacuated groundwater stabilize to within 10 percent of the previous readings.

Groundwater Sampling Procedures

Groundwater samples will be collected from the new wells at least 48 hours after development. The depth to groundwater will be measured to the nearest 1/100 foot before sampling using an electric water-level sounder. Approximately 3 casing volumes will be purged from the wells before sampling. Throughout purging and just before sampling the wells, the pH, specific conductivity, and temperature of the purged groundwater will be measured and recorded. These measurements will be made to confirm that the well is purged sufficiently. Groundwater samples will be collected after the measurements stabilize to within 10 percent of the previous readings.

Sampling will be performed using a 1-inch-diameter disposable polyethylene bailer suspended from a nylon line. The bailer will be equipped with a bottom-release device. Samples will be collected from just below the water surface after the water level has recovered to at least 80 percent of the pre-purge level.

Water samples will be transferred from the bailer to new 40-milliliter glass bottles with Teflon-lined caps provided by the analytical laboratory. The bottles will be filled so that no air bubbles (i.e., headspace) will be present in the vial. A field (equipment) blank will be collected after decontamination of the sampling equipment. A field blank will not be collected if the wells are sampled using disposable bailers.

Soil Vapor Sampling Method

Soil vapor samples will be collected in a Tedlar bag. A new bag will be connected to the tubing upstream of the pump and placed inside a vacuum chamber. The bag will remain empty until purging is complete and the pump connection will be switched from a purge port to a vacuum outlet port for sample collection. Vacuum will be applied to the chamber to inflate the bag and collect the sample. To prevent the backflow of ambient air, the connections to the purge port and vacuum outlet port will be made with single shut-off quick disconnect fittings. The pump will continue to operate during sample connection. The samples will be analyzed within approximately 72 hours of collection by a State-certified analytical laboratory.

Well Surveying

A licensed surveyor will survey the elevation and location of the new wells following the requirements of State Assembly Bill 2886. The locations will be measured to the nearest 1/10 foot and the elevations to the nearest 1/100 foot relative to mean sea level.

Field QA/QC Procedures

Procedures for preserving and transporting soil and groundwater samples, decontaminating field equipment, managing wastes generated, and documenting the field program are described below.

Preservation and Delivery of Samples

The analytical laboratory will provide the preservatives necessary for the groundwater samples. The samples will be stored on ice in the field and transported in a portable ice chest to the analytical laboratory. The samples will be delivered to the analytical laboratory by courier within 24 to 48 hours of sample collection.

Chain-of-Custody Records

Chain-of-custody records will be completed before packaging the samples for shipment. One copy of these records will accompany the samples during transportation to the laboratory. The person in the analytical laboratory who accepts responsibility for the samples will sign and date the original chain-of-custody form.

Equipment Decontamination Procedures

Soil and groundwater sampling equipment will be decontaminated between sampling events using the following procedures:

1. Rinse with water using a brush to remove soil and mud.
2. Wash with non-phosphate detergent and water using a brush.
3. Rinse with deionized or distilled water.
4. Rinse again with deionized or distilled water.
5. Air dry.

Drill augers will be steam-cleaned before each boring is drilled.

Management of Drill Cuttings and Wastewater

Soil cuttings and wastewater will be placed in 55-gallon drums that meet U.S. Department of Transportation specifications and stored on site pending the results of the laboratory analyses. Each drum will be labeled with the date and drum contents. When a drum is filled with soil, the depths of collection will be noted on the drum. Analytical results will determine if the soil samples are impacted and the cuttings will be managed accordingly. Wastewater will be transported off site for recycling.

Documentation Procedures

Arctos personnel will follow documentation procedures developed for site investigation to (1) provide a record of the activities performed in the field and (2) identify samples and track their status in the field, during shipment, and at the laboratory.

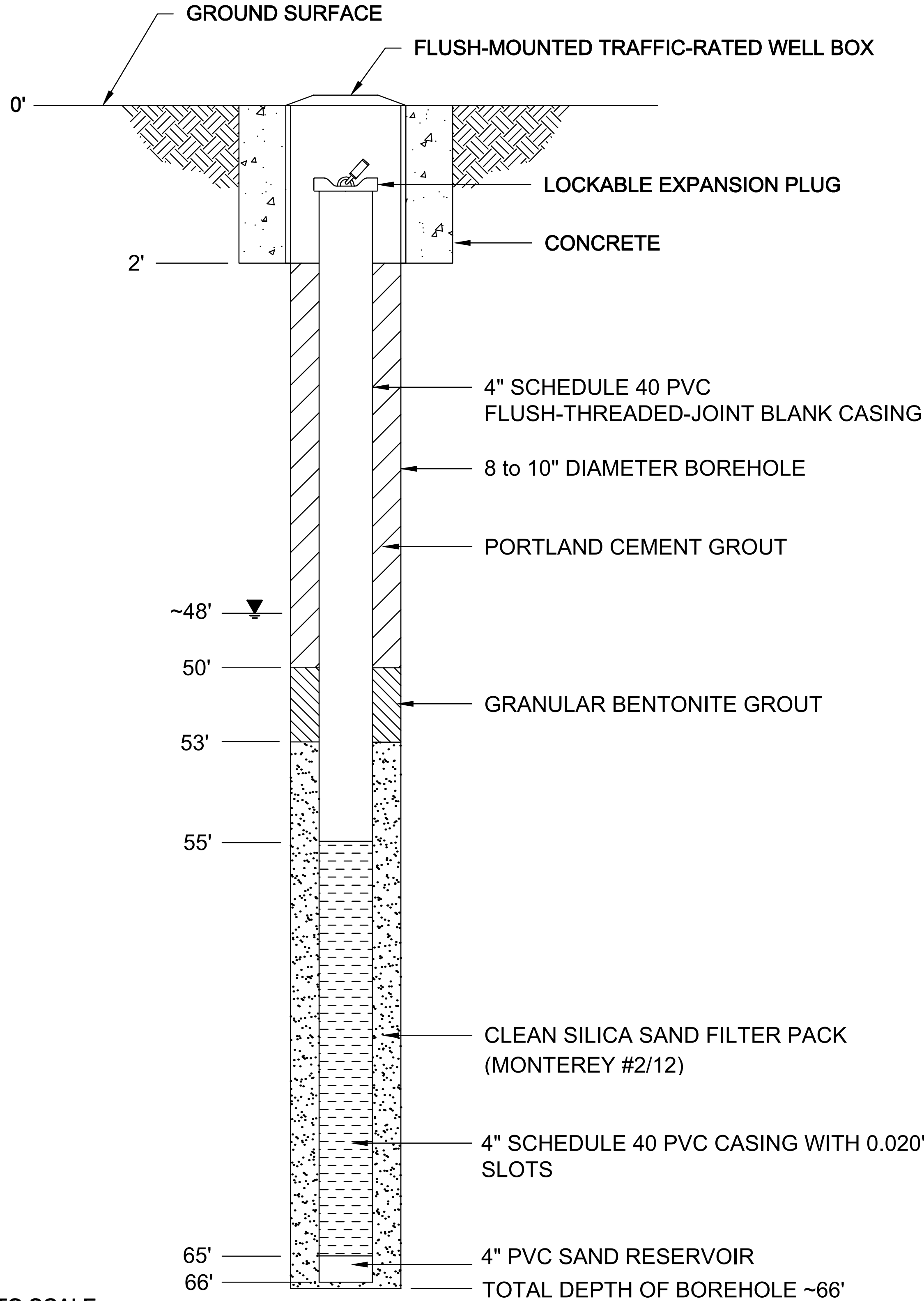
Arctos field personnel will be on site to observe the progress of each boring. The information recorded on the boring log will include drilling equipment used, boring location, nature of the materials encountered, backfill material, and other pertinent data. The boring logs will be drafted for presentation in the final report.

Analytical QA/QC Procedures

Laboratory analytical QA/QC procedures to be used for this work will include (1) preparing and analyzing laboratory samples to assess the performance of the analytical laboratory and (2) conducting data validation in accordance with the protocols described below. QA/QC samples prepared by the laboratory will include method blanks, matrix spike and matrix spike duplicates, and laboratory control samples.

The laboratory results will be reviewed in general accordance with EPA guidelines for data validation. The data validation process will include reviewing laboratory results for the following parameters:

- Completeness of the data package
- Compliance with EPA-required holding times
- Agreement of dilution factors with reported detection limits
- Presence or absence of analytes in the method blanks
- Agreement of duplicate samples
- Percent recovery and relative percent difference results for matrix spike and matrix spike duplicate analyses
- Percent recovery results for laboratory control samples.



NOTES:

1. DRAWING NOT TO SCALE.
2. ACTUAL WELL CONSTRUCTION MAY VARY BASED ON FIELD INVESTIGATION.

REVISION: 0

REVISIONS

NO.	BY	DATE	DESCRIPTION
0	MN	3/21/08	IRAP

ARCTOS ENVIRONMENTAL

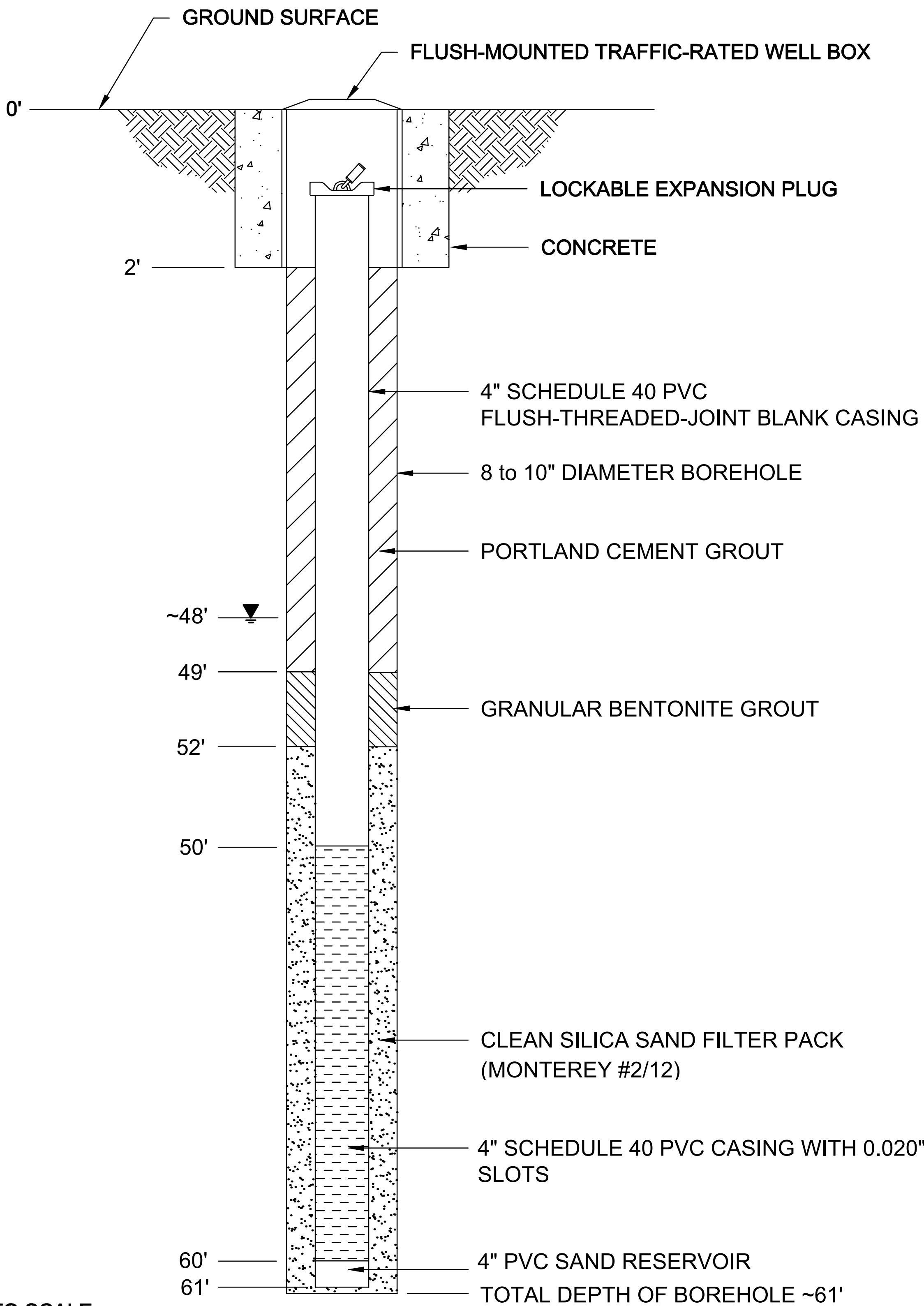
TESORO - LIVERMORE

WELL CONSTRUCTION DIAGRAM
WELL DW-1

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	JPG	JPG

FILE NO. DW-1 well const.pdf

FIGURE C-1



NOTES:

1. DRAWING NOT TO SCALE.
2. ACTUAL WELL CONSTRUCTION MAY VARY BASED ON FIELD INVESTIGATION.

REVISION	REVISIONS			
	NO.	BY	DATE	DESCRIPTION
0	0	MN	3/21/08	IRAP

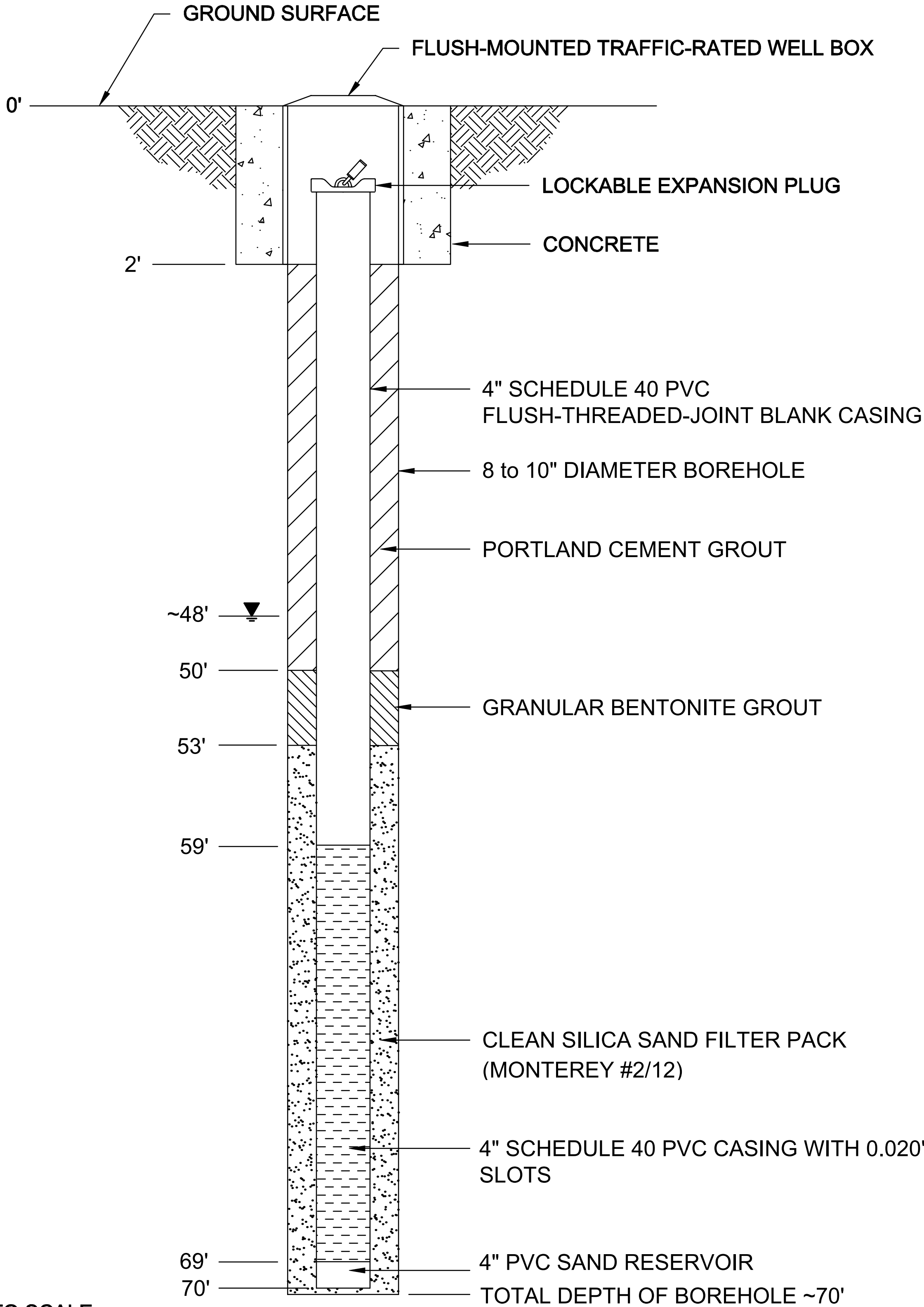
ARCTOS ENVIRONMENTAL

TESORO - LIVERMORE

WELL CONSTRUCTION DIAGRAM
WELLS DW-2 AND DW-3

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	JPG	JPG

FILE NO.	
DW-2 and DW-3 well const.pdf	FIGURE C-2



NOTES:

1. DRAWING NOT TO SCALE.
2. ACTUAL WELL CONSTRUCTION MAY VARY BASED ON FIELD INVESTIGATION.

REVISION	NO.	BY	DATE	DESCRIPTION
0	0	MN	3/21/08	IRAP

ARCTOS ENVIRONMENTAL

TESORO - LIVERMORE

WELL CONSTRUCTION DIAGRAM
WELL DW-4

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	JPG	JPG

FILE NO. DW-4 well const.pdf

FIGURE C-3

APPENDIX D

SVE PILOT TEST PROCEDURES AND RESULTS

APPENDIX D
SVE PILOT TEST PROCEDURES AND RESULTS

A soil vapor extraction (SVE) pilot test was conducted by Arctos Environmental (Arctos) on 5 December 2007. The objectives of the pilot test were to (1) assess the applicability of SVE technology to remediate the exposed saturated zone soil and (2) collect site-specific data to establish design parameters for a full-scale SVE system design. To accomplish these objectives, Arctos performed an 8-hour, single well pilot test to monitor mass removal rate, flow, vacuum, and radius of influence. SVE pilot test logs are in tables D-1 and D-2.

D.1 Pilot Test Procedures

GeoRestoration Inc. of San Jose, California, provided a portable SVE unit containing a truck-mounted positive displacement blower and an electric catalytic oxidizer. The unit had a maximum flow rate of 250 standard cubic feet per minute (scfm) or a maximum vacuum of 12 inches of mercury. The unit was permitted by the Bay Area Air Quality Management District (BAAQMD) for operation at various locations.

The inlet of the SVE unit was connected to the casing of extraction well VW-2 during the pilot test. Throughout the pilot test, the subsurface pressure (vacuum) was measured periodically in nearby monitoring wells. Arctos also monitored the system flow rate and extraction wellhead vacuum during the test and conducted a step test to measure extraction rates at various applied vacuums.

Soil gas concentrations from the extraction well were monitored continuously during the pilot test by a flame ionization detector (FID). Influent and effluent samples were collected for compliance with the BAAQMD permit. These samples were delivered to McCampbell Analytical, Inc. (McCampbell), a State-certified laboratory in Pittsburg, California, for chemical analysis of petroleum hydrocarbons by U.S. Environmental Protection Agency (EPA) Methods SW8021B/8015Cm.

D.2 VOC Mass Removed

VOC concentrations were generally stable during extraction from well VW-2. The concentrations measured by the FID during the pilot test ranged from 8,712 to 9,775 micrograms per liter (μg/l) or 2,130 to 2,390 parts per million by volume (ppmv). Dilution air was used during the SVE pilot test to protect the oxidizer's catalyst, therefore concentrations during initial operation of a full-scale SVE system are expected to be higher. The influent vapor sample collected contained total petroleum hydrocarbon as gasoline (TPHg) and benzene concentrations of 11,000 and 21 μg/l, respectively. The mass removal rate ranged from 99 to 114 pounds per day, and the total hydrocarbon mass removed during the 8-hour pilot test was approximately 33 pounds.

D.3 Applied Vacuum and Flow Rate

Applied vacuum and flow rates during the pilot test ranged from 3.5 to 10 inches of mercury (in. Hg), and 5 to 55 standard cubic feet per minute (scfm) respectively. The extraction well flow rate was measured at varying applied vacuums during the SVE step test. The range of applied vacuum and flow rate measurements will be used to size the extraction blower in a full-scale system. Figure D-1 shows the flow rate versus the applied vacuum for extraction well VW-2.

D.4 Radius of Influence and Recommended Well Spacing

Arctos evaluated the effective radius of influence of the extraction well to identify optimal well spacing for a full-scale SVE system. The radius of influence was estimated by (1) measuring the radial distance at which the subsurface vacuum reached 0.5 inch of water, (2) calculating the soil gas velocity at varying flow rates and distances and comparing to a "critical" value of 0.01 centimeters per second (cm/s), and (3) calculating the time to extract 1,000 pore volumes at the critical velocity distance.

The radius of vacuum influence was measured by monitoring the vacuum at monitoring wells TP-1, MW-2, TP-2, VW-3, and MW-3. Background vacuum readings were collected from well MW-6 to the northwest and well MW-4 to the northeast (Figure 2). The vacuum measured at the monitoring wells was plotted versus the logarithm of distance to produce a line that was projected to show the radial distance at 0.5 inch of water vacuum. Figure D-2 shows the radius of vacuum influence graph. The radius of vacuum influence estimated from the pilot test is 26 feet.

The radius of influence was further evaluated by calculating the distance at which significant remediation could occur within a reasonable time. A critical subsurface gas velocity of 0.001 to 0.01 cm/s is commonly used as the minimum pore-gas velocity required for effective SVE remediation. Figure D-3 shows the pore-gas velocities for extraction well VW-2 at varying flow rates and radial distances. The radius at which a critical pore-gas velocity of 0.01 cm/s is achieved at a flow rate of 25 scfm is 34 feet.

The optimal soil gas removal rate for an extraction well was evaluated by estimating the volume of significant remediation at the radius of critical pore-gas velocity. In general, 500 to 2,000 pore volumes should be flushed to remove a majority of the hydrocarbons adsorbed to soil particles and dissolved in pore moisture. The potential number of pore volumes flushed by an extraction well was calculated for varying radii and flow rates. The following table shows the estimated time to flush 1,000 pore volumes from the extraction interval at different extraction rates with a constant radius of 25 feet:

Extraction Well	Column Height (feet)	Well Spacing (feet)	Extraction Rate (scfm)	Time to Flush 1 Pore Volume (hours)	Time to Flush 1,000 Pore Volumes (days)
VW-2	15	25	10	12.3	511
			20	6.1	256
			30	4.1	170

This indicates that, depending on the extraction rate, it could take 0.5 to 1.4 years to flush 1,000 pore volumes at a distance of 25 feet.

TABLE D-1

SVE PILOT TEST LOG
TESORO - LIVERMORE

Date: **12/5/2007**

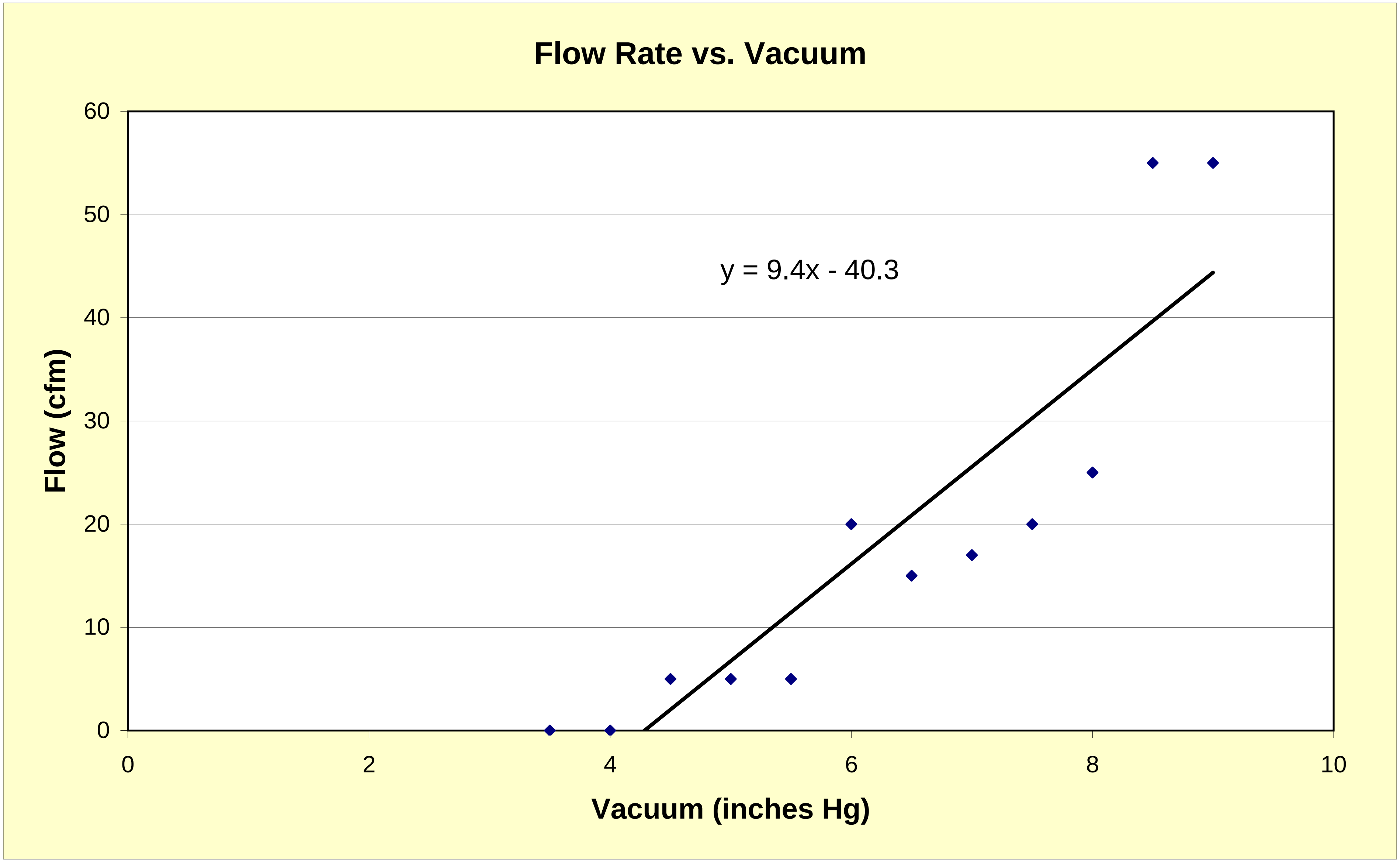
TP-1		MW-2		TP-2		VW-3		MW-3		MW-4		MW-6			
Time	**Vac. (in. WC)**	**Time**	**Vac. (in. WC)**	**Time**	**Vac. (in. WC)**	**Time**	**Vac. (in. WC)**	**Time**	**Vac. (in. WC)**	**Time**	**Vac. (in. WC)**	**Time**	**Vac. (in. WC)**	**FID (ppmv)**	**Comments**
0737	0.02	0737	0.01	0738	-0.01	0737	0	0745	0.18	0744	0.01	0737	0.01		Baseline
0747	0.11	0748	0.12	0750	0.05	0801	0.05	0828	0.04	0945	0.03	0833	0.05		Begin test
0747.5	0.26	0749	0.18	0752	0.06	0828	0.05	0945	0.06	1145	-0.04	0948	0.07		Dilution air is open for entire test.
0748	0.43	0750	0.31	0754	0.09	0945	0.09	1145	0	1500	0.04	1130	-0.01		
0749	0.5	0751	0.51	0802	0.1	1125	0.03	1500	-0.01			1510	0.01		flow = 150cfm, vac = 9"Hg
0749.5	0.59	0752	0.38	0808	0.11	1430	0.07								
0750	0.63	0754	0.53	0818	0.12	1512	0.02								
0750.5	0.66	0758	0.66	0828	0.12									2,140	vac = 11 "Hg
0751	0.61	0800	0.71	0838	0.12										
0751.5	0.48	0804	0.75	0904	0.12										
0752	0.49	0808	0.78	0945	0.12									2,300	vac = 10 "Hg
0752.5	0.6	0814	0.8	1045	0.11									2,340	
0753	0.61	0824	0.85	1145	0.11									2,370	
0754	0.62	0834	0.7	1406	0.07									2,370	
0755	0.65	0844	0.87	1514	0.13									2,380	
0756	0.73	0900	0.89											2,390	flow = 150 cfm, vac = 9.8 "Hg
0757	0.79	0930	0.91											2,360	
0758	0.83	1000	0.92											2,330	vac = 9.6
0800	0.85	1030	0.89											2,310	
0803	0.86	1100	0.92											2,280	
0805	0.90	1130	0.70											2,280	vac = 9.4
0807	0.90	1200	0.94											2,260	
0814	0.94	1230	0.94											2,250	
0821	0.98	1300	0.95											2,230	vac = 9.2
0826	0.99	1330	0.91											2,210	
0831	0.96	1400	0.90											2,200	
0840	0.98	1430	0.87											2,180	vac = 9.0
0845	1.03	1500	0.95											2,160	vac = 9.0
0850	1.00														
0900	1.07														
0910	1.07														
0930	1.12														
0950	1.11														
1020	1.14														
1050	1.14														
1120	1.17														
1200	1.17														
1230	1.14														
1300	1.19														
1330	1.18														
1400	1.17														
1430	1.21														
1500	1.21														

Notes:

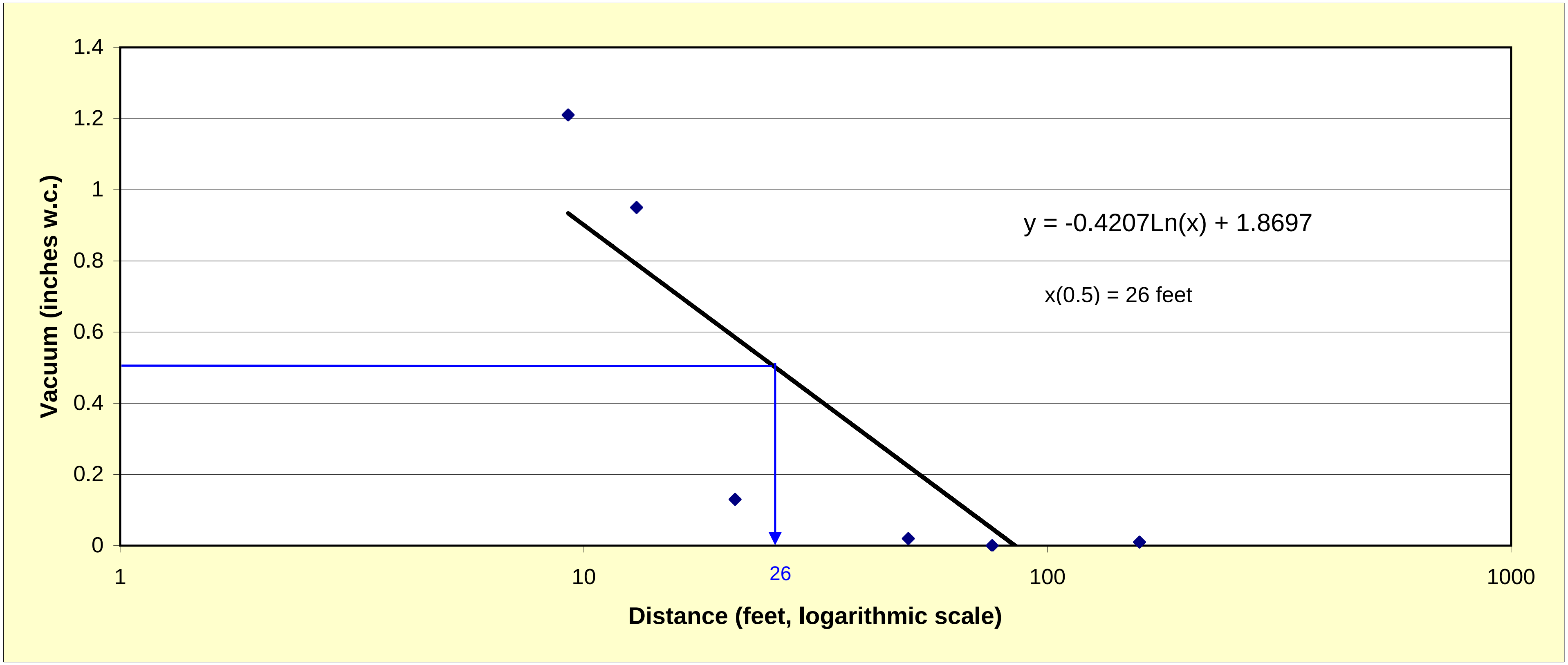
TABLE D-2

SVE PILOT TEST STEP TEST LOG
TESORO - LIVERMORE

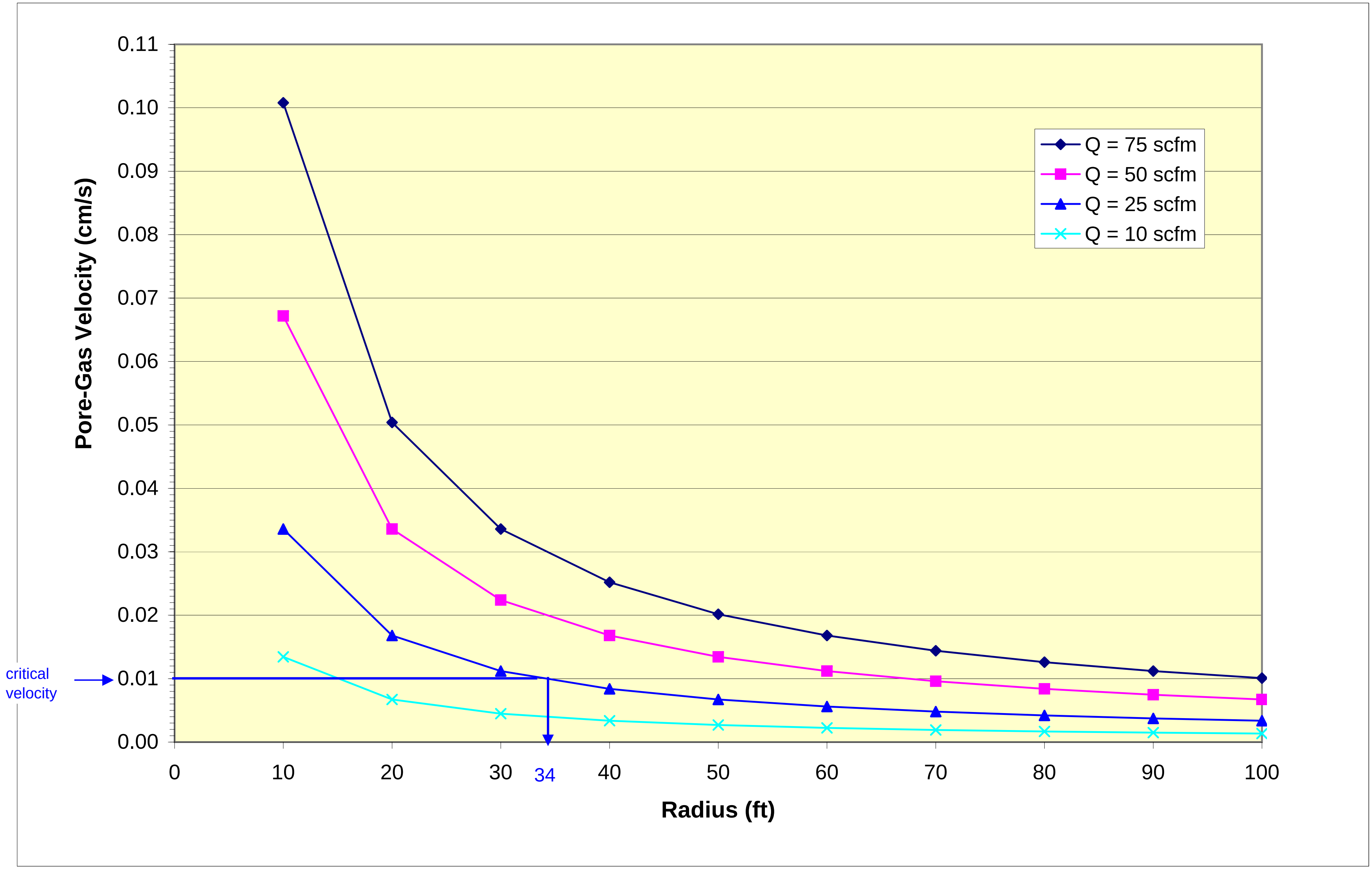
Extraction Well	Time	Manifold Vacuum (in. H_2O)	SVE Unit FID (ppmv)	SVE Unit Total Flow (cfm)	SVE Unit Dilution Air Flow	SVE Unit Well Flow (cfm)
VW-2	1500	9.0	2,160	150	95	55
	1504	8.5		150	95	55
	1507	8.0	1,870	155	130	25
	1510	7.5	1,637	160	140	20
	1512	7.0	1,550	162	145	17
	1514	6.5	1,415	170	155	15
	1516	6.0	1,280	180	160	20
	1519	5.5	1,150	185	180	5
	1520	5.0	1,033	185	180	5
	1521	4.5	883	195	190	5
	1523	4.0	790	200	200	0
	1524	3.5	663	210	210	0



ARCTOS Arctos Environmental	Tesoro - Livermore	FLOW RATE VERSUS VACUUM	Figure D-1
Flow vs Vacuum 01LV.xls 3/21/2008			



ARCTOS Arctos Environmental		Tesoro - Livermore	RADIUS OF VACUUM INFLUENCE	Figure D-2
ROI Graphs 01LV.xls	3/21/2008			



ARCTOS Arctos Environmental		Tesoro - Livermore	CRITICAL VELOCITY AT VARYING FLOW RATES	Figure D-3
velocity and cleanup time 01LV.xls	3/21/2008			