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11:04 am, Dec 15, 2008

Alameda County
Environmental Health

December 8, 2008

Aminifilibadi Masood & Amini Sharbano
909 Blue Bell Drive
Livermore, CA 94551

Re: Transmittal Letter
Site Location: Springtown Gas
909 Blue Bell Drive, Livermore, CA 94551

Dear Mr. Wickham:

On behalf of Aminifilibadi Masood & Amini Sharbano, Geological Technics Inc. (GTI) prepared the Site Conceptual Model Report, dated December 5, 2008 that was sent to your office via electronic delivery per Alameda County's guidelines on December 8, 2008.

I declare under penalty of law that the information and/or recommendations contained in the above referenced document or report is true and correct to the best of my knowledge.

Respectfully submitted,

Aminifilibadi Masood/Amini Sharbano
Property Owner
909 Blue Bell Drive
Livermore, CA 94551

Geological Technics Inc.

Report

Site Conceptual Model
December 2008

Springtown Gas
909 Bluebell Drive
Livermore, California

Project No. 1409.2
December 8, 2008

Prepared for:
Masood Filibadi and Sharbano Amini
909 Bluebell Drive
Livermore, California 95353

Prepared by:
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December 5, 2008

Project No.: 1409.2
Project Name: Springtown Gas (Blue Bell)

Masood Filibadi and Sharbano Amini
Springtown Gas
909 Bluebell Drive
Livermore, California 94551

RE: Report – Site Conceptual Model
Location: Springtown Gas, 909 Bluebell Drive, Livermore, California

Dear Masood Filibadi and Sharbano Amini:

Geological Technics Inc. is pleased to present the attached Site Conceptual Model Report for the above subject Site. The present report summarizes the current status of a gasoline release at the 909 Bluebell Drive property in Livermore, California by synthesizing the existing site characterization data including geology, hydrogeology, contaminant distribution, migration pathways and potential human receptors to provide a framework for additional assessment work and developing a Corrective Action Plan (CAP).

The work presented in the report is based on the work plan prepared by Geological Technics Inc. (GTI) dated July 30, 2008 and approved by Alameda County Health Care Services Agency (ACHCSA) on August 8, 2008.

If you have any questions or need additional information, please contact me. Thank you for this opportunity to serve your environmental needs.

Respectfully Submitted,

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

cc: Jerry Wickham - ACHCSA
USTCUF

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Report

Site Conceptual Model

Springtown Gas
909 Bluebell Drive
Livermore, California

Project No. 1409.2
December 8, 2008

1.0 INTRODUCTION

This Site Conceptual Model (SCM) Report has been developed in accordance with the Alameda County Environmental Health (ACEH) directives. On behalf of Masood Filibadi and Sharbano Amini, Geological Technics, Inc, (GTI) has prepared this Report for the property located at 909 Bluebell Drive, Livermore, Alameda County, California, hereinafter referred to as the Site (Alameda County Health Care Services Fuel Leak Case No. RO0002894).

Gasoline range petroleum hydrocarbons associated with underground storage tanks (UST), underground waste oil tank systems, and piping/dispenser network have been documented in soil and groundwater at the above Site (sees Figures 1 and 2 for vicinity and site maps). The Site, former Springtown Arco Service Station was found as a potential contribution to soil and groundwater contamination in an August 1988 inspection by Alameda County Department of Environmental Health, Hazardous Materials Division. During the course of inspection, the Division noted the presence of three 10,000 gallon underground storage tanks and one 1000 gallon underground waste oil tank. Springtown Arco Service Station was a part of Springtown Towing Business that was converted to a gasoline/retail minimart in 1988.

ACHCSA in their correspondence dated March 27, 1990 directed the removal of the underground waste oil tank and the cleanup of any soil or groundwater contamination that may have resulted from the tank system.

The work performed to date at the Site is summarized below:

- Removal of one underground waste oil tank at the Site on February 7, 1992 by Alpha Geo Services Inc. Soil sampling from underneath the tank (6 feet deep) and soil analysis report by Soil Tech Engineering on the same day. Soil sample collected beneath the tank area at six feet deep showed elevated levels of total oil and grease (5,000 ppm), TPH-D (89 ppm) and lead (140 ppm). Because of the degree of contamination found at the Site which exceeded regulatory threshold levels, further environmental assessment was directed by ACHCSA in their correspondence dated December 2, 1993.
- Removal of three 10,000 gallon underground storage tanks on December, 13, 1993 and installation of three new gasoline USTs in a separate pit on the east side of the Site (present underground storage tanks). After the removal of the fuel UST's a sheen was noted on the groundwater in the excavation. Soil samples were collected from sidewalls at the end of each UST (S1-S6). These samples contained up to 43 ppm TPH-G, 0.29, 0.33, 0.35, and 1.1 ppm BTEX respectively. Since product sheen was noted on groundwater, 1000 gallons of grossly contaminated water was removed from the pit and recycled at waste oil recovery. Another 20,000 gallons was later pumped from the fuel pit and stored in a holding tank. On December 16, 1993, the fuel tank pit was over excavated laterally and removed a couple of feet more of soil in the side walls. The depth of the excavation was extended from 11 feet to 14 feet below ground surface. Soil samples were collected from the north, south and west walls. The analytical results identified elevated hydrocarbons in the north and east walls. These two walls were over excavated and re-sampled on December 30, 1993. Analytical results indicated that the north wall still contained up to 7,200 ppm TPH-G and 5.8, 88, 46 and 550 ppm BTEX respectively. A groundwater sample was also collected from the pit. Up to 33,000 μg/l TPH-G, and 160, 200, 220, and 1,200 μg/l BTEX, respectively were detected in the groundwater sample. A total of 1,500 cubic yard of hydrocarbon impacted soil was removed from the waste oil and fuel UST pits. The soil was heat-treated onsite by National Vapor Industries. The treated soil was sampled in March 1995. Approximately 20 cy still contained elevated hydrocarbons and was disposed at Vasco Road landfill, in Livermore. The remaining treated soil was deemed clean and was reused to backfill the former UST's pit.
- Installation of three monitoring wells at the Site (MW-1, MW-2 and MW-3) on July 5, 1996. Soil samples were collected at 10 feet bgs from each boring. Soil from boring MW-1, located immediately north of the fuel UST pit, didn't contain petroleum hydrocarbons. Apparently the residual soil contamination along the north wall of the former tank excavation is limited in extent. Groundwater samples were collected from the three monitoring wells in July 1996 and April 1999. A maximum of 180 μg/l TPH-G, 130 μg/l MTBE, and 17, ND, 0.31, and 3.6 μg/l BTEX respectively were identified. Apparently the gasoline release from the former UST's didn't significantly affect groundwater quality beneath the Site.
- On August 30, 2000 the Alameda County Health Care Services Agency issued a "Remedial Action Completion Certification" for the Site and site closure was recommended because: the leak and ongoing sources were removed, the Site was

characterized adequately, the dissolved hydrocarbon plume appeared to not be migrating, no preferential pathways was recognized at the Site, no water wells or surface water was likely to be impacted by the contamination at the Site and the Site was thought not to present any significant risk to human health or environment. They mentioned in their correspondence that there is still 7000 ppm of TPH-G and 5.8 ppm of benzene in soil underneath the Site.

- Demolition of the former minimart building and construction of the existing minimart structure, undertaking a UST top upgrade to the three existing USTs on the Site, and removal and replacement of product delivery piping and product dispensers during the first and second quarters of 2005.

- On June 29, 2005, soil and groundwater samples were collected from the product dispenser and delivery piping removal areas (H_2OGEOL 2005) directed by the Livermore-Pleasanton Fire Department. Elevated concentrations of TPHd and TPHg were detected only in soil and groundwater samples collected at product dispenser 1-2. The impacted soil was removed by overexcavation. Elevated concentrations of MtBE and TBA were detected in soil samples collected at approximately 0.5 feet bgs from product dispenser 1-2, product dispenser 5-6, product dispenser 7-8, and the product delivery piping removal areas, with the highest concentrations detected in proximity to the UST cluster. The groundwater sample also contained elevated concentrations of MtBE and TBA.

- An Underground Storage Tank Unauthorized Release Report for the Site was issued by the Livermore Pleasanton Fire Department on June 29, 2005. The Site was transferred to the ACHCS on August 10, 2005.

- Advancement of 9 soil borings (SB-1 to SB-9) around the UST cluster and the product dispenser area (ESTC, March 2007). Soil and groundwater samples were collected from the soil borings. TPH-G, TPH-D and BTEX were not detected in soil samples, but elevated levels of MTBE and TBA were detected between 5 and 15 feet of depth. Elevated level of TPH-G and MTBE were detected in groundwater samples.
- In March 2007, a 2000-foot receptor well survey was conducted (ESTC, March 2007). One domestic well and one supply well were located within 2,000 feet of the Site.
- In June 2007, two Cone Penetrometer Test (CPT) borings were advanced hydraulically (CPT-1 and CPT-2) at the north side of the UST cluster and the southwest corner of the product dispenser area, to characterize the soil lithology underlying the Site, and collect grab groundwater samples from water-bearing zones to evaluate vertical extent of groundwater impact (ESTC July 2007).
- In August 2007, seven soil borings were advanced by direct-push methods (GP-1 thru GP-7), three of which were converted to 2-inch diameter groundwater monitoring wells (GP-5/STMW-1, GP-6/STMW-2, and GP-7/STMW-3).
- The groundwater monitoring wells were monitored for groundwater level/field parameters and samples were collected for hydrocarbon analyses in September 2007, December 2007 and September 2008.

- In May 2008, four borings were advanced by direct-push methods on a commercial parcel on the north side of Bluebell Drive directly north of the Site (GP-7 thru GP-10), and one boring (GP-6) advanced on a commercial parcel adjoining the Site to the east (ESTC, July 2008).
- On June 6, 2008, a soil vapor pilot test (SVPT) was conducted on the Site using two vapor extraction wells (VE-1 and VE-2) and the existing monitoring wells on the Site as vacuum monitoring wells (STMW-1, STMW-2 and STMW-3). 1998- Soil gas survey.
- An injection well (P1) was installed at the Site for the hydrogen peroxide injection pilot test on September 19, 2008 by GTI.
- A hydrogen peroxide injection pilot test was conducted at the Site between September 29 and November 6, 2008. The pilot test included hydrogen peroxide injection at STMW-1, STMW-3 and P1, and DO, ORP, EC and pH parameters measurement (GTI).

The data compiled during the course of this investigation indicate that the soil and groundwater were impacted with petroleum hydrocarbons from the underground storage tanks at the Site. A number of site investigation activities were performed since the time the Site came under regulatory oversight in the early 1990's. Geological Technics Inc. (GTI) has prepared this document based on previous investigation activities conducted at the Site by other consulting firms.

2.0 ASSESSMENT OF IMPACT

2.1 Release Documentation

Gasoline range petroleum hydrocarbons associated with underground storage tanks (UST), underground waste oil tank systems, and piping/dispenser network have been documented in soil and groundwater at the above Site (see Figures 1 and 2 for vicinity and site maps). The Site, former Springtown Arco Service Station was found as a potential contribution to soil and groundwater contamination in an August 1988 inspection by Alameda County Department of Environmental Health, Hazardous Materials Division. During the course of inspection, the Division noted the presence of three 10,000 gallon underground storage tanks and one 1000 gallon underground waste oil tank. Springtown Arco Service Station was a part of Springtown Towing Business that was converted to a gasoline/retail minimart in 1988.

ACHCSA in their correspondence dated March 27, 1990 directed the removal of the underground waste oil tank and the cleanup of any soil or groundwater contamination that may have resulted from the tank system.

The underground waste oil tank was removed by Alpha Geo Services Inc. on February 7, 1992. Soil samples collected beneath the tank area at six feet deep showed elevated levels of total oil and grease (5,000 ppm), TPH-D (89 ppm) and lead (140 ppm).

The three 10,000 gallon underground storage tanks were removed on December 13, 1993. After excavation sheen was observed on groundwater, an indication of hydrocarbon contamination resulted from tank leakage. Groundwater analysis of the sample taken from the pit indicated a 33,000 μg/l of TPH-G, 160, 200, 220, and 1,200 μg/l BTEX respectively. Soil samples were collected from the side walls of excavation. The samples contained up to 43 ppm TPH-G, 0.29, 0.33, 0.35 and 1.1 ppm BTEX respectively.

Upon demolition of the former minimart building and construction of the new one and upgrading the new UST, top soil and groundwater samples were collected from the product dispenser and delivery piping removal areas by H_2OGEOL in June 2005. The sampling was directed by the Livermore-Pleasanton Fire Department. Elevated concentrations of TPHd and TPHg were detected only in soil and groundwater samples collected at product dispenser 1-2. The impacted soil was removed by over-excavation. Elevated concentrations of MtBE and TBA were detected in soil samples collected at approximately 0.5 feet bgs from product dispenser 1-2, product dispenser 5-6, product dispenser 7-8, and the product delivery piping removal areas, with the highest concentrations detected in proximity to the UST cluster. The groundwater sample also contained elevated concentrations of MtBE and TBA.

2.2 Site Investigation

As outlined above in Section 1.0, the site investigation has consisted of multiple soil borings, the installation of monitoring wells and receptor well surveys. These efforts generated the data that will be summarized in the following sections:

2.2.1 1992-2000

One 1000-gallon capacity waste oil UST tank was removed from the south-central portion of the Site in February 1992 (Figure 2). Soil confirmation samples collected at 6 feet bgs contained minor concentrations of total petroleum hydrocarbons as diesel (TPHd), trace concentrations of toluene, ethylbenzene, total xylenes and tetrachloroethane (PCE), and elevated concentrations of total lead (Pb). In February 1995, the waste oil UST removal excavation was reopened and overexcavated. Confirmation samples collected from the over-excavated areas did not contain analytically detectable concentrations of TPHd, TPH as gasoline (TPHg), TOG, or benzene toluene, ethylbenzene, total xylenes (BTEX).

In December 1993, three 10,000-gallon capacity gasoline USTs used to store gasoline were removed from the southwest portion of the Site (Figure 3).

- Following removal a noticeable sheen was observed on groundwater entering the excavation (ACHCS 2000). Initially, 1,000 gallons of groundwater was removed from the gasoline UST removal pit, with another 6,000 gallons removed later (ACHCS 2000).
- The groundwater in the removal excavation was found to contain elevated TPHg and BTEX concentrations. The water was subsequently transported and treated offsite in December 1993.
- Soil confirmation samples collected along the sidewalls and at each end of the removal excavation contained minor concentrations of TPHg and BTEX.

- The gasoline UST removal pit was over excavated twice to remove TPH impacted soils. Product delivery piping was also removed concurrent with the removal of the gasoline USTs.
- Soil confirmation samples collected from the delivery line removal trenches (Figure 3) contained trace to non-detect concentrations of TPH.

A total of 1,500 cubic yards of impacted soil were removed from the waste oil and gasoline UST removal excavations. The impacted soil was heat-treated on the Site for approximately 3 months. Approximately 20 cubic yards were found to contain elevated TPH concentrations at the end of the treatment period, and were transported and disposed offsite. The remaining 1,480 cubic yards were used to backfill the gasoline UST removal excavation.

In January 1996, three groundwater monitoring wells were installed at the Site (Figure 3). Groundwater samples collected from the monitoring wells in July 1996 and April 1999 contained a maximum of 180 micrograms per liter (µg/l) TPHg, 130 µg/l methyl-tertiary butyl ether (MtBE), 17 µg/l benzene and trace TEX. Halogenated volatile organic compounds (HVOCs) were not detected.

The Site received Remedial Action Completion Certification from the ACHCS on August 30, 2000 (ACHCS 2000). The ACHCS Case Closure Letter stated that up to 7,000 milligrams per kilogram (mg/kg) TPHg and 5.8 mg/kg benzene exists in soil beneath the gasoline UST removal excavation, and that up to 5,000 g/kg TOG exists in soil beneath the waste oil UST removal excavation. The three groundwater monitoring wells that were installed in January 1996 were subsequently abandoned later in 2000.

2.2.2 2005 to Present

During the First and Second Quarters of 2005, the Site underwent extensive renovation. This included demolition of the former minimart building and construction of the existing minimart structure, undertaking a UST top upgrade to the three existing USTs on the Site, and removal and replacement of product delivery piping and product dispensers.

On June 29, 2005, soil samples were collected from the product dispenser and delivery piping removal areas (H_2OGEOL 2005). The samples were collected at the direction of the Livermore-Pleasanton Fire Department. A total of 14 soil samples, one groundwater sample, and three soil stockpile samples, were collected for laboratory analyses of TPHd, TPHg, BTEX, MtBE, tert-butyl alcohol (TBA), di-isopropyl ether (DIPE), ethyl-tert-butyl ether (EtBE) and tert-amyl-methyl ether (TAME). The soil stockpile samples were also analyzed for total lead (Pb). The soil and groundwater sample locations are illustrated on Figure 2 (Dispenser 1-2, Dispenser 3-4, Dispenser 5-6, Dispenser 7-8, PL1 through PL5, SCor1-2 and Ncor1-2, and PL1-1-2-GW). Table 4 in "Tables from previous work done by other consultants" lists the soil analytical results, and Table 2 lists the groundwater analytical result. Elevated concentrations of TPHd and TPHg were detected only in soil and groundwater samples collected at product dispenser 1-2. The impacted soil was removed by over-excavation. The soil stockpile samples contained trace amounts of TPHd and TPHg. BTEX compounds were not analytically detected in the soil samples, soil stockpile samples and the groundwater sample. Elevated concentrations of MtBE and TBA were detected in soil samples collected at approximately 0.5 feet bgs from product dispenser 1-2, product dispenser 5-6, product dispenser 7-8, and the product delivery piping removal areas, with the highest concentrations detected in proximity to the UST cluster. The groundwater sample also contained elevated concentrations of MtBE and TBA. The soil stockpile samples contained low to moderate levels of MtBE and TBA and low levels of total lead (Pb).

Based on the analytical results, an Underground Storage Tank Unauthorized Release Report for the Site was issued by the Livermore Pleasanton Fire Department on June 29, 2005. The Site was transferred to the ACHCS on August 10, 2005.

In February 2007, nine borings were advanced by direct-push methods (SB-1 thru SB-9) around the UST cluster and the product dispenser area (ESTC, March 2007). The locations of the borings are illustrated on Figure 2. The soil lithology encountered ranged from black stiff clay to gray silty clay to 20 feet bgs (maximum depth explored).

- Soil and groundwater samples were collected from each boring for laboratory analyses. Table 1 lists the soil analytical results, and Table 2 lists the groundwater analytical results (Tables from previous works done by other consultants).
- Concentrations of TPHd, TPHg and BTEX were not analytically detected in the soil samples. Elevated concentrations of MtBE and TBA were detected in soil samples collected between 5 feet and 15 feet bgs from boring SB-5 in the southwest portion of the product dispenser area, and borings SB-6, SB-7 and SB-8 in proximity to the north and west sides of the UST cluster, and the southwest portion of the dispenser area (SB-5).
- For the groundwater samples, elevated concentrations of TPHg were detected at borings SB-5 and SB-6 with the remaining borings all non-detect. Elevated concentrations of MtBE were detected in the groundwater samples collected from all of the borings except SB-1 and SB-8, with the highest concentrations at boring SB-5 and SB-6. Concentrations of TBA were elevated in groundwater samples collected from all of the borings except SB-3, SB-4 and SB-9, with the highest concentrations at borings SB-6, SB-7 and SB-8, all at the UST cluster.

In March 2007, a 2000-foot receptor well survey was conducted (ESTC, March 2007). A total of 51 wells were located within 2,000 feet of the Site, of which 49 are monitoring wells for other contaminated sites. One domestic well and one supply well were located within 2,000 feet of the Site. The domestic well is located approximately 1950 feet southeast of the Site and the supply well is located approximately 1,400 feet southeast of the Site.

In June 2007, two Cone Penetrometer Test (CPT) boreholes were advanced hydraulically (CPT-1 and CPT-2) at the north side of the UST cluster and the southwest corner of the product dispenser area, to characterize the soil lithology underlying the Site, and collect grab groundwater samples from water-bearing zones to evaluate vertical extent of groundwater impact (ESTC July 2007). The locations of the two CPT boreholes are illustrated on Figure 2.

- At CPT-1, clay and silty clay was interpreted to approximately 30 feet bgs, followed by sand to approximately 40 feet, followed by sandy silt and clayey silt to approximately 63 feet bgs, followed by sand to approximately 68 feet bgs (maximum depth explored).

- At CPT-2, clay and silty clay followed by sandy silt and clayey silt were interpreted to approximately 16 feet bgs, followed by sand to approximately 22 feet bgs, followed by sandy silt and clayey silt to 28 feet bgs, followed by sand to 35 feet bgs, followed by sandy silt and clayey silt to 60 feet bgs, with a thin layer of sand at approximately 41 feet bgs (maximum depth explored).
- Grab Groundwater samples were collected from the CPT-interpreted sand zones. The analytical results are listed on Table 2. Concentrations of TPHg and BTEX were not detected in the samples collected. Concentrations of MtBE were detected in the samples collected from CPT-1 between 34 feet to 38 feet bgs (1.4 µg/l), and from CPT-2 between 18 feet and 22 feet bgs (89 µg/l).
- Trace concentrations of chloroform and PCE were detected in the sample collected from CPT-1 between 34 feet to 38 feet bgs, and at CPT-2 between 31 feet to 35 feet bgs.
- The analytical results established that only uppermost groundwater (<20 feet bgs) is impacted with dissolved-phase hydrocarbons.

In August 2007, four soil borings were advanced by direct-push methods (GP-1 thru GP-7), three of which were converted to 2-inch diameter groundwater monitoring wells (GP-5/STMW-1, GP-6/STMW-2, and GP-7/STMW-3). The locations of the borings and monitoring wells are illustrated on Figure 2, site map (ESTC October 2007).

- The soil lithology encountered ranged from black stiff clay to gray silty clay to 20 feet bgs (maximum depth explored) in borings GP-1 and GP-6/STMW-2.
- At GP-5/STMW-1 light brown clayey sand was encountered between approximately 13 feet and 16 feet bgs. At borings GP-2, GP-3, GP-4 and GP-7/STMW-3, a light brown to gray sand ranging from fine-grained to gravelly was encountered between approximately 13 feet to 20 feet bgs, and was inferred to correlate with the CPT-interpreted sand between 16 feet and 22 feet bgs in CPT-2 (June 2007). The sand bed was interpreted to occur only along the north end of the Site.
- Soil samples were collected from each boring for laboratory analyses. Table 1 lists the soil analytical results. Concentrations of TPHg and BTEX were not detected in the samples collected. Concentrations of MtBE and TBA were detected in samples collected from GP-1 at 5 feet bgs and 20 feet bgs, from GP-2 at 10 feet bgs, from GP-3 at 10 feet and 20 feet bgs, from GP-5/STMW-1 at 10 feet, 15 feet and 20 feet bgs, and from GP-6/STMW-2 at 5 feet and 10 feet bgs. The highest concentrations were detected at GP-5/STMW-1 and GP-6/STMW-2 north and south of the UST cluster (Figure 2), and GP-2 at the northwest comer of the product dispenser area. Correlating the soil analytical results from this investigation with the February and June 2007 investigations identified the highest soil impact in proximity to the UST cluster and the northwest portion of the product dispenser area.
- Grab groundwater samples were collected from borings GP-1 thru GP-4. Table 2 lists the grab groundwater analytical results. Concentrations of TPHg and BTEX were not detected in the grab groundwater samples, with the exception of the sample from boring GP-3, the analyses of which did not indicate a gasoline pattern. Elevated

concentrations of MtBE and TBA were detected in the grab groundwater samples collected from borings GP-1 thru GP-3, with the highest MtBE concentration detected in boring GP-3, and the highest TBA concentration detected in boring GP-2. A trace concentration of methanol was detected in boring GP-2. Correlating the grab groundwater analytical results from this investigation with the February and June 2007 investigations identified the highest MtBE impact in proximity to the UST cluster and the northwest portion of the product dispenser area, coinciding with the combined soil analytical results in these two areas of the Site.

- Offsite migration of MtBE with groundwater to the north and northwest was also apparent.
- The UST cluster was inferred to be the MtBE Source Area (ESTC, October 2007).

The three groundwater monitoring wells were developed and surveyed in late August 2007, and groundwater samples collected on September 4, 2007. A rainbow sheen was observed on the groundwater sample collected from monitoring well STMW-1 (ESTC January 2008).

- Table 2 lists the analytical results. Concentrations of TPHg were detected only in the groundwater samples collected from monitoring wells STMW-1 (220 µg/l) and STMW-3 (59 µg/l). Concentrations of BTEX were not detected. Concentrations of MtBE were detected only in the groundwater samples collected from monitoring wells STMW-1 (850 µg/l) and STMW-3 (160 µg/l). Concentrations of TBA were detected in each monitoring well, with the highest concentration detected in the sample collected from STMW-1 (6,500 µg/l).
- Depth to water measurements ranged from 6.58 feet bgs (510.97 feet above mean sea level [amsl]) at STMW-1, 8.30 feet bgs (511.29 feet amsl) at STMW-2, to 9.52 feet bgs (510.85 feet amsl) at STMW-3.
- Based on the depth to water measurements, groundwater was determined to be flowing northwest at a gradient of 0.006 ft/ft.
- Table 3 lists the monitoring data. The well screens in the wells were drowned (groundwater surface above the top of well screen) at the time depth to water measurements and groundwater samples were collected from the wells.

In December 2007, the monitoring wells were monitored and sampled, with the event reported as the Fourth Quarter 2007 Groundwater Monitoring and Sampling Event (ESTC, January 2008). Groundwater samples were collected on December 10, 2007. No sheen or product odor was observed on the samples collected from the three monitoring wells.

- Table 2 lists the analytical results. Concentrations of TPHg were detected only in the groundwater sample collected from monitoring wells STMW-1 (210 µg/l). Concentrations of BTEX were not detected. Concentrations of MtBE were detected only in the groundwater samples collected from monitoring wells STMW-1 (540 µg/l) and STMW-3 (17 µg/l). Concentrations of TBA were detected in each monitoring well, with the highest concentration detected in the sample collected from STMW-1 (4,200 µg/l). Methanol was detected at 10,000 µg/l in the groundwater sample collected from STMW-1.

- Depth to water measurements ranged from 6.26 feet bgs (511.29 feet amsl) at STMW-1, 8.02 feet bgs (511.57 feet amsl) at STMW-2, to 9.12 feet bgs (511.25 feet amsl) at STMW-3.
- Based on the depth to water measurements, groundwater was determined to be flowing northwest at a gradient of 0.004 ft/ft.
- Table 3 lists the monitoring data. The well screens in the wells were drowned at the time depth to water measurements and groundwater samples were collected from the wells.

In May 2008, four borings were advanced by direct-push methods on a commercial parcel on the north side of Bluebell Drive directly north of the Site (GP-7 thru GP-10), and one boring (GP-5) advanced on a commercial parcel adjoining the Site to the east (ESTC, July 2008). The locations of the borings are illustrated on Figure 2.

- The soil lithology encountered at GP-5 ranged from black stiff clay to gray silty clay to 20 feet bgs (maximum depth explored). At borings GP-7 thru GP-8, a light brown to gray to white sand ranging from coarse-grained to gravelly in texture was encountered between approximately 10 feet to 20 feet bgs, and was inferred to correlate with the CPT-interpreted sand between 16 feet and 22 feet bgs in CPT-2 (June 2007).
- Soil and groundwater samples were collected from each boring for laboratory analyses. Table 1 lists the soil analytical results, and Table 2 lists the groundwater analytical results. Concentrations of TPHg and BTEX were not analytically detected in the soil samples. Concentrations of MtBE were detected in the soil samples collected from boring GP-7 at 10 feet bgs (6.5 µg/l), boring GP-8 at 10 feet and 15 feet bgs (440 µg/l and 44 µg/l, respectively), and boring GP-9 at 15 feet bgs (14 µg/l). Concentrations of TBA were detected only in the soil samples collected from boring GP-8 at 10 feet bgs (2,300 µg/l) and 15 feet bgs (270 µg/l).
- For the groundwater samples, concentrations of TPHg were detected at borings GP-6 (560 µg/l) and GP-8 (530 µg/l) with the remaining borings non-detect. Elevated concentrations of MtBE were detected in the groundwater samples collected from all of the borings except GP-6 and GP-10, with the highest concentration at boring GP-8 (970 µg/l). Concentrations of TBA were detected in the groundwater sample collected from boring GP-8 at 4,100 µg/l.

On June 6, 2008, a soil vapor pilot test (SVPT) was conducted on the Site using two vapor extraction wells (VE-1 and VE-2) and the existing monitoring wells on the Site as vacuum monitoring wells (STMW-1, STMW-2 and STMW-3). The purpose of the SVPT was to evaluate soil vapor extraction as an alternative for remediating soil impact in the vadose zone above uppermost groundwater at the Site. The locations of the SVPT extraction wells and vacuum monitoring wells are illustrated on Figure 2, site map (ESTC, July 2008). The extraction wells were installed in May 2008 to a depth of 10 feet bgs, and completed with 7 feet of well screen casing between 3 feet and 10 feet bgs. The test was conducted using an internal combustion engine (ICE) driving a positive displacement blower. The SVPT was run in steps to optimize air flow/vacuum characteristics for potential design purposes. Magnahellic gauges were used to measure vacuum in the vacuum monitoring wells.

Unfortunately, the groundwater monitoring well screens were drowned during the SVPT, effectively precluding their use as vacuum monitoring wells. No vacuum was observed in the extraction wells when used as vacuum monitoring wells. Therefore, the results of the SVPT were inconclusive.

On September 19, 2008 an injection well (P1) was installed at the Site to be used in hydrogen peroxide injection pilot test between September 29 and November 6, 2008. The hydrogen peroxide injection included weekly hydrogen peroxide injection at STMW-1, STMW-3 and P1, and DO, ORP, EC and pH parameters measurement. The three monitoring wells, vapor extraction wells and STMW-2 were sampled for 21 metals, TPH-G, BTEX and Fuel Oxygenates analysis on September 24 and November 20, 2008 to test the effect of hydrogen peroxide injection on groundwater contamination.

The 2008 third quarter groundwater monitoring event took place on September 25, 2008. Groundwater gradient in this event was found to be 0.003 ft/ft in N54°W direction. Total Petroleum Hydrocarbons as Gasoline (TPHg) was detected in STMW-1 only (230 μg/l). MtBE was detected in STMW-1 and 3 in the amount of 204 and 67 μg/l, respectively. TBA was detected in STMW-1,2 and 3 in the amount of 704, 71 and 31.7 μg/l, respectively.

2.3 Chemicals of Concern

Gasoline

The investigation of the release documented in Sections 2.1 and 2.2 above has identified gasoline range petroleum hydrocarbons as the chemicals of concern (COC) at the Site. The analysis of gasoline components is usually limited to benzene, toluene, xylene and ethyl benzene (BTXE), total petroleum hydrocarbons as gasoline (TPH-G) because: (1) they are readily adaptable to gas chromatographic detection, (2) they pose a serious threat to human health (benzene is carcinogen), (3) they have the potential to move through soil and contaminate groundwater, (4) their vapors are highly flammable and explosive (*Leaking Underground Fuel Tank Field Manual*, State of California Leaking Underground Fuel Tank Task Force, October 1989), and (5) a high percent of gasoline is composed of these compounds. These COC have been identified at the Site and are included in the monitoring and analytical protocols. Among the compounds mentioned above BTEX has not been detected either in soil or groundwater recently since 2005 that the investigation started at the Site. However, TPH-G has been detected both in soil and groundwater in several occasions and most recently in groundwater samples collected at groundwater monitoring wells during quarterly monitoring events.

Fuel Oxygenates

Fuel oxygenates are classified in 5 compounds: Tert Butyl Alcohol (TBA), Methyl tert-Butyl Ether (MtBE), Di-Isopropyl Ether (DIE), Ethyl tert-Butyl Ether (EtBE), and Tert-Amyl Methyl Ether (TAME). Among these 5 fuel oxygenates TBA and MtBE are considered as the COC since they have been detected both in groundwater and soil samples in different sampling events since 2005. The most recent samples are groundwater samples from the monitoring wells that shows elevated level of both MtBE and TBA. It is believed that TBA is a byproduct of MtBE breakdown. Fuel oxygenates are added to gasoline to enhance the oxidation of fuel and increases the efficiency of fuel application.

GTI has compiled fact sheets available on government and commercial internet sites for the COC and has included the sheets in Appendix D. The fact sheets include physical and chemical properties of the COC in a pure form, not necessarily that which occurs upon release to the environment. Although the solubility of the COC in water varies from chemical to chemical, each of the COC has the potential to migrate off site with groundwater movement.

2.4 Geological/Hydrogeologic Site Characteristics

The Site is situated in a mixed commercial-residential land-use area of Livermore, California, and is located at the southeast corner of the intersection of Springtown Boulevard and Blue Bell Drive, approximately 300 feet north of westbound Interstate 580 (Figure 1). The Site occupies approximately 0.74 acres, and is currently an operating service station with mini-mart retailing Chevron-branded gasoline and diesel fuel products. The Site contains one UST cluster in the east portion of the Site consisting of one 12,000 gallon capacity unleaded gasoline UST, and a 12,000 gallon capacity segmented UST storing 6,000 gallons of diesel and 6,000 gallons of premium unleaded. The Site has a single story mini-mart in the south portion and six canopied fuel dispensers in the north portion. No automotive repair facilities exist on the Site. Figure 2 illustrates the features on the Site. The Site is adjoined by Springtown Boulevard on the west, motel properties on the south and east, and Bluebell Drive on the north. Retail land-use is located on the north side of Bluebell Drive, with residential land-use beyond to the north and northeast.

In 2000 the Site was purchased by Masood Filibadi and Sharbano Amini from James E. and Angie P. McAtee, who purchased the Site from Gulf Oil Corporation in 1970.

Geology

The Site is located at an elevation of approximately 520 feet above mean sea level in the northeast portion of the Livermore Valley (USGS 1981). The Livermore Valley is a structural basin bounded by faults on the east and west that create the Altamont Hills uplift on the east and the Pleasanton Ridge uplift on the west (CDM&G, 1991). The shallow Pleistocene to Recent sediment underlying the basin consists of alluvial deposits that have been informally divided into upper and lower units. The sediment, ranging from coarse-grained gravel to fine-grained mud, was transported northward from the Northern Diablo Range on the southern margin of the basin and deposited in alluvial fan, braided stream, and lacustrine environments. Because the sediment prograded northward, the coarse-grained sediment makes up nearly 80% of the sediment in the southern part of the basin, but northward and westward interfingers with clay deposits that may be as much as 30 feet thick (DWR, 2004)

The following section briefly discusses the subjective field observations and geology documented during this investigation based on the interpretations of various field geologists (see Appendix C for boring logs):

Wells MW-1 through MW-3 (1995):

- These borings were advanced to approximately 21.5 feet bgs and BSK & Associates described the shallow subsurface as predominantly silty clay up to 10 feet in MW-1, from 10 to 15 ft silty sand and from 15 to total depth sandy clay with silty clay at the bottom. The soil in MW-2 and MW-3 were described as silty clay from the top to bottom with slightly mixture of sandy clay between 10 and 15 feet in MW-3.

Boreholes SB-1 through SB-9 (2007):

- These borings were advanced to approximately 20 feet bgs and ETSC described the soils as follows: The stiff black clay grades downward to silty or sandy clay that varies from light gray to olive-gray to light brown in color. This silty clay is thickest on the southern and eastern perimeter of the dispenser facility, extending to a depth of 17 feet in SB-8 and to at least 20 feet in SB-1, SB-2, SB-6, and SB-7. Toward the northwest, this clay extends to 14-16 feet below grade in SB-3, SB-4, SB-5, and SB-9. The silty-sandy clay is underlain by several feet of coarser-grained sediment that is light brown in color. This layer consists of clayey to sandy silt in SB-5 and SB-9, but the grain size in SB-3, SB-4, and SB-8 ranges between silt and coarse-grained sand.

Boreholes STMW-1 through STMW-3 (2007):

- Borings were advanced to 20 feet bgs and ESTC described the soils as follows:
- STMW-1: stiff silty clay up to 11 feet that changes color from black to gray and green from the top to bottom. Soil changes from sandy clay to clayey sand between 11 and 16 feet of depth. The stiff silty clay with gray to brown color appears again from 16 to 20 feet of depth.
- STMW-2: Stiff sandy clay up to 10 feet of depth changing in color from black to gray. Between 10 and 15 soil is predominantly grayish-brown stiff silty clay. From 15 to 20 feet of depth sandy silty clay appears again.
- STMW-3: Stiff sandy clay to sandy silt changing color from black to brown and gray from the top to bottom extends from the top to 14 feet of depth. From 14 to 17 ft the soil mainly consists of brown clayey sand with some gravel and from 17 to the total depth is mainly light gray gravelly sand with some clay.

Boreholes GP-1 to GP-4 (2007):

- These borings were advanced to approximately 20 feet bgs and ETSC described the soils as follows: The stiff black silty clay observed in almost all the borings such as SB-1 to SB-9, CPT-1 and CP-2 is observed in GP-1 to GP-4 as well extending from the top to 10 and 14 feet depth. A sand layer, ranging from fine grained to gravely, is present in GP-3 and GP-4 from 14 to at least 20 feet and in GP-2 from 13 to 16 feet. This bed correlates with the sand bed that was previously logged in SB-3, SB-4, and CPT-2. All five borings penetrated this bed at about the same depth, and the log from

CPT-2 indicates that the bed coarsens downward to its base at about 19.5 feet. The bed is present only along the northern edge of the property, and it was not encountered in any of the other borings. This implies that it trends in a northeast-southwest direction and probably acts as a preferential pathway for groundwater flow.

Boreholes CPT-1 and CPT-2 (2007):

- These borings were advanced to approximately 70 and 60 feet bgs respectively. ETSC described the soils in these two borings as follows:
- Fine-grained sediment, ranging from stiff black clay to friable, gray, silty clay, was logged from the surface to a depth of 15 or locally 20 feet in the nine Geoprobe borings that were drilled in February 2007. The log of CPT-1, which is located between borings SB-6 and B-8, indicates that this sediment extends to as much as 30 feet below surface grade in this area (Appendix "C"). In CPT-2, clayey silt and sandy silt are interbedded above 15 feet, but a coarser-grained layer, ranging from gravelly sand in the lower part to silty sand in the upper part, is present between 15 and 20 feet. This unit is not present in CPT-1, but was cored in nearby borings SB-3 and SB-4 in February 2007.
- A coarse-grained (gravelly) sand bed was penetrated between 30 and 40 feet in CPT-1. This same bed was also present in CPT-2, from 27 to 35 feet. Silt is interbedded with thin lenses of sand or sandy silt from 40 to 63 feet in CPT-1 and to at least 60 feet in CPT-2. No samples were collected from this interval in CPT-1, but one sample was collected between 55 and 59 feet in CPT-2. Another coarse-grained sand bed, similar to the bed from 30-40 feet, was penetrated at 64 feet in CPT-1. The base of this bed was not reached, implying that it is more than 6 feet thick.
- Drilling to a depth of 70 feet reveals that there are two thick, coarse-grained, permeable sand beds between the surface and this depth at the Site. The top of one of these is approximately 28 feet below grade, and the top of the other is approximately 65 feet below grade. Both beds appear to be relatively extensive, upward-fining fluvial channel deposits and are likely to be good aquifers. A thinner, finer-grained, less extensive sand bed is present near the southwest corner of the former dispenser island and has been identified in four borings: CPT-2, SB-3, SB-4, and SB-5. This bed is present in the depth range of 15-20 feet and is at least 6 feet thick in SB-4, but is less than 5 feet thick in the others.

Borings VE-1 and VE-2 (2008):

- These borings were advanced to 10 feet bgs and ESTC described the soils as follows:
  - VE-1: Black stiff and damp clay from surface to 5 feet of depth. From 5 to 10 feet depth soil is predominantly silty clay with few small size pea gravels toward the bottom.
  - VE-2: Black stiff silty clay from the top to the bottom by changing color from black to gray and green toward to bottom.

Borings GP-5 and GP-7 to GP-10 (2008):

- The black stiff silty clay is present in all these 5 borings with different thicknesses. The sandy gravel present in the northern borings and wells was observed in all borings in this group except for GP-5. Cross sections H-H' and G-G' shows the geology formation variation across these borings.

GTI logged the last well installed at Site in September 2008 (P1):

- The black stiff silty clay layer is present in P1 from the top to 13 and the gravelly sand is present between 13 and 17 feet. This sand layer is observed in GP-2 from 13-16 and in GP-3 and GP-4 from 14-20 feet of depth. This is the same layer that is just observed on the northern part of the Site and is believed to act as a preferential pathway for groundwater flow. No odor was observed in the drilling process of P1 from the top to bottom and all OVM readings were zero.

<u>Note</u>: *The cross sections were developed using data gathered by different individuals utilizing different methodologies. Therefore, they need to be looked at as one of several possible interpretations of actual site conditions.*

GTI has completed cross sections depicting our interpretation of the subsurface- see Figure 3a for section locations. The subsurface lithology falls into two predominant categories- stiff silty clay and sand with some gravel. Since the interpretations of different individuals have been different from the subsurface soil we categorize the soil observed beneath the Site up to 20 feet of depth as silty clay and sandy gravel. The silty clay is predominant especially in the southern portion of the Site while the sandy gravel is limited in thickness and horizontal extent, it is present just on the north and northwest and it appears that the thickness increases toward northwest. This grouping serves to identify potential preferential pathways for contaminant migration through units of greater hydraulic conductivity.

Figures 4, 11 and 7 through 9 illustrate the geology trending from north to south side of the Site. Figures 5, 6, 10 and 12 illustrate the geology trending from west to east side of the Site. The diagrams indicate that sandy gravel units are present on the north and west portions of the Site from 11 to 20 ft bgs that is replaced by silty clay for a portion of this interval in some points. The north and northeast borings, GP-7, 8, 9, and 10, shows that the sandy gravel continues to the other side of Bluebell Drive. This observation indicates that the sandy gravel layer is channelized toward north and northeast of the Site starting from the north boundary of the Site. This layer might continue toward northeast also on the other side of Bluebell Drive but no information is available. The information on hand shows that the northwest most points have a thicker layer of sandy gravel and there is a possibility that it continues increasing the thickness in that direction.

Hydrogeology

Drainages from the south, north, and east converge in the western part of the Livermore Valley basin and flow out of the basin toward the Sunol Valley and Alameda Creek west of Pleasanton Ridge. The nearest surface drainages are Las Positas Creek located approximately 1 mile west of the Site, and Cavetano Creek 2 miles west of the Site (USGS 1981).

The alluvial fan, braided stream and lacustrine deposits are the principal aquifers for most domestic and irrigation purposes in the Livermore valley, although the underlying Livermore Formation, which may be as much as 4,000 feet thick, yields significant quantities of groundwater on the eastern side of the basin (DWR 2004).

The depth to groundwater observed in the Site's wells has ranged from approximately 6.26 to 9.72 feet below grade surface between September 2007 and September 2008. The groundwater elevation in the same period ranges from 510.75 to 511.38 feet AMSL on average. Horizontal groundwater gradient for the first two groundwater monitoring events (September 4, and December 10, 2007) were measured as 0.006 and 0.004 ft/ft respectively and during September 25, 2008 groundwater monitoring event was measured as 0.003 ft/ft. Bearing for the three groundwater monitoring events has been N66°W, N2°W and N54°W respectively. Therefore, horizontal groundwater gradient at the Site is between 0.003 and 0.006 ft/ft and the average is 0.004 ft/ft. Groundwater bearing on average is N61°W. Figures 13 to 15 show the groundwater elevation map for the three groundwater monitoring events and Figure 16 shows the rose diagram of horizontal groundwater gradient changes over time.

There is limited evidence that the thickness of sand layer towards the northwest is increasing; therefore, if any contamination reaches this layer there would be a high risk of receiving contamination down gradient in a much faster pace than it moves in the silty clay layer. GTI recommends having a Geoprobe investigation on the other side of Bluebell Drive on the west and northwest of the side to check on the vertical and horizontal extent of the sand layer and explore the contamination conditions in this layer. The sandy gravel layer in Geoprobe GP-7 through GP-10 indicates that this layer is channelized toward north and northwest of the Site and continues to the other side of Bluebell Drive. However, the channelizing direction is not coordinated with the ambient groundwater flow direction.

Vertical groundwater gradient was not studied at the Site since there is no deep well to be able to calculate the gradient between the top and lower sand layers observed at 30-40 at CPT-2 and 64-70 feet at CPT-1. GTI recommends installing one intermediate and one deep well next to STMW-3 to be screened at 35-40 and 65-70 ft bgs of coarse layer respectively. The base of the coarse layer at CPT-1 was not reached and therefore the coarse layer is thicker than 6 feet.

2.5 Contaminant Distribution

Groundwater and soil contaminants at the Site are primarily MtBE or TBA. Minimal amount of TPH-G and Methanol is also observed in groundwater and soil but is insignificant. To estimate the contaminant mass, MtBE and TBA plumes were investigated. Most of the contamination is in soil and minimal amount is in groundwater. The contamination in the vapor phase is negligible since the soil vapor extraction pilot test in 2007 at the Site was not successful.

2.5.1 Groundwater

There are only three groundwater monitoring wells at the Site (STMW-1, STMW-2 and STMW-3) that are all screened between 10 and 20 feet of depth. The total depth in all three wells is 20 feet. The sandy gravel layer mentioned in the geology and hydrogeology sections is present in STMW-1 and STMW-3 only. The thickness of this sandy layer at STMW-1 is 3 feet while it is about 9 feet thick at STMW-3. There has been just three groundwater monitoring events since the three monitoring wells were installed in 2007.

In order to have a better representation of groundwater we used the analytical results from the grab samples collected during other soil borings installations. During 2007 four geoprobes (GP-1 through GP-4) and 9 soil borings (SB-1 through SB-9) were installed at the Site for soil and groundwater contamination investigation. The total depth in all was 20 feet. Groundwater samples were collected from these geoprobes and soil borings between 10 and 20 feet. Groundwater analytical results from September 4, 2007 groundwater monitoring event along with February 2, 2007 groundwater sampling from soil borings, and August 22, 2007 groundwater sampling from four geoprobes were used to develop the groundwater plumes (MtBE and TBA plumes). If we use just the analytical data obtained from groundwater monitoring events the plumes wouldn't be representative of the contamination distribution at the Site since the number of points of data collection is very small (three wells only).

Two CPT boreholes were advanced at the Site on June 13, 2007 up to 60 and 70 feet deep (CPT-1 and CPT-2). MTBE was detected in CPT-1 at 34-38 feet deep (1.4 µg/l). MTBE was also detected in CPT-2 at 18-22 feet interval (89 µg/l). The samples collected from these two intervals were non-detect for all other constituents. Additional samples were collected at CPT-1 and CPT-2. Additional sampling interval at CPT-1 was 64-68 feet bgs and that of CPT-2 were 31-35 and 55-59 feet bgs. All samples collected from additional sampling intervals at two CPT boreholes were non-detect for all petroleum based hydrocarbon constituents. These results suggest that most probably the vertical extent of plume (MtBE and TBA) doesn't extend beyond 20 feet. However, it is recommended to advance more deep soil boreholes at the Site and explore the contamination level in lower sections.

Note: *The Isoconcentration contours are generated utilizing the SURFER® and AutoCAD® computer modeling programs. We recognize that computer generated contour maps do not provide the most accurate representation of what is taking place in the field. However, even hand-contoured maps at best provide a shadow of reality. Both need to be looked at as interpretation, not reality.*

The MtBE plume in groundwater is illustrated in Figure 17 and TBA plume in groundwater is illustrated in Figure 18. From the shape of the plumes it is clear that the plume is elongated in the groundwater flow direction. TPH-G plume was not prepared since few points of detection is observed (STMW-1).

2.5.2 Soil

Soil contamination at the Site was investigated through geoprobes, soil borings and monitoring wells installed at the Site in 2007. All geoprobes, soil borings and groundwater monitoring wells were advanced up to 20 feet. The soil contamination in geoprobes, soil borings and groundwater monitoring wells extended over 10 feet, either from 5 to 15 or from 10 to 20, based on samples collected. 56 soil samples were collected from 9 soil borings, 4 geoprobes and 3 groundwater monitoring wells in total. The contamination level was averaged over a 10 foot interval in all points and one number as the contamination level was given to each point for estimating the soil plume. MtBE and TBA plumes in soil were prepared based on the above mentioned assumption. MtBE and TBA plumes in soil are shown in Figures 19 and 20 respectively.

2.6 Contaminant Mass Estimate Calculations

The total mass of gasoline petroleum hydrocarbons released at the Site is unknown however, in order to determine the fate and transport of the contamination and hence the future risk these compounds may pose to human health, an estimate of contaminant mass is necessary.

Calculation of contaminant mass is difficult for many reasons:

- Spatial variability of contaminant concentrations, both laterally and vertical. This variability is controlled by geology, soil moisture, contaminant type, etc. Due to these variabilities, when contaminant concentrations are averaged between sample locations, the estimate may be either higher or lower than what is actually present.
- Insufficient data points. Because site characterization activities usually focus on defining the extent of the plume, few borings, and hence samples, are collected from the central portions of the plume. This generally creates a data set with few very “hot” samples and many low concentration samples around the edges of the plume. This is compounded by the spatial variability noted above.
- Extended period of time over which samples are collected. The samples were collected over several months; they were not collected at the same time.

The contaminant plumes at the Site consist of three phases: adsorbed to the soil particles, dissolved in the groundwater and as vapor in the pore spaces of the soil. Of these, the bulk of petroleum hydrocarbons will generally be adsorbed to soil particles. Contamination dissolved in groundwater is much smaller than that adsorbed to soil. The contamination in the vapor phase or soil gas at the Site is negligible since the Soil vapor extraction pilot test at the Site in 2007 was not successful, it was not able to extract enough vapor.

2.6.1 Soil Plume

MtBE and TBA mass in soil were calculated using the plumes of these two contaminants in soil. A depth of 10 feet was assumed for the soil plume and was multiplied by the area between each two consecutive plume contours to obtain the soil volume captured by two consecutive contours. Contaminant load for this specific area was calculated by taking an average between the values of the two contours. To calculate the soil mass a grain density of 2.6 g/cm3 and porosity of 0.4 were considered. Multiplication of soil mass and contaminant load resulted in contaminant mass. The mass of MtBE in soil at the Site was estimated 3.5 pounds and that of TBA was estimated 72.5 pounds. Contaminant mass calculation in soil is shown in Table 4.

2.6.2 Groundwater Plume

MtBE and TBA mass in groundwater were calculated using the plumes of these two contaminants in groundwater. A depth of 10 feet was assumed for the groundwater plume. GTI calculated the mass of contaminant in the groundwater at the Site utilizing the following procedure. This data was then used in the contaminant mass calculations.

The total mass of contaminant in groundwater at the Site was determined by first calculating the volume of water in each aquifer levels' contours. GTI used CAD software to determine the area (in square feet) within each contaminant contour line in Figures 17 and 18. The area was then multiplied by the height of the aquifer level (10 feet) to produce the volume of each contour in cubic feet. The volume (in cubic feet) of each contour was then multiplied by a porosity value of 40% to obtain the total volume of water in each zone. This value was then converted to liters and then multiplied by the average contaminant value in mg/l within the contour zone. This produces the mass of contaminant within each contour.

As shown in Table 3 there is approximately 18.1 pounds of TBA and 0.9 pounds of MtBE of TPH-G in groundwater at the Site.

The total MtBE at the Site in soil and groundwater combined is estimated to be 4.4 pounds and that of TBA is estimated to be 90.6 pounds.

2.7 Groundwater Beneficial Uses

The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) Basin Plan designates the beneficial uses of groundwater in the Livermore Valley as domestic, municipal, and industrial/agricultural supply.

In March 2007, a 2000-foot receptor well survey was conducted (ESTC, March 2007). A total of 51 wells were located within 2,000 feet of the Site, of which 49 are monitoring wells for other contaminated sites. One domestic well and one supply well were located within 2,000 feet of the Site. The domestic well (3S/2E 3H2) is located approximately 1950 (feet southeast of the Site and the supply well (3S/2E 3H4) is located approximately 1,400 feet southeast of the Site. Based on new update on 2000 feet receptor well survey in November 2008 the "Zone 7 Water Agency" map (Appendix D) shows that both domestic and supply wells mentioned above are abandoned. A new water supply well, 3S/2E 3H5 was discovered right at 200 feet radius of the Site on the map but our correspondence with the Department of Water Resources Central District indicates that the well is unknown and abandoned.

Given the above information obtained from the Zone 7 Water Agency and Department of Water Resources Central District, there is no well receptor within 200 feet radius from the Site. Therefore, the contamination at the Site doesn't impact any known water supply well.

3.0 POTENTIAL OFF-SITE SOURCES OF GASOLINE CONTAMINATION

GTI has identified two sites with petroleum based contaminants leakage into groundwater and soil in the vicinity of the subject Site. The first site is around 250 feet on the west side of the Site and has no monitoring data available but from the soil boring investigation the chemicals of concern are known as TPH-Gasoline and BTEX. The second site is around 750 feet southeast of the Site and no records of monitoring is available; the chemical of concern at this site is Diesel. None of the sites can be an offsite source for the contamination at the Site because first the chemicals of concern are different and secondly the distance and groundwater flow and gradient do not suggest that flow of contaminants would be in the direction of the Site.

4.0 POTENTIAL EFFECTS OF RESIDUAL CONTAMINATION

When petroleum hydrocarbons are released to the soil, the material percolates and moves deeper under the primary influences of gravity, groundwater flow patterns, and capillary action. As the product reaches the water table it concentrates in a pool on the top of the groundwater surface due to its lesser density. Petroleum constituents then dissolve from the pool into the groundwater to form a contaminant plume that migrates under the control of the groundwater gradient. At the same time the dissolved plume is forming and migrating, non-dissolved petroleum product remains in the pore spaces in the soil due to capillary forces. These forces make it difficult to remove the non-aqueous phase liquids (NAPL) trapped in the pore spaces. Fresh water moving through the soil can eventually flush a portion of the NAPL out, but this process can take a very long time and can contribute to an extensive groundwater plume.

As stated above the majority of the residual contamination is within the water table smear zone extending at depths from approximately 5 feet to 20 feet bgs. It will continue to source a groundwater plume that will migrate with the groundwater flow that is primarily to the northwest. All the data on groundwater and soil contamination we have was collected in 2007 and 2008, therefore, at this time we cannot specify the effectiveness of biodegradation and natural attenuation processes on groundwater and soil contamination at the Site. However, from the well receptor survey we know that there is no groundwater receptors within the current plume boundaries.

The SFBRWCQB developed numerical Water Quality Objectives (WQO) for municipal supply (May 2008). The WQO for the Site's COC and their September 2008 maximum levels in groundwater are included in the table below (SFBRWQCB WQO data included in Appendix E):

COC	2007-2008 [max. conc. (ug/l)]	WQO
Gasoline	230	100 µg/l*

MtBE	850	5 µg/l
TBA	6500	12 µg/l

*Gasoline Taste and Odor Threshold cross referenced by SFBRWQCB to CV-RWQCB document.

All of the COC's concentrations exceed the SFBWQCB water quality objectives.

5.0 DISCUSSION AND CONCLUSIONS

5.1 Discussion

Soil Plume Definition

Soil plume at the Site is defined using the soil analytical data obtained from sampling over an interval of 10 feet (either from 5 to 15 or 10 to 20 feet). Moreover the soil samples were collected for analysis in different dates (three groups several months apart). Soil boring investigation including 9 soil borings (SB-1 through SB-9) were advanced in February 2007 and three monitoring wells (STMW-1 through STMW-3) and four geoprobes (GP-1 through GP-4) were advanced in August 2007. In general 6 months difference in soil analytical data wouldn't make a big difference but application of all the data in plume definition will significantly improve the soil plume delineation. The soil plumes (MtBE and TBA) defined for the Site both are elongated along the groundwater gradient and flow and therefore they represent the processes important in mass transport.

Groundwater Plume Definition

Two plumes in groundwater were developed (MtBE and TBA) using the data obtained from groundwater monitoring wells and the analytical data resulted from the grab samples collected from the soil borings and geoprobes at Site. All the data used are within a 6 month range in time intervals. The reason that we used all this data together although they have slightly different time frames is that there is not enough data points from groundwater monitoring wells and using just 3 points (three groundwater monitoring wells) to develop the plume will result in a plume that is not representative of the conditions at the Site. The two plumes developed represents the real conditions very well since the plume in both cases (MtBE and TBA) are elongated along the groundwater flow direction. However the plumes just represent the conditions in the first 20 feet below ground surface and we virtually don't know that much about the depths greater than 20 feet below ground surface. CPT-1 and CPT-2 were advanced at the Site up to 70 and 60 feet respectively in June 2007. The groundwater grab samples collected from different depths didn't show any contamination except for 34-35 feet deep at CPT-1 that showed minimal amount of MtBE (1.4 µg/l) and 18-22 feet interval for CPT-2 that showed a small amount of MtBE (89 µg/l). The MtBE level at CPT-2 is observed in the same zone that is observed in all other borings and wells, meaning that this contamination doesn't represent the layers below 20 feet. The MtBE level in CPT-1 at 34-35 is very low and therefore it might be a cross contamination from the top layers introduced to the groundwater grab sample during sample collection. Given all this information on groundwater contamination beyond 20 feet deep the vertical extent of the plume in groundwater remains unknown.

Geology at the Site includes thick layers of stiff silty clay and thinner layers of sand and sandy gravel. The first layer of sand from the top occurs between 11 and 20 feet below ground surface but its thickness is different from point to point. The sand layer is absent on the southern part of the Site and it is just present on the north and northwest side of the Site. From the information collected from soil borings and wells there is evidence of a northwestern vertical extension of the sand layer. For instance the thickness of sand layer in the northwestern borings and wells such as GP-4 and STMW-3 is the highest among all. To learn more about vertical extension of this layer on the northwestern part of the Site we recommend drilling deep soil borings on the other side of Bluebell Drive in a northwestern direction from the Site. The second layer of sand of this kind is present between 30 and 40 feet below ground surface that is evident in CPT-1. The third layer of sand was observed in CPT-2 between 54 and 60 feet deep (a layer more than 6 feet thick); the base of this layer did not reach CPT-2.

Groundwater horizontal gradient has been consistently north western over almost two years of monitoring (3 groundwater monitoring events between February 2007 and September 2008). However, we don't know anything about the vertical groundwater gradient between the sand layers mentioned above. It is important to know the vertical groundwater gradient to better understand the plume extension in lower aquifer zones.

To define the northern and north eastern boundaries of the groundwater and soil plumes it is necessary to advance several geoprobes on the east, north and northeast of the Site. The geoprobes on the north and northeast side of the Site will be located on the other side of Bluebell Drive and the ones on the east will be located on the property boundary.

5.2 Conclusions

Based on our interpretation of the data collected over the course of this subsurface investigation, GTI has reached several conclusions. These conclusions are based on the premise that the data considered, although incomplete, are representative of actual Site conditions. We acknowledge that there may be undiscovered conditions, which would upon their consideration, change our interpretation and thus our conclusions.

Geological Technics Inc. makes the following conclusions.

- The geology of the Site consists primarily of silty clay units from the surface to approximately 10 – 15 feet bgs. Below these depths are 5 to 10 feet of sand units. The sand units are absent on the southern side of the Site and it occurs on the north and northwest side of the Site. The thickness of sand layer on the northwestern part of the Site is around 10 feet extending from 11 to 20 feet below ground surface and most probably it extends to lower depths as we go farther from the Site in that direction. The clay layer on the south side of the Site seems to retard the vertical migration of contaminants. Borehole logs from GP-7 through GP-10 suggest that the sand unit continues to the other side of the road (Bluebell Drive) and channelized, the middle portion has larger thickness than the side portions.

- The historical depth to groundwater in three groundwater monitoring wells is from 6.26 to 9.45 feet below ground surface in STMW-1 and STMW-3 respectively. Historical average groundwater elevation obtained from 3 groundwater monitoring events between February 2007 and September 2008 is 511.09 feet above Mean Sea Level. Historical groundwater gradient is 0.004 ft/ft in N61ºW direction. Groundwater bearing has been consistently toward northwest with few degrees difference from one event to another.
- The contamination at the Site is limited to two phases only: soil and water. A Soil Vapor Extraction Pilot test by ESTC in 2008 proved that contamination in vapor phase is negligible since the Vapor Extraction System couldn't extract any contaminant in vapor phase. Most important contaminants at Site are MtBE and TBA. The contaminant load both in soil and groundwater is more TBA than MtBE. It is believed that TBA is a byproduct of MtBE breakdown. This idea suggests that probably the MtBE breakdown process started at the Site a long time ago.
- Minimal amount of TPHg is found in groundwater samples collected from STMW-1 (3 times) and STMW-3 (one time). The level of TPHg contamination in STMW-1 is almost twice as much as Environmental Screening Level (ESL) for drinking water and that of STMW-3 is almost half of ESL for drinking water. ESL for drinking water for TPHg is 100 µg/l. Therefore, the TPH-Gasoline level in groundwater is not considered a threat since natural attenuation will destroy this minimal level of contamination over a relatively short time.
- The biggest concern in terms of contaminants at the Site is TBA because the concentrations are much higher than ESL. The highest concentration of TBA at the Site between 2007 and 2008 has been 6500 µg/l and the ESL for drinking water is 12 µg/l. The highest concentration of MtBE at the Site is 850 µg/l and its ESL is 5 µg/l for drinking water.
- Contamination in soil phase is much higher than that of liquid phase. Contaminant mass calculation shows 18.1 pounds of TBA in the groundwater and only 0.7 pounds of MtBE is in groundwater. Contaminant mass estimation in soil shows that there is 72.5 pounds of TBA and 2.7 pounds of MtBE in the soil phase at the Site.
- Vertical groundwater gradient was not calculated at the Site since there is no deep groundwater monitoring to obtain groundwater level information in lower water bearing zones.
- The Site poses negligible threat to human health since there are no wells within the boundaries of the groundwater plume to act as a conduit to human receptors.

6.0 RECOMMENDATIONS

Our recommendations are based on our knowledge of site conditions, and on the state and limitations of subsurface investigative technology. Based on the conclusions outlined above, Geological Technics Inc. recommends the following:

- Maintain the quarterly groundwater monitoring/sampling as directed by ACEH. This should consist of all the present groundwater monitoring wells and the proposed new wells including a deep and intermediate depth well next to STMW-1 and at least two monitoring wells off Site on the other side of Bluebell Drive.
- Advance 5-6 geoprobes on the north, east and northwest of the Site to determine the horizontal extent of the plume and learn more about the sand layer on the north side of the Site.
- Advance 3-4 deep geoprobes up to 70 feet deep close to the core of plume to determine the vertical extension of the plume.
- Once the vertical and horizontal extension of the plume has been defined, install a group of shallow (10 feet) and deep (20 feet) injection wells on top of the plume and apply hydrogen peroxide injection for oxidation of contaminants in a fast mode.
- Report the results obtained from the hydrogen peroxide injection pilot test conducted at the Site between September 29 and November 6, 2008. This report is in progress and will be done on or before December 8, 2008.
- Develop a Site Corrective Action Plan to reduce the residual contamination in the vicinity of the core of the groundwater plume using hydrogen peroxide injection. Performing this action will hasten the collapse of the groundwater and soil plumes and reduce the contaminants concentrations to levels acceptable for site closure.

7.0 LIMITATIONS

This report was prepared in accordance with the generally accepted standard of care and practice in effect at the time Services were rendered. It should be recognized that definition and evaluation of environmental conditions is an inexact science and that the state or practice of environmental geology/hydrology is changing and evolving and that standards existing at the present time may change as knowledge increases and the state of the practice continues to improve. Further, that differing subsurface soil characteristics can be experienced within a small distance and therefore cannot be known in an absolute sense. All conclusions and recommendations are based on the available data and information.

The tasks proposed and completed during this project were reviewed and approved by the local regulatory agency for compliance with the law. No warranty, expressed or implied, is made.

8.0 REFERENCES

USGS, Livermore Quadrangle, 7.5 Minute Series Topographic Map, 1981 photo-revision.

California Division of Mines and Geology (CDM&G), Map 5A, San Francisco-San Jose Quadrangle, 1991.

California Department of Water Resources (DWR), Bulletin No. 118, San Francisco Bay Hydrologic Region, Livermore Valley Groundwater Basin, February 27, 2004.

Alameda County Health Care Services (ACHCS), *Remedial Action Completion Certification, StID 2112 – 909 Bluebell Drive, Livermore, California*, August 30, 2000.

H_2OGEOL, *Report on Dispenser and Fuel Pipeline Soil Sampling – Springtown Gas, 909 Bluebell Drive, Livermore, California*, July 29, 2005.

Enviro Soil Tech Consultants (ESTC), *Preliminary Investigation and Evaluation Report for the Property Located at 909 Bluebell Drive, Livermore, California*, March 28, 2007.

Enviro Soil Tech Consultants (ESTC), *Cone Penetrometer Drilling at the Property Located at 909 Bluebell Drive, Livermore, California,* July 23, 2007.

Enviro Soil Tech Consultants (ESTC), *Drilling and Monitoring Well Installation at the Property Located at 909 Bluebell Drive, Livermore, California,* October 1, 2007.

Enviro Soil Tech Consultants (ESTC), *Fourth Quarter of 2007 Groundwater Monitoring and Sampling at the Property Located at 909 Bluebell Drive, Livermore, California,* January 2, 2008.

Enviro Soil Tech Consultants (ESTC), *Off-Site Drilling and Vapor Extraction Pilot Test at the Property Located at 909 Bluebell Drive, Livermore, California*, July 1, 2008.

9.0 SIGNATURES AND CERTIFICATION

This report was prepared by:

Reza Namdar Ghanbari, Ph.D.
Project Manager

This report was reviewed by:

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

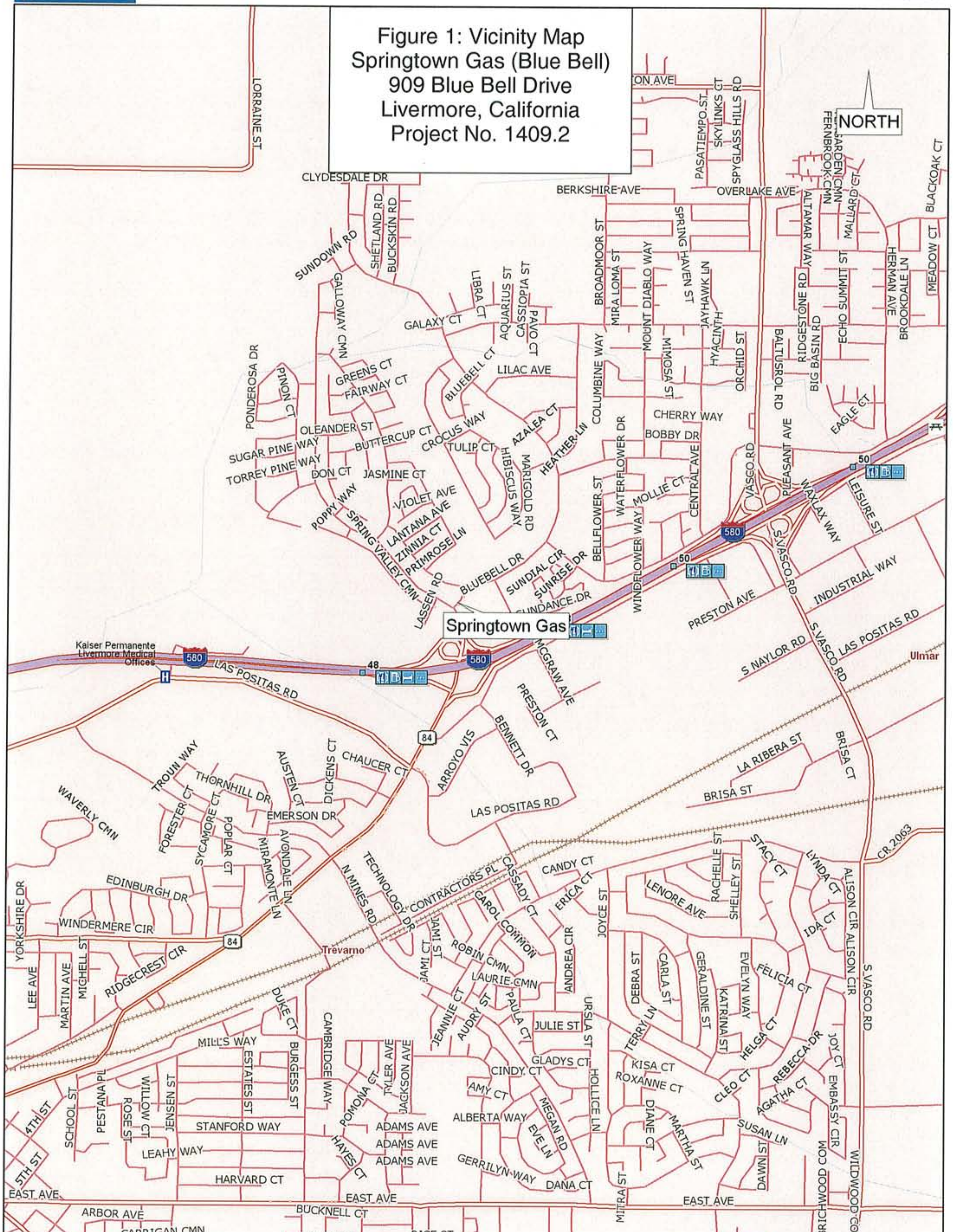


Figure 1: Vicinity Map
Springtown Gas (Blue Bell)
909 Blue Bell Drive
Livermore, California
Project No. 1409.2

Data use subject to license.

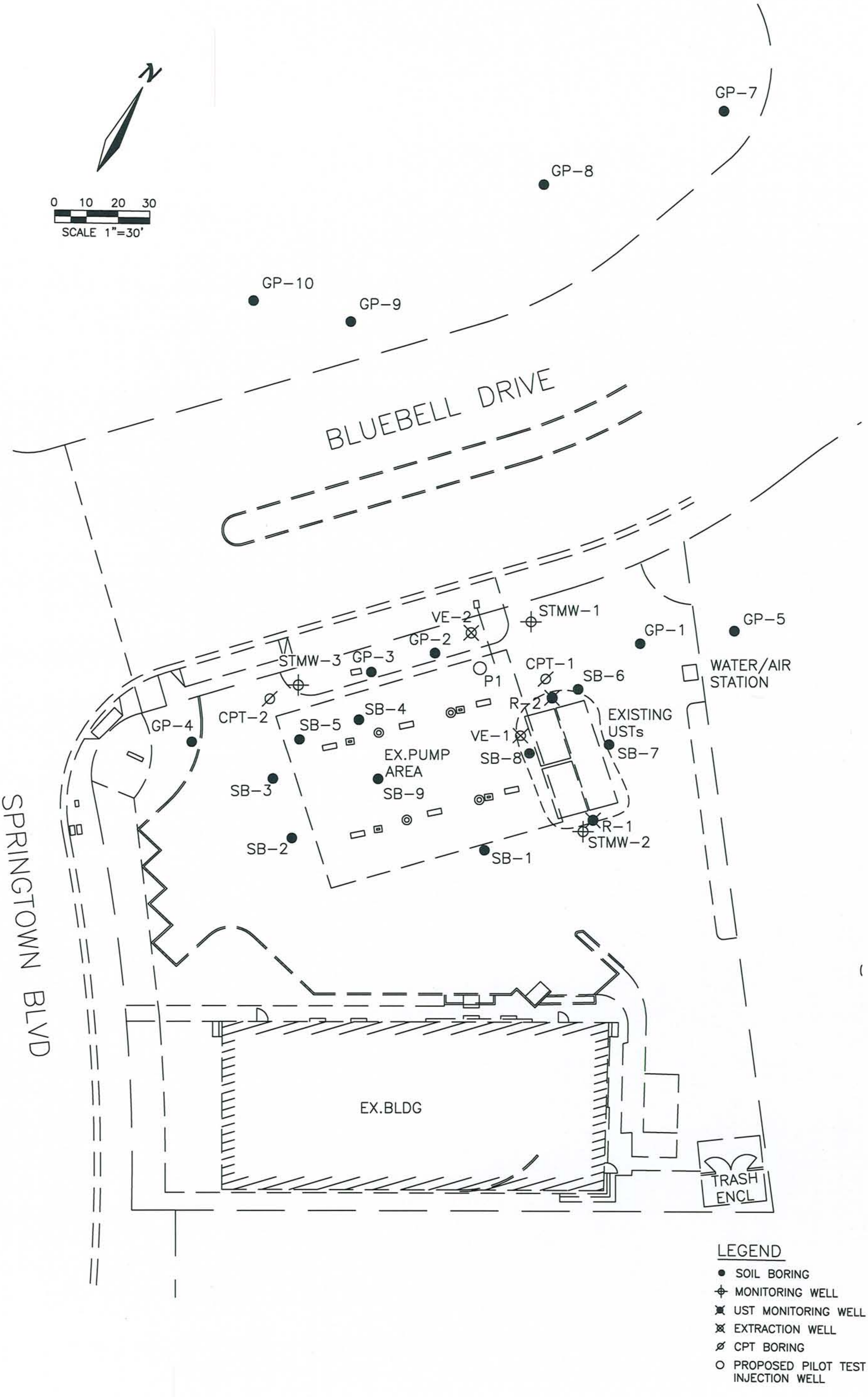
TN

MN (14.3°E)

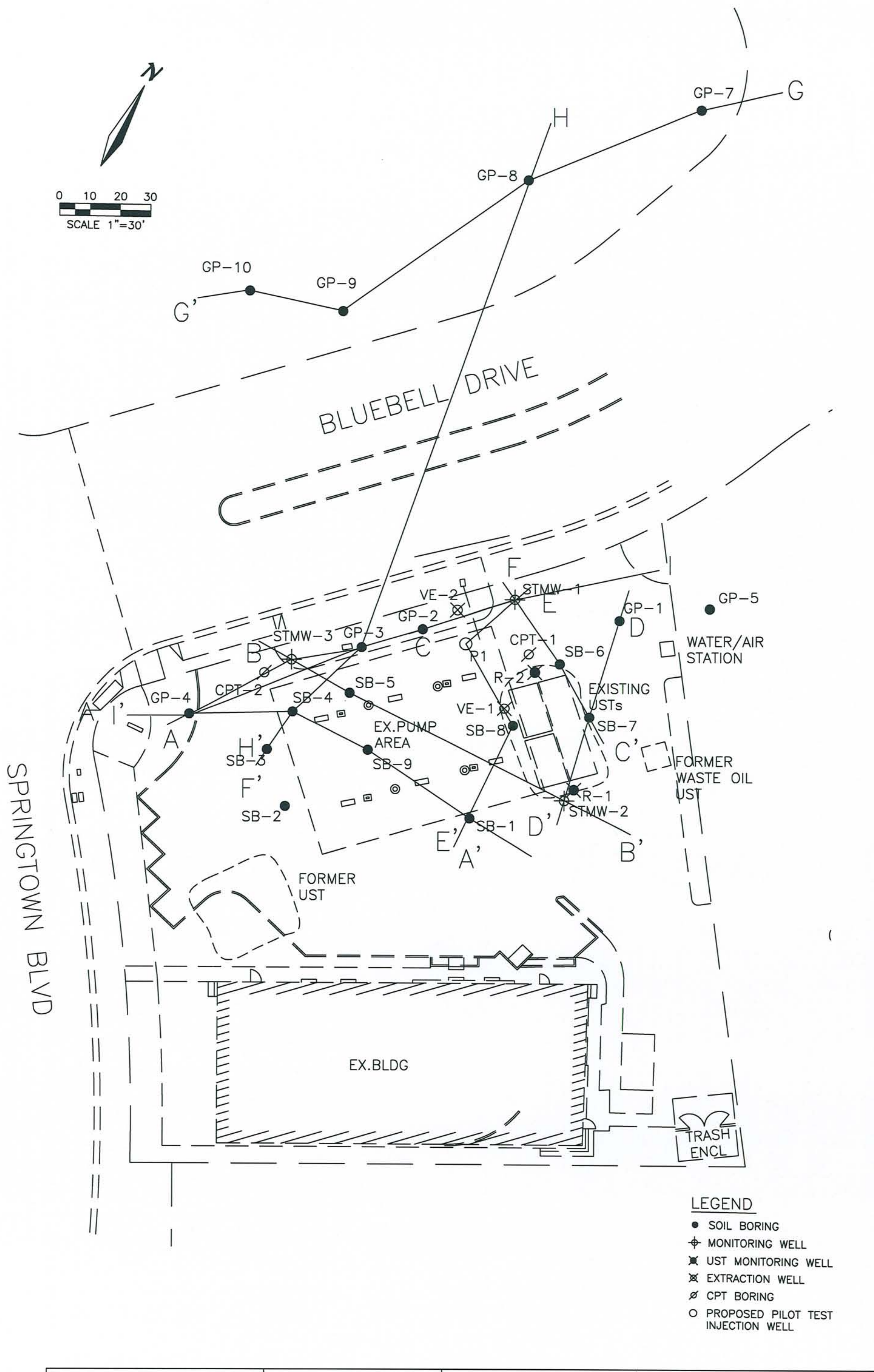
Scale 1 : 24,000

1" = 2,000.0 ft

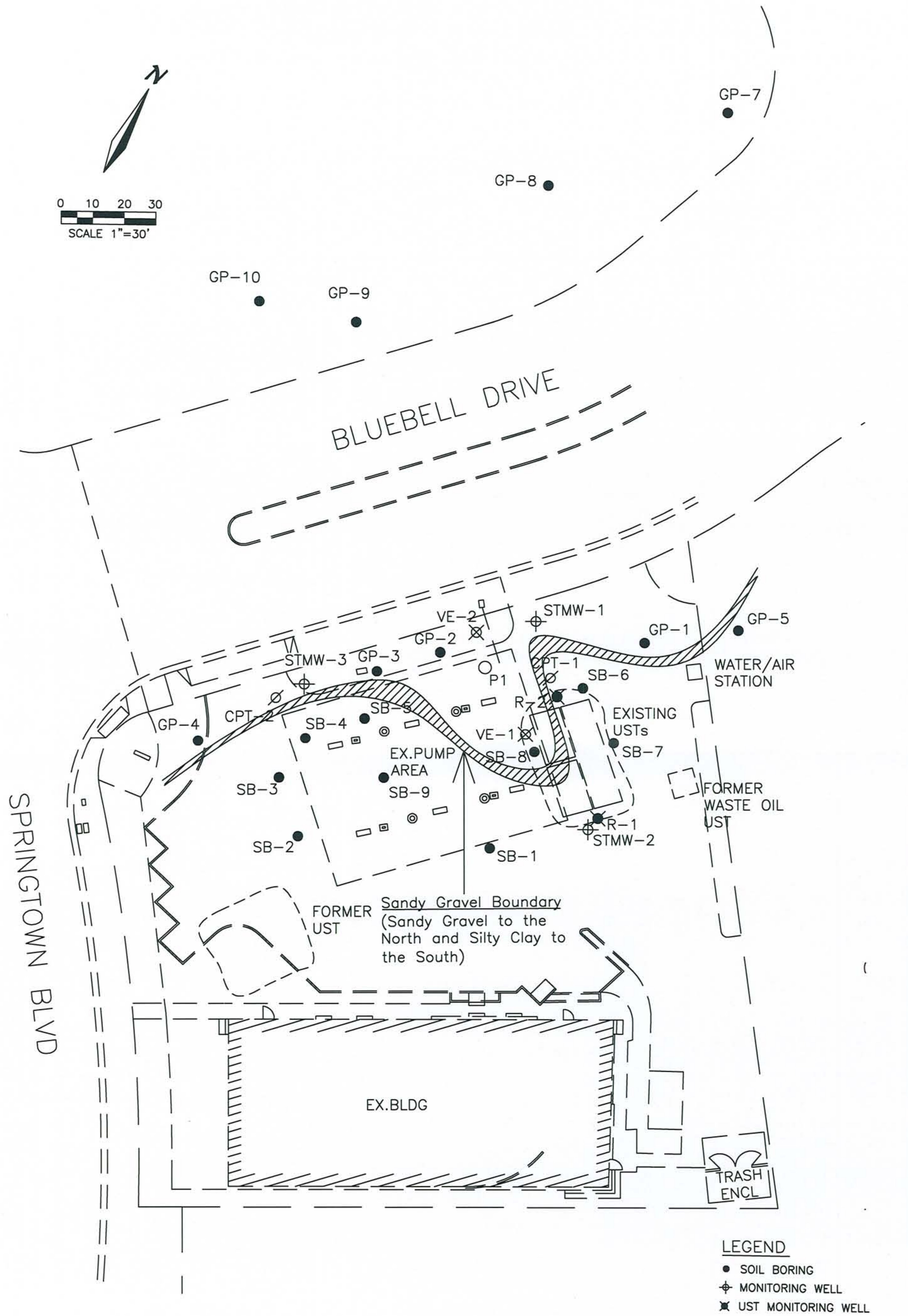
Data Zoom 13-1



By: TB	*Geological Technics, Inc.* 1101 7th Street Modesto, CA 95354 209.522.4119 (tel) 209.522.4227 (fax)	FIGURE 2: Site Map	
Job No: 1409.2 Date: 11/26/08		SPRINGTOWN GAS (BLUEBELL) 909 BLUEBELL DRIVE LIVERMORE, CA	
Scale: 1"=30'			
File: 14092 site plan			Page 1 of 1



By: TB	Geological Technics, Inc.	FIGURE 3-a: Site Map with Cross Sections Locations	
Job No: 1409.2 Date: 11/26/08	1101 7th Street Modesto, CA 95354	SPRINGTOWN GAS (BLUEBELL)	
Scale: 1"=30'	209.522.4119 (tel) 209.522.4227 (fax)	909 BLUEBELL DRIVE	
File: 14092 site plan		LIVERMORE, CA	Page 1 of 1



By: TB		Geological Technics, Inc. 1101 7th Street Modesto, CA 95354 209.522.4119 (tel) 209.522.4227 (fax)	FIGURE 3-b: Sandy Gravel Boundary
Job No: 1409.2	Date: 11/26/08		SPRINGTOWN GAS (BLUEBELL) 909 BLUEBELL DRIVE LIVERMORE, CA
Scale: 1"=30'			
File: 14092 site plan			Page 1 of 1

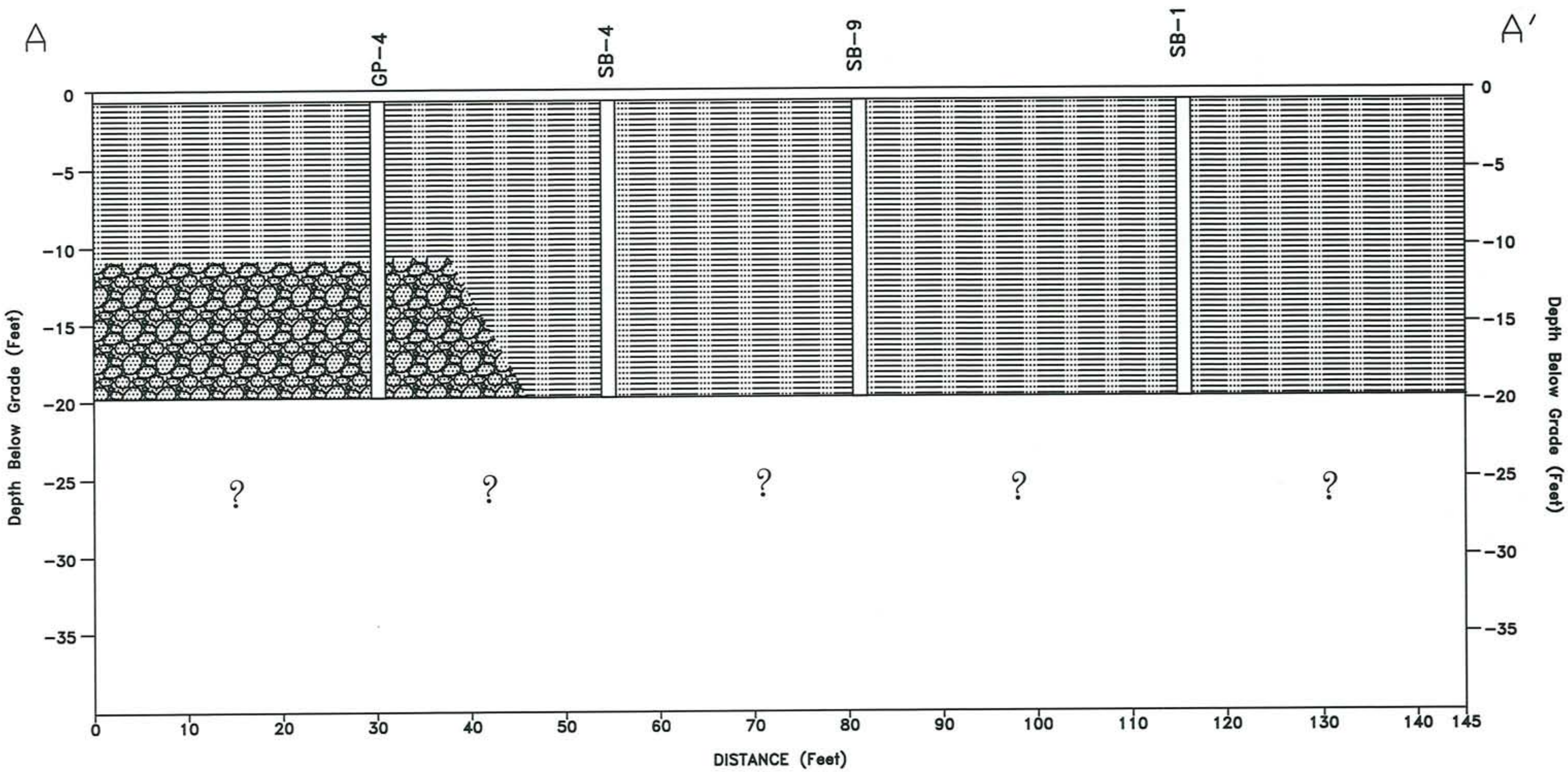


Figure 4:	GEOLOGIC CROSS SECTION	LEGEND
Springtown Gas 909 Bluebell Drive Livermore, CA	Cross Section A-A' Southwest to Northeast	Sandy gravel Silty-Clay Mixtures
Project No.: 1409.2		
Geological Technics, Inc. 11/20/08	No Vertical Exaggeration	

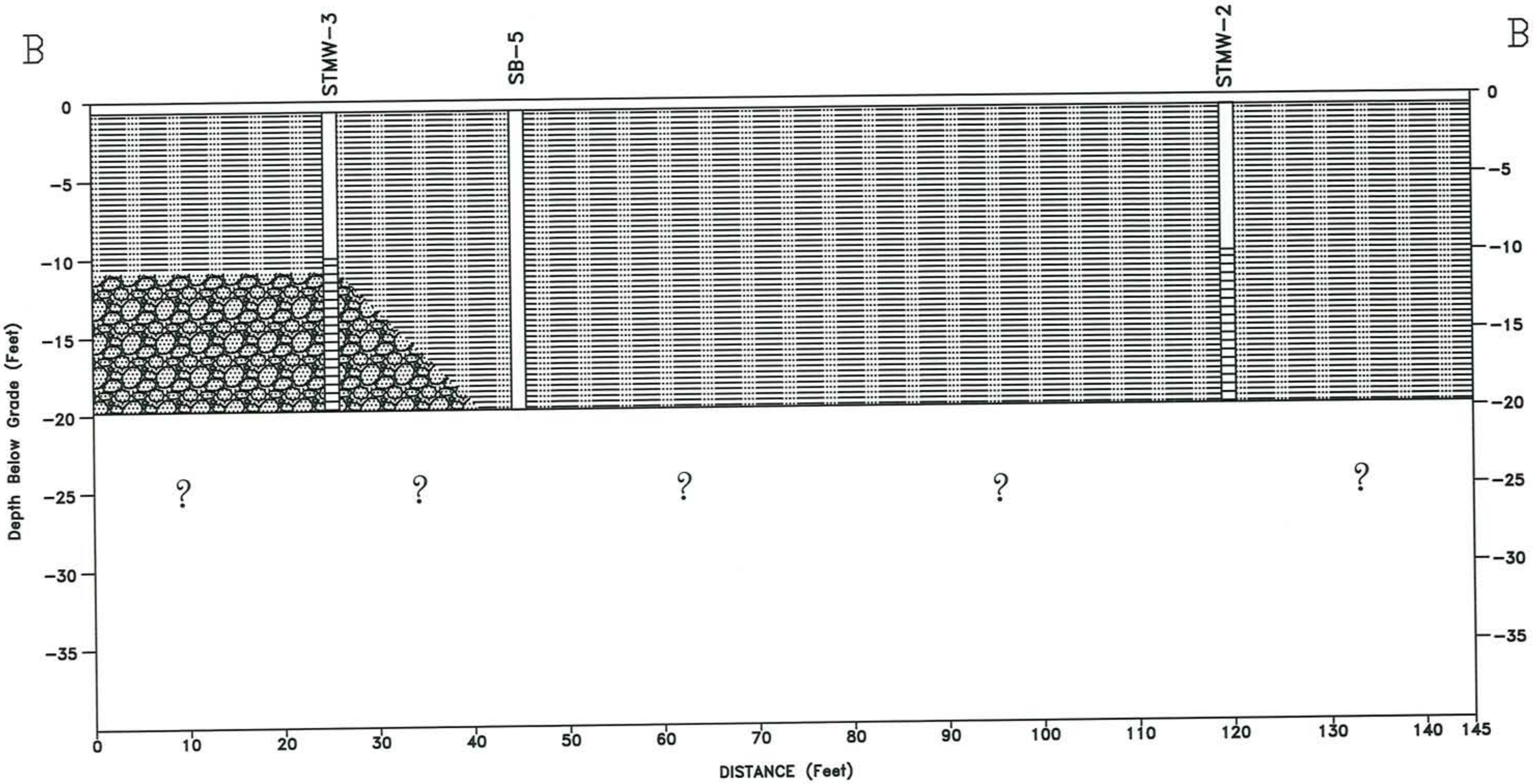


Figure 5:	GEOLOGIC CROSS SECTION	LEGEND
Springtown Gas 909 Bluebell Drive Livermore, CA	Cross Section B-B' Northwest to Southeast	Sandy gravel Silty-Clay Mixtures
Project No.: 1409.2		
Geological Technics, Inc. 11/20/08	No Vertical Exaggeration	

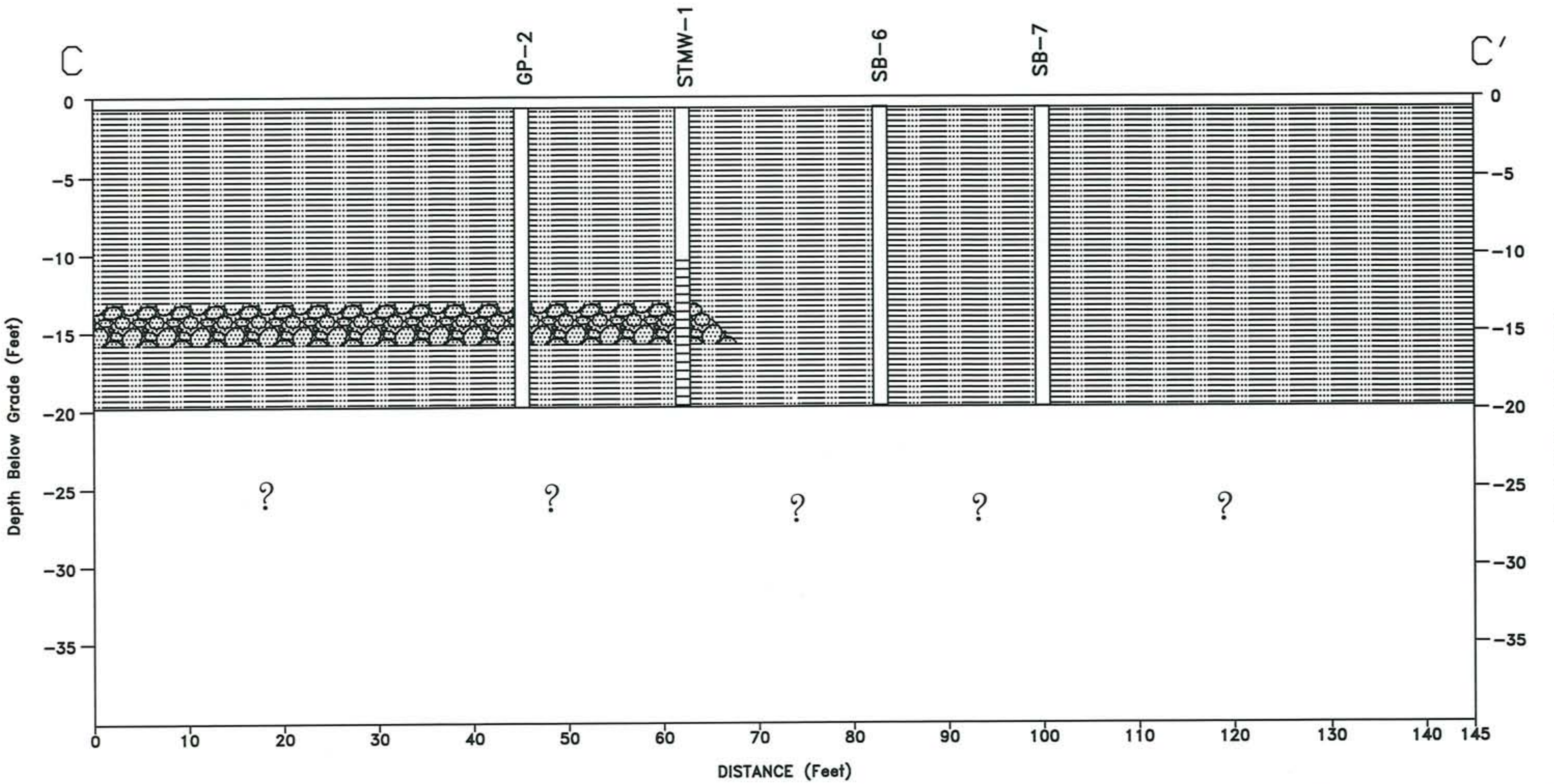


Figure 6:	GEOLOGIC CROSS SECTION	LEGEND
Springtown Gas 909 Bluebell Drive Livermore, CA	Cross Section C–C' Northwest to Southeast	Sandy gravel Silty-Clay Mixtures
Project No.: 1409.2		
Geological Technics, Inc. 11/20/08	No Vertical Exaggeration	

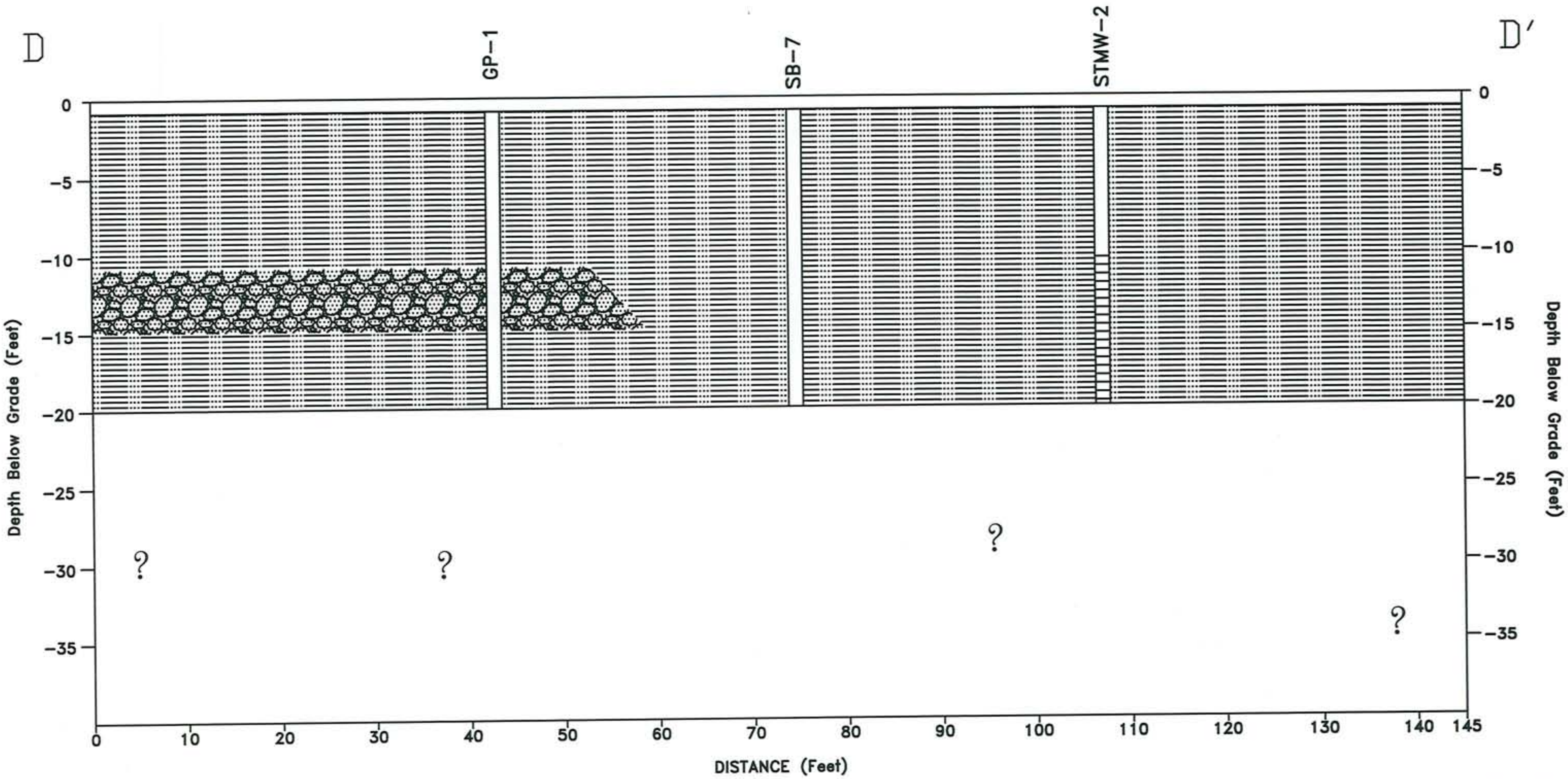


Figure 7:

Springtown Gas
909 Bluebell Drive
Livermore, CA

Project No.: 1409.2

Geological Technics, Inc. 11/20/08

GEOLOGIC CROSS SECTION

Cross Section D–D'

North to South

No Vertical Exaggeration

LEGEND

Sandy gravel

Silty-Clay Mixtures

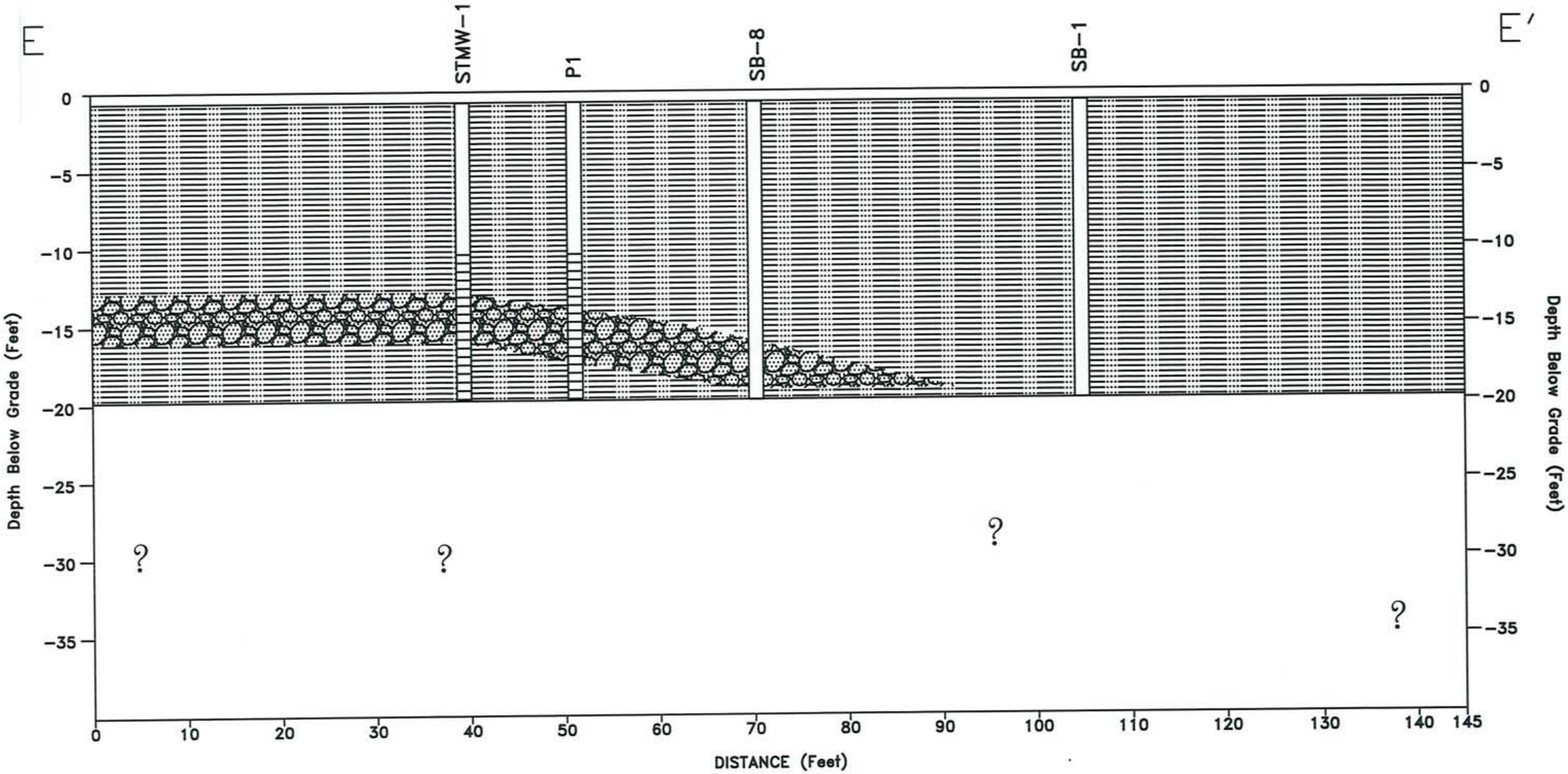


Figure 8:

GEOLOGIC CROSS SECTION

Springtown Gas
909 Bluebell Drive
Livermore, CA

Cross Section E-E'
North to South

Project No.: 1409.2

Geological Technics, Inc. 11/20/08

No Vertical Exaggeration

LEGEND

Sandy gravel

Silty-Clay Mixtures

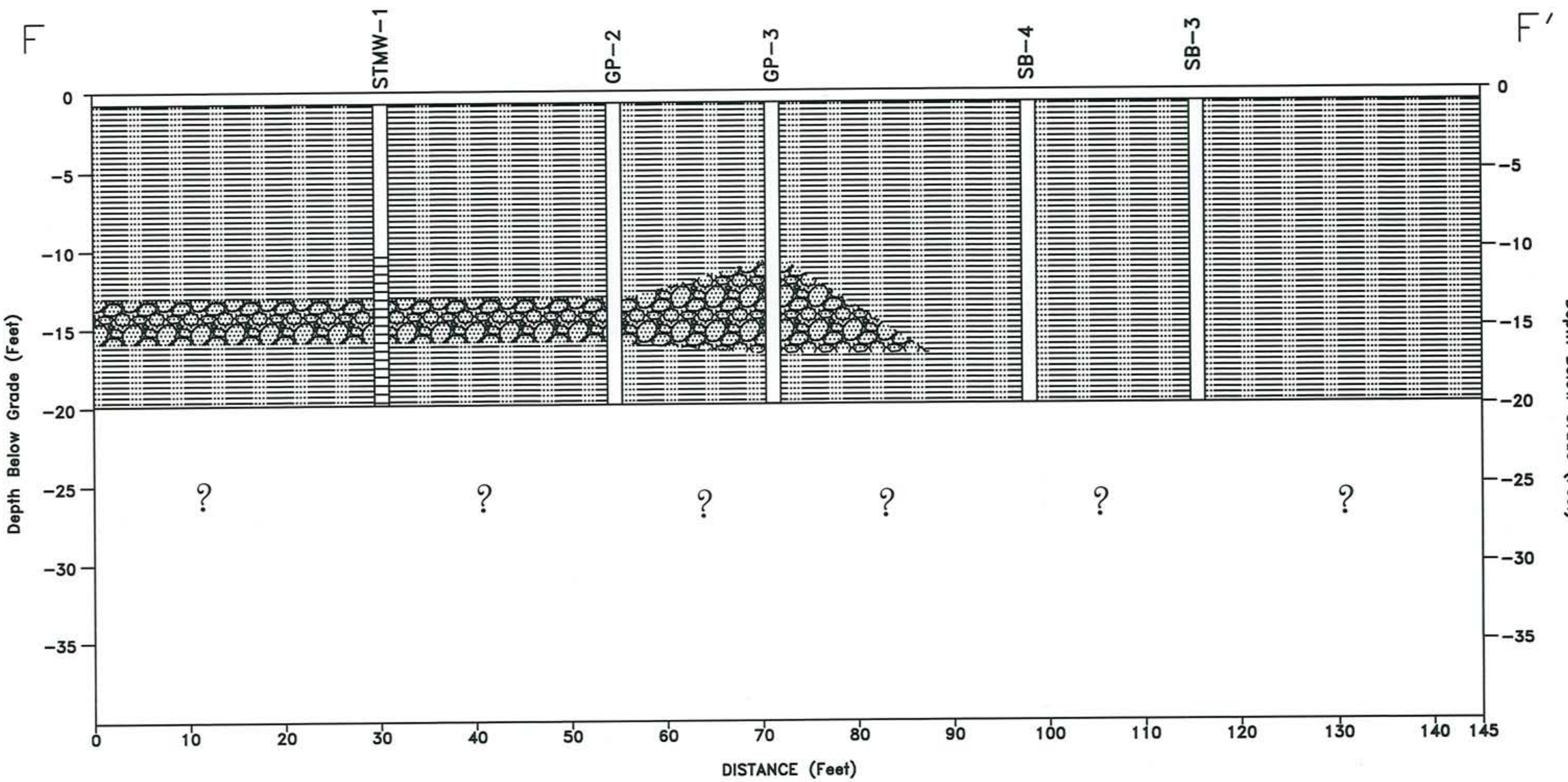


Figure 9:	GEOLOGIC CROSS SECTION	LEGEND
Springtown Gas 909 Bluebell Drive Livermore, CA	Cross Section F–F' Northeast to Southwest	Sandy gravel Silty-Clay Mixtures
Project No.: 1409.2		
Geological Technics, Inc. 11/20/08	No Vertical Exaggeration	

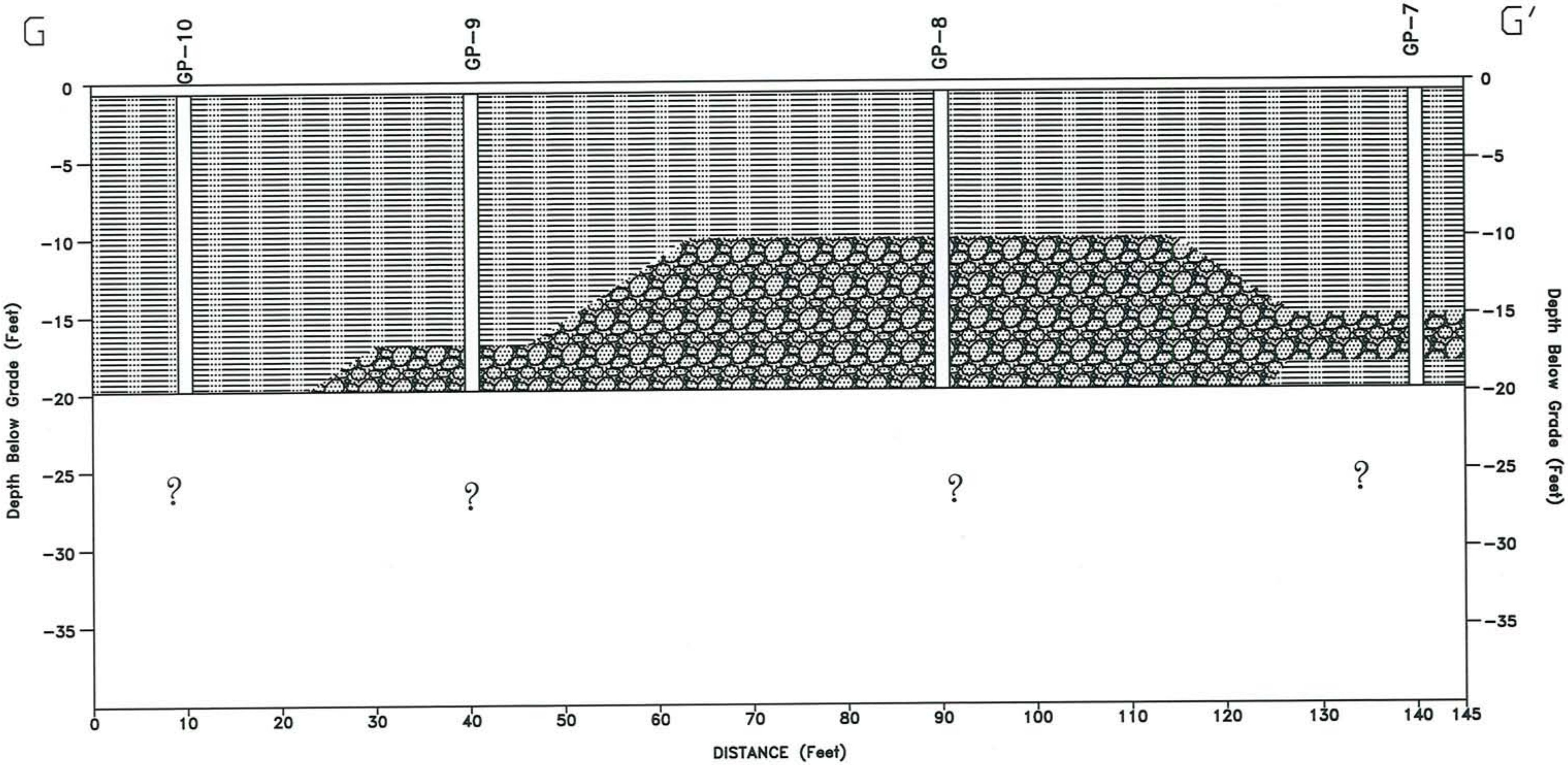


Figure 10:	GEOLOGIC CROSS SECTION	LEGEND
Springtown Gas 909 Bluebell Drive Livermore, CA	Cross Section G–G' Northeast to Southwest	Sandy gravel Silty-Clay Mixtures
Project No.: 1409.2		
Geological Technics, Inc. 11/20/08	No Vertical Exaggeration	

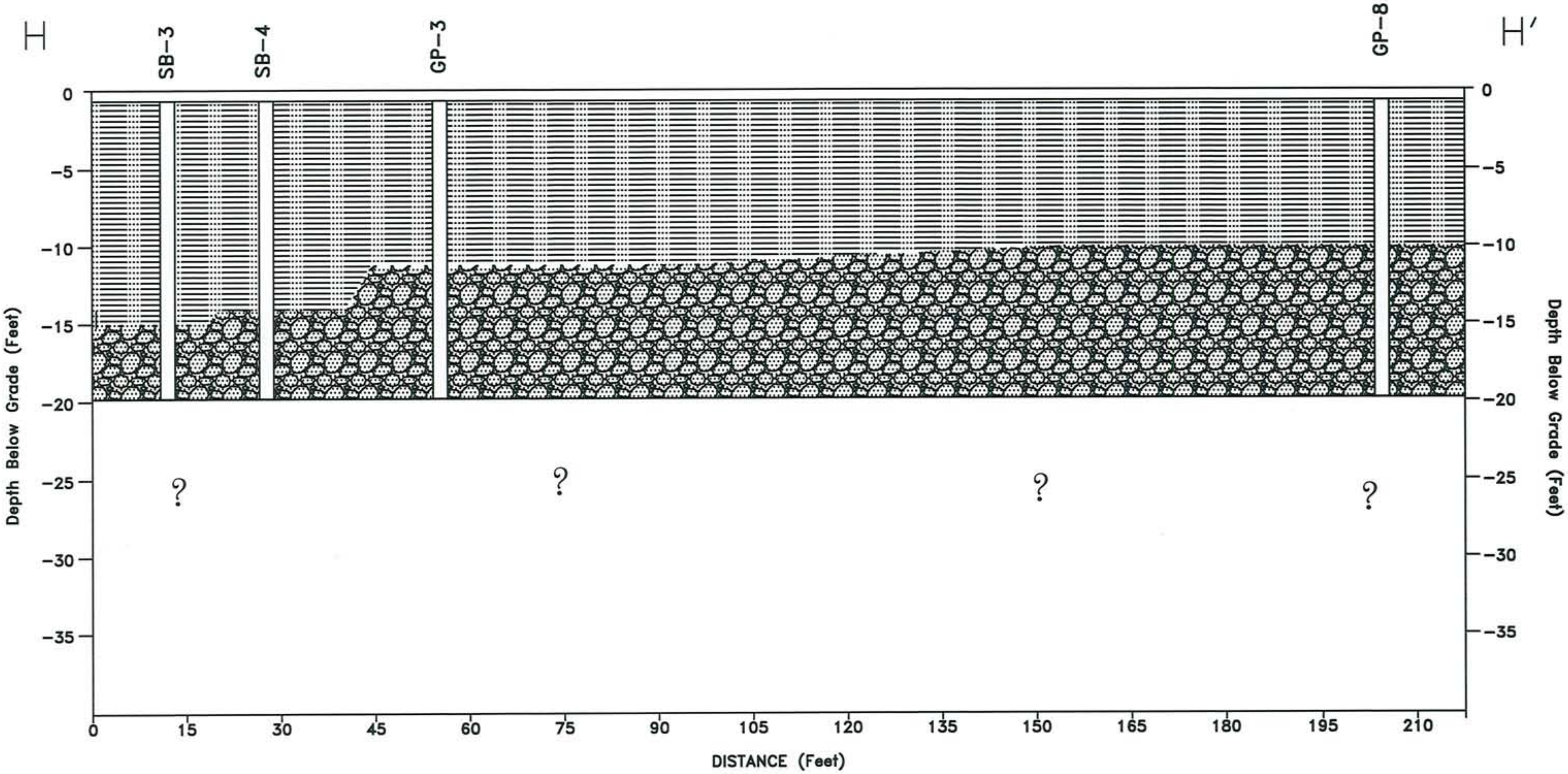


Figure 11	GEOLOGIC CROSS SECTION	LEGEND
Springtown Gas 909 Bluebell Drive Livermore, CA	Cross Section H-H' South to North	Sandy gravel Silty-Clay Mixtures
Project No.: 1409.2		
Geological Technics, Inc. 11/20/08	No Vertical Exaggeration	

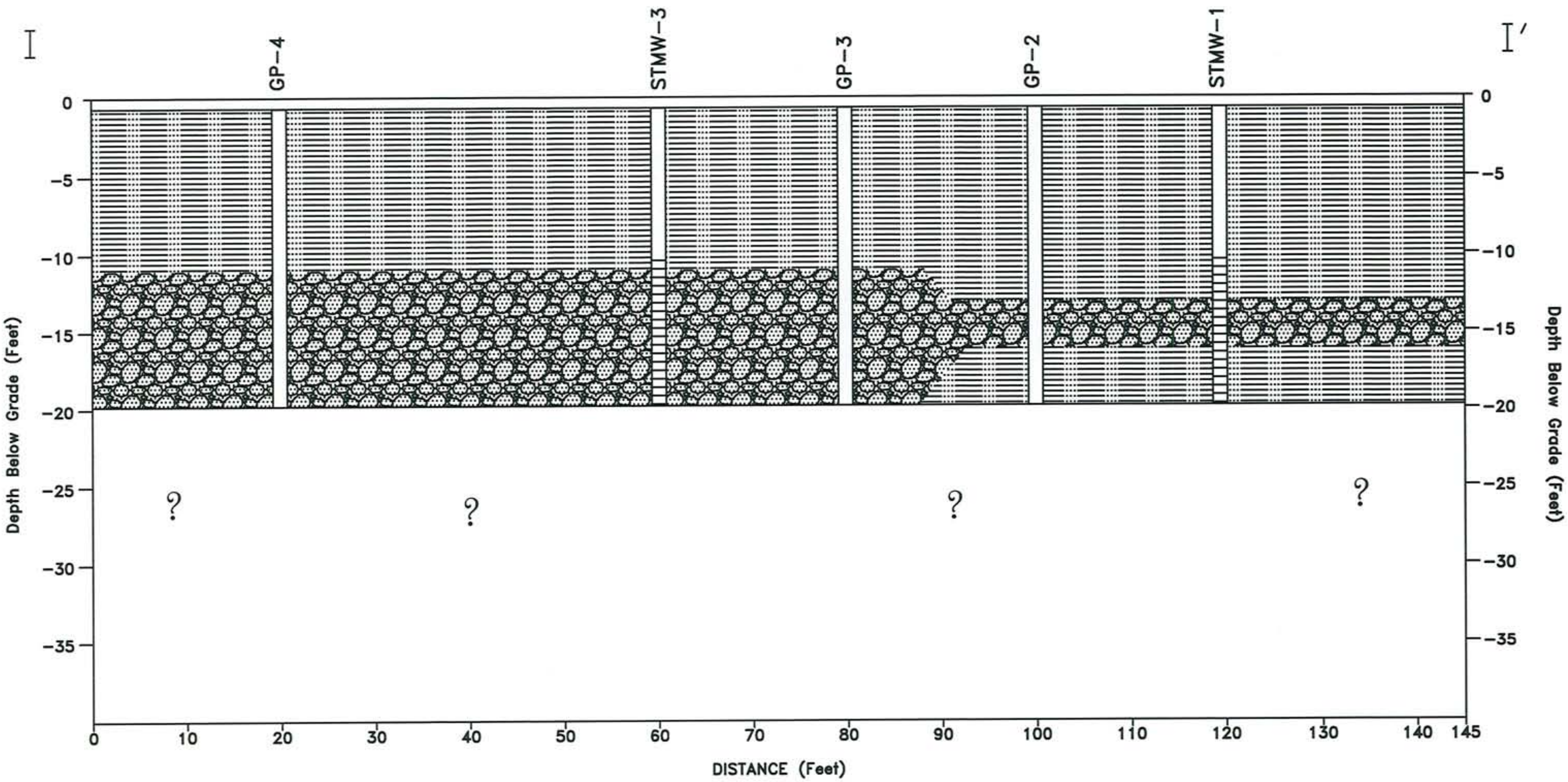
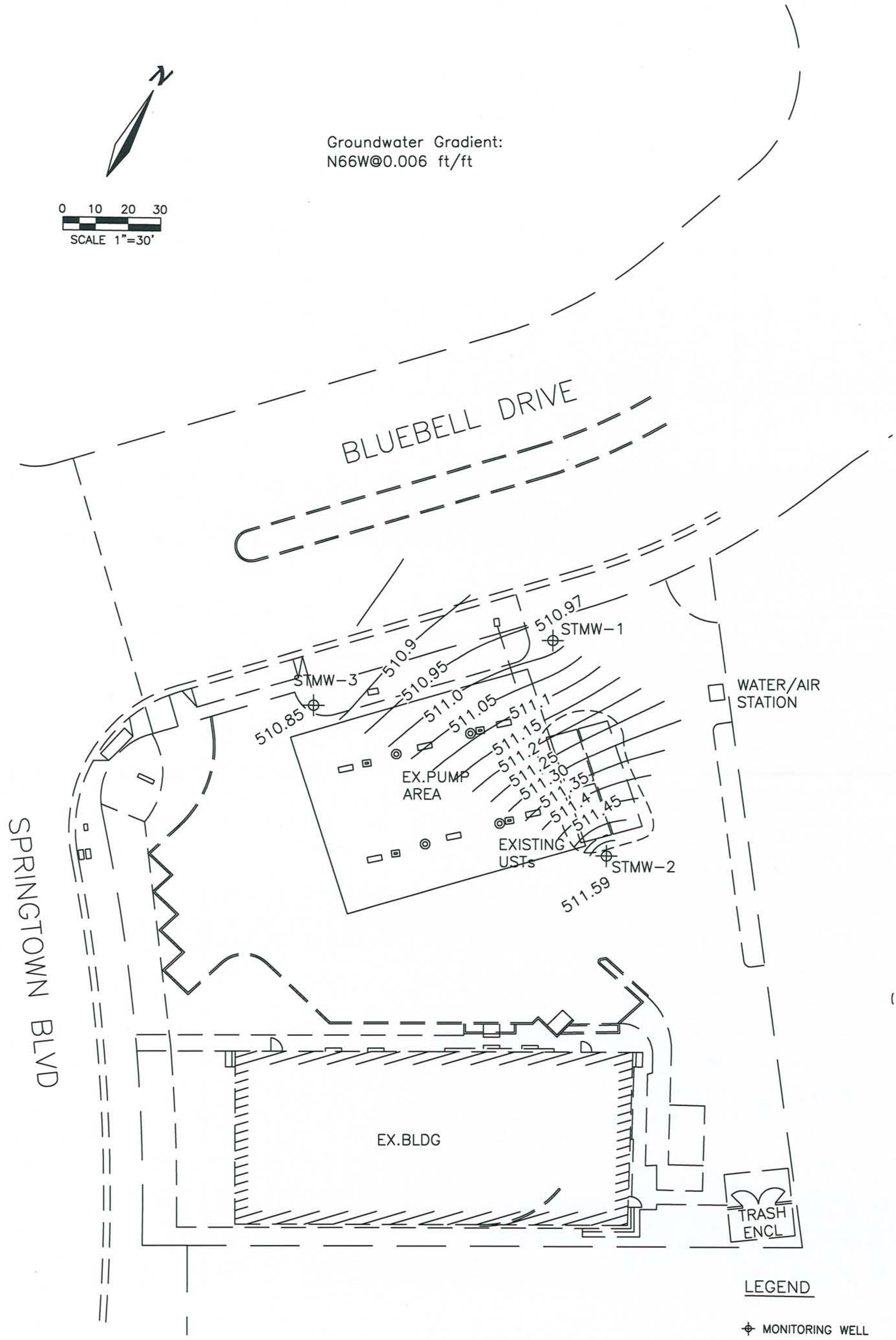


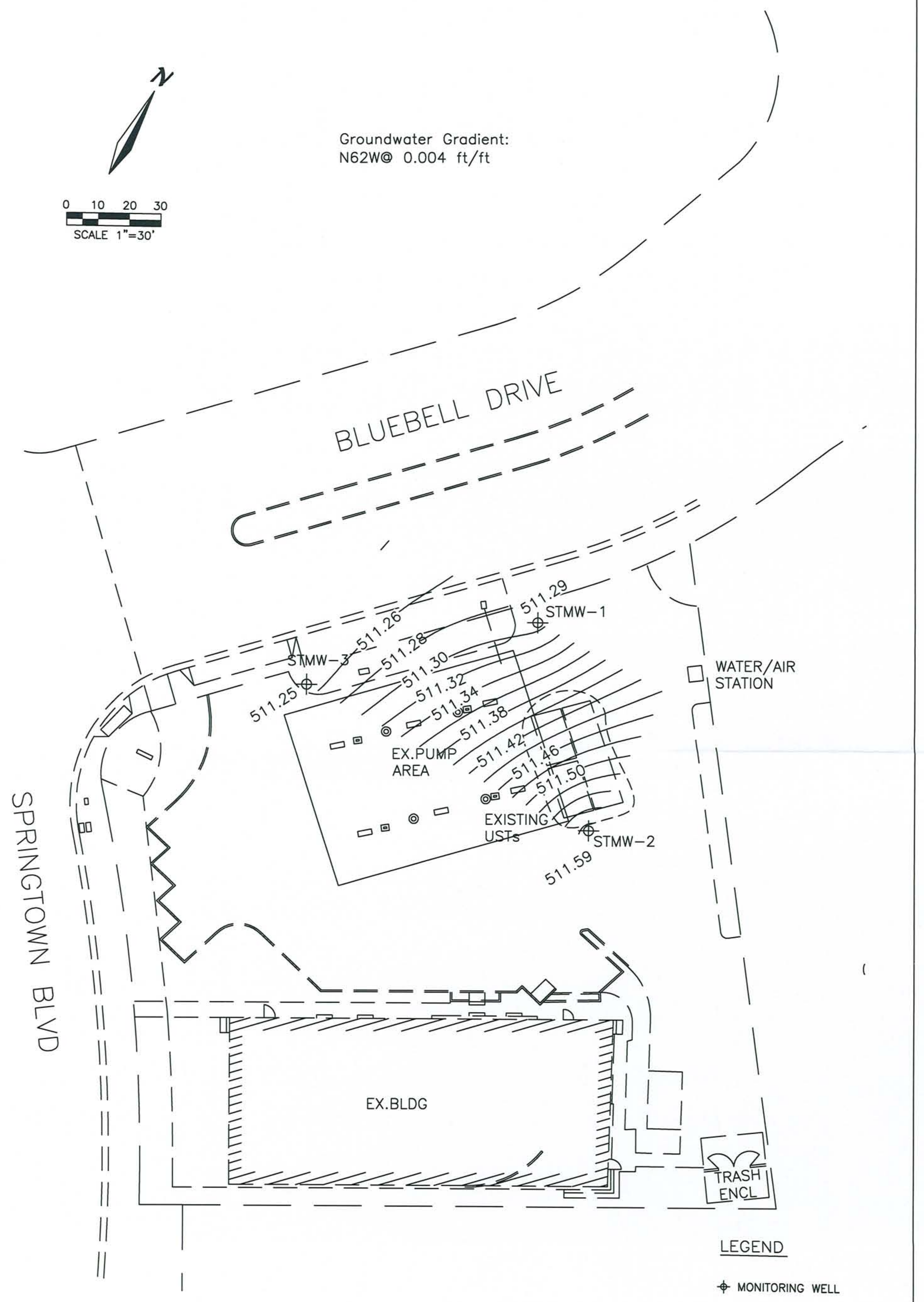
Figure 12:	GEOLOGIC CROSS SECTION	LEGEND
Springtown Gas 909 Bluebell Drive Livermore, CA	Cross Section I-I' Southwest to Northeast	Sandy gravel Silty-Clay Mixtures
Project No.: 1409.2		
Geological Technics, Inc. 11/20/08	No Vertical Exaggeration	



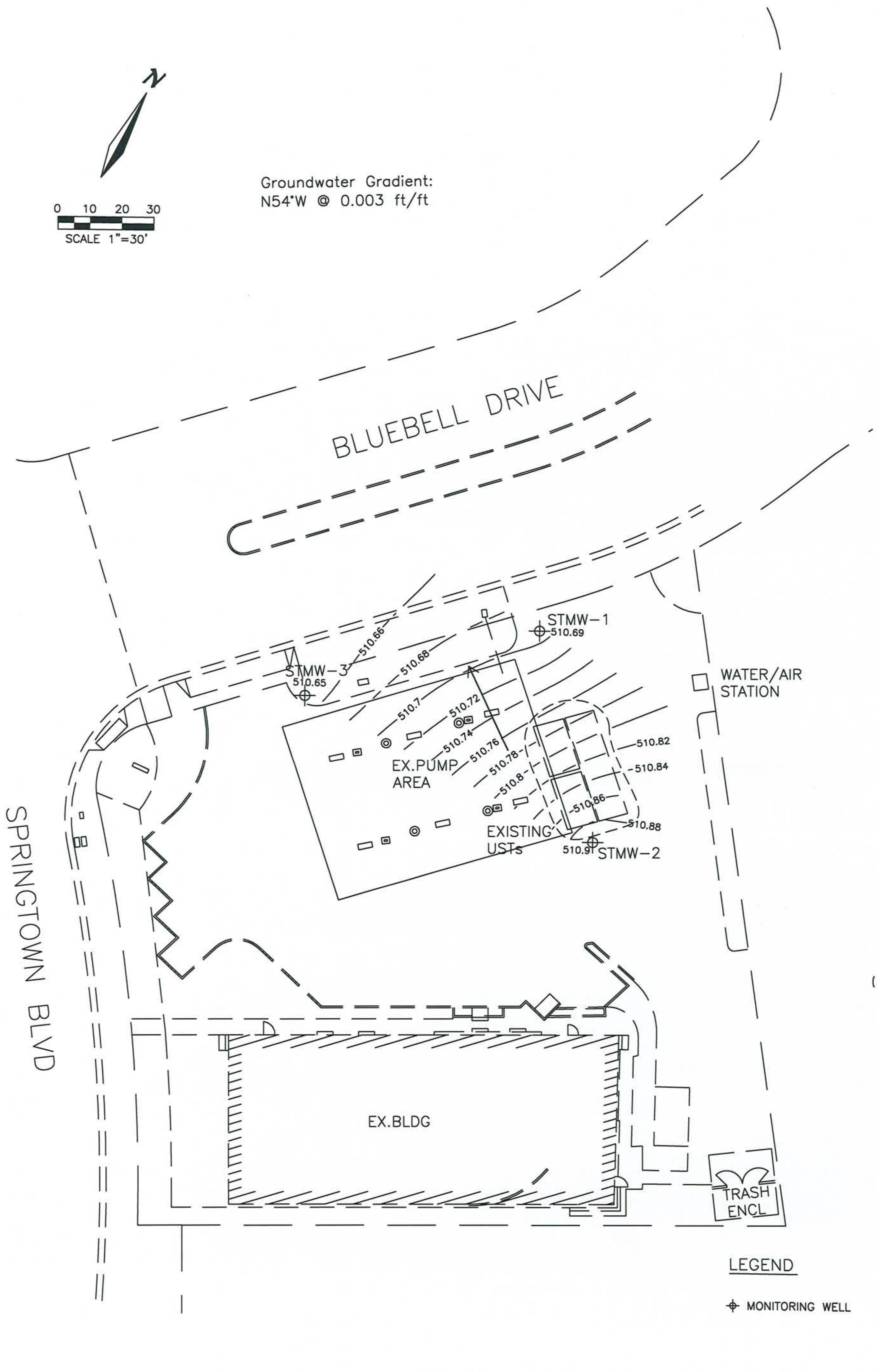
By:	MV
Job No:	1409.2 Date: 11/25/08
Scale:	1"=30'
File:	14092 site plan

Geological Technics, Inc.
1101 7th Street
Modesto, CA
95354
209.522.4119 (tel)
209.522.4227 (fax)

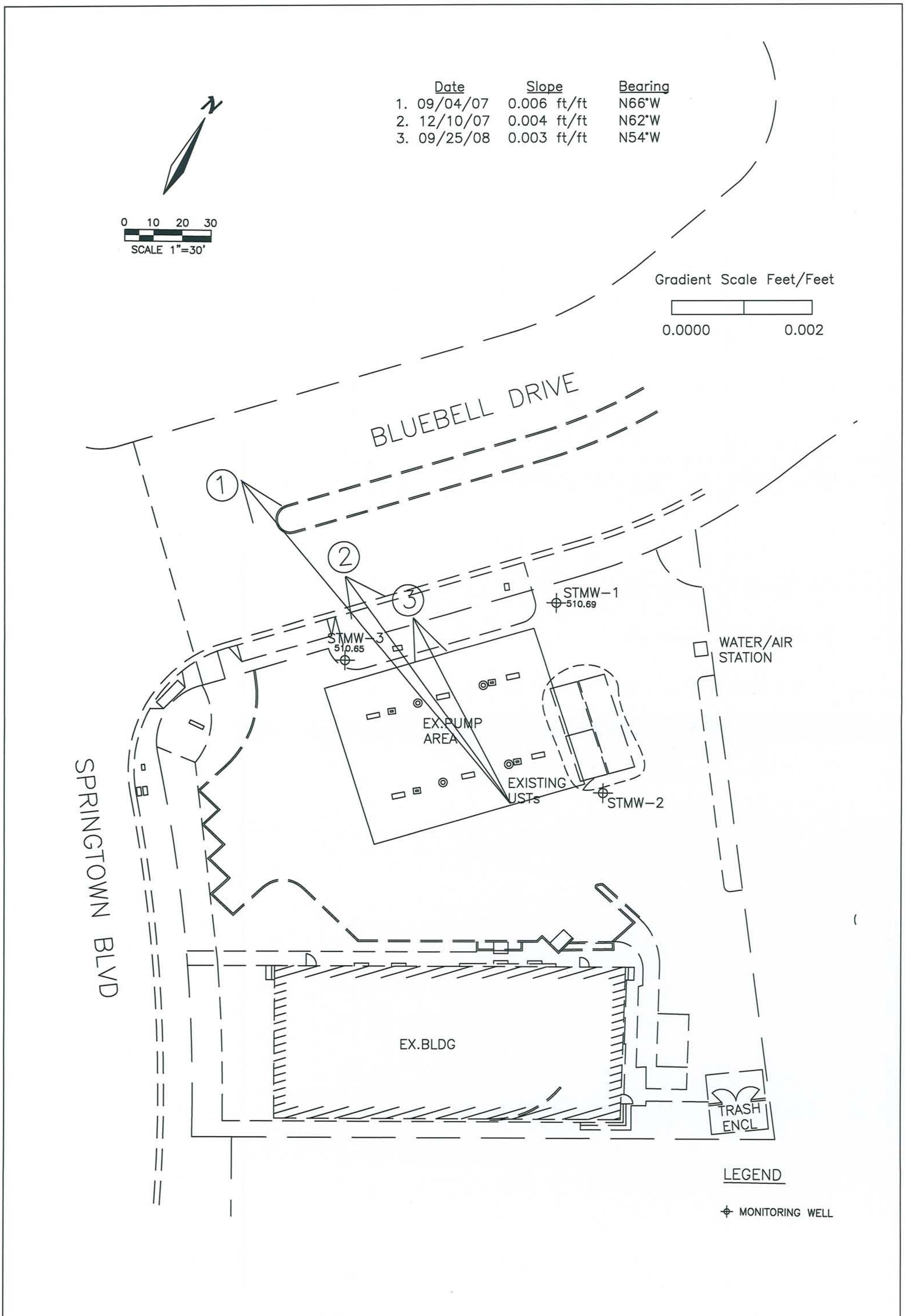
Figure 13 Groundwater Gradient Map
SEPTEMBER 2007
SPRINGTOWN GAS (BLUEBELL)
909 BLUEBELL DRIVE
LIVERMORE, CA



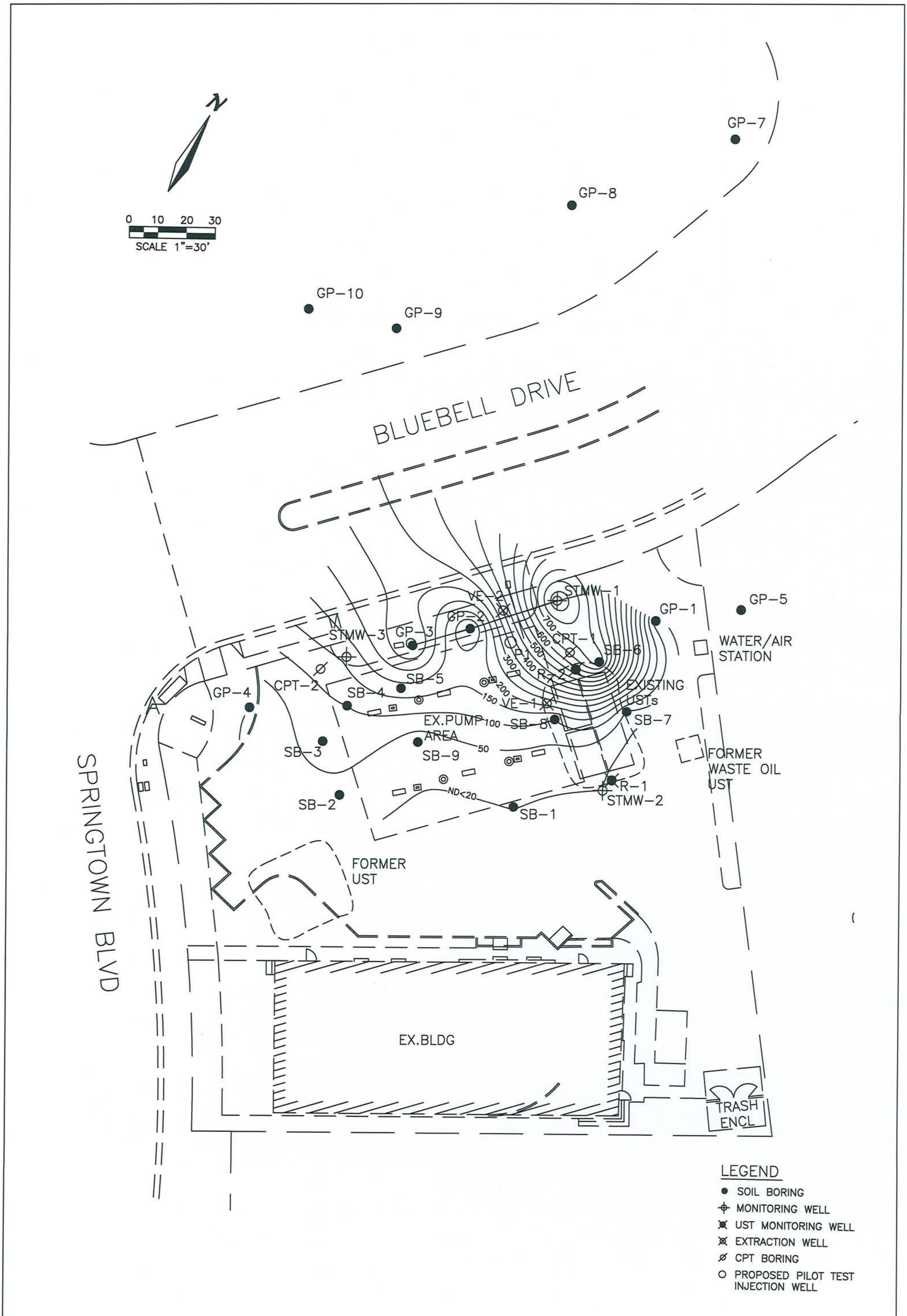
By:	MV	Geological Technics, Inc.	Figure 14 Groundwater Gradient Map
Job No: 1409.2	Date: 11/25/08	1101 7th Street Modesto, CA 95354	December 2007
Scale:	1"=30'	209.522.4119 (tel) 209.522.4227 (fax)	SPRINGTOWN GAS (BLUEBELL) 909 BLUEBELL DRIVE
File:	14092 site plan		LIVERMORE, CA Page 1 of 1



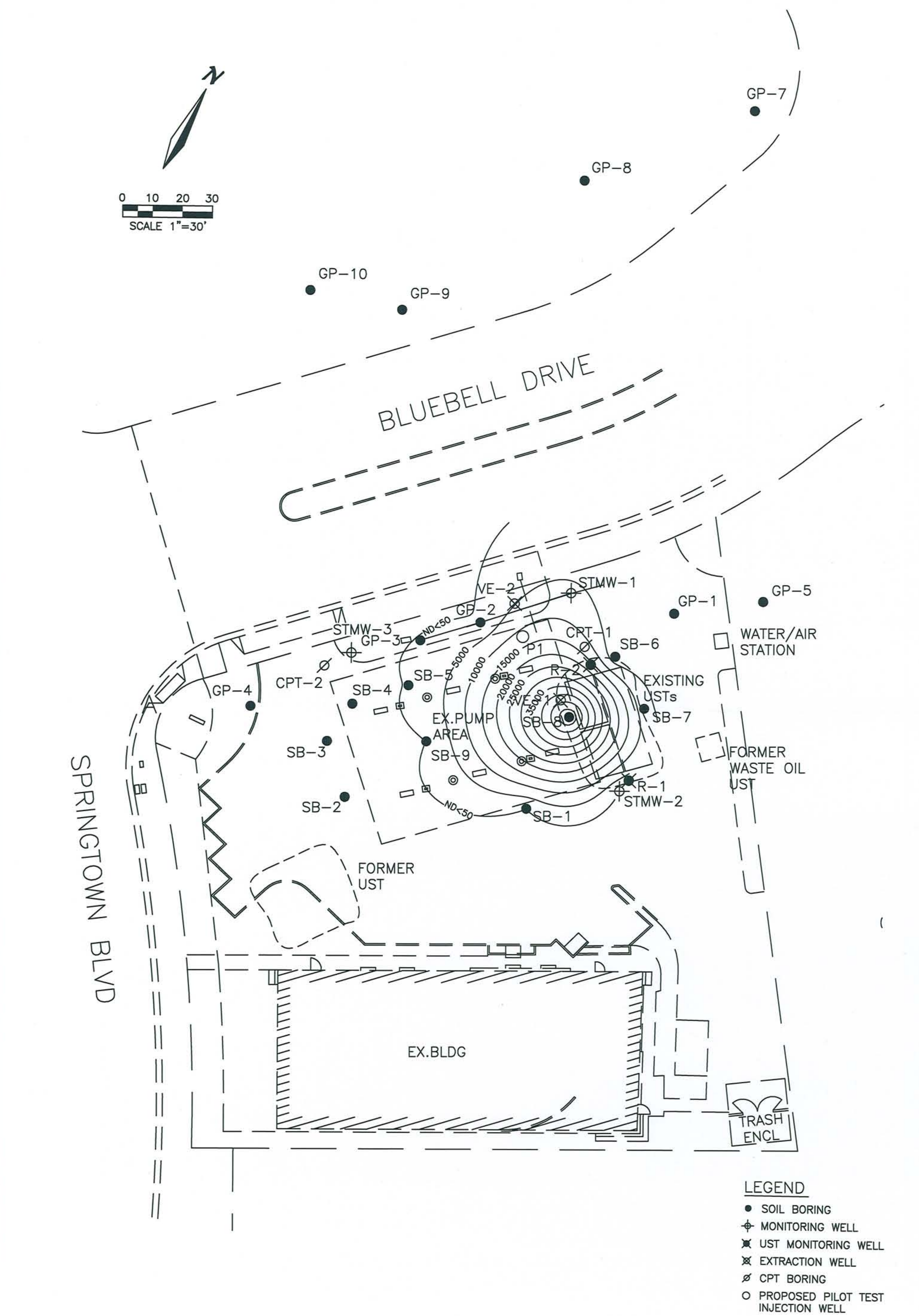
By: MV	*Geological Technics, Inc.* 1101 7th Street Modesto, CA 95354 209.522.4119 (tel) 209.522.4227 (fax)	Figure 15 Groundwater Gradient Map SEPTEMBER 2008 SPRINGTOWN GAS (BLUEBELL) 909 BLUEBELL DRIVE LIVERMORE, CA
Job No: 1409.2 Date: 11/25/08		
Scale: 1"=30'		
File: 3Q08 Springtown GWG		Page 1 of 1



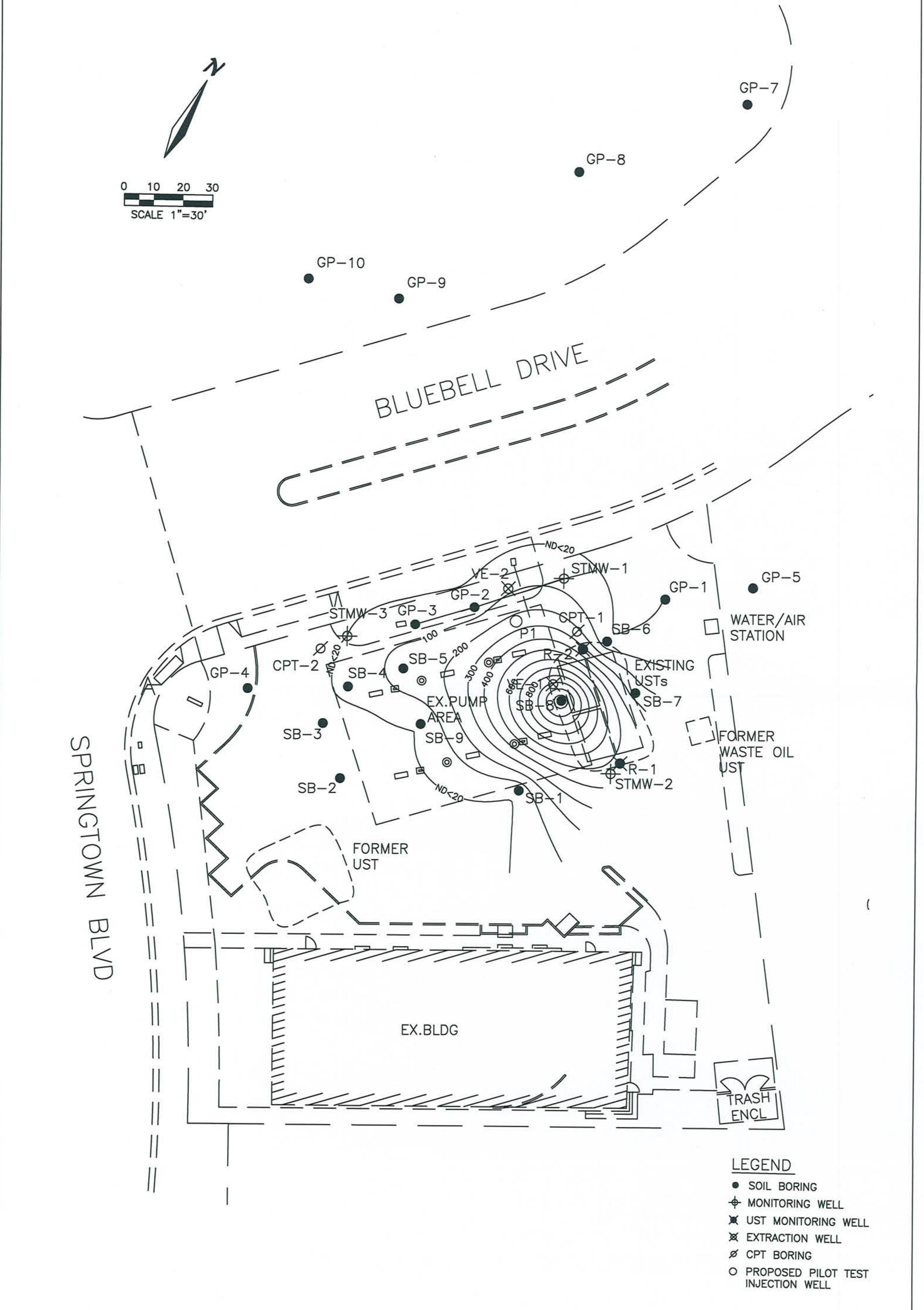
By: RG	*Geological Technics, Inc.* 1101 7th Street Modesto, CA 95354 209.522.4119 (tel) 209.522.4227 (fax)	Figure 16 Groundwater Gradient Rose Diagram
Job No: 1409.2 Date: 11/26/08		SPRINGTOWN GAS (BLUEBELL) 909 BLUEBELL DRIVE LIVERMORE, CA
Scale: 1"=30'		
File: 4Q08 Rose Springtown		Page 1 of 1



By: TB	*Geological Technics, Inc.* 1101 7th Street Modesto, CA 95354 209.522.4119 (tel) 209.522.4227 (fax)	FIGURE 17: MTBE Plume in Groundwater	
Job No: 1409.2 Date: 11/25/08		SPRINGTOWN GAS (BLUEBELL)	
Scale: 1"=30'		909 BLUEBELL DRIVE	
File: 14092 site plan		LIVERMORE, CA	Page 1 of 1



By: TB	Geological Technics, Inc.	FIGURE 18: TBA Plume in Groundwater	
Job No: 1409.2 Date: 11/25/08	1101 7th Street Modesto, CA 95354 209.522.4119 (tel) 209.522.4227 (fax)	SPRINGTOWN GAS (BLUEBELL) 909 BLUEBELL DRIVE LIVERMORE, CA	
Scale: 1"=30'			
File: 14092 site plan			Page 1 of 1



By:	TB
Job No: 1409.2	Date: 11/25/08
Scale:	1"=30'
File:	14092 site plan

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Modesto, CA
95354
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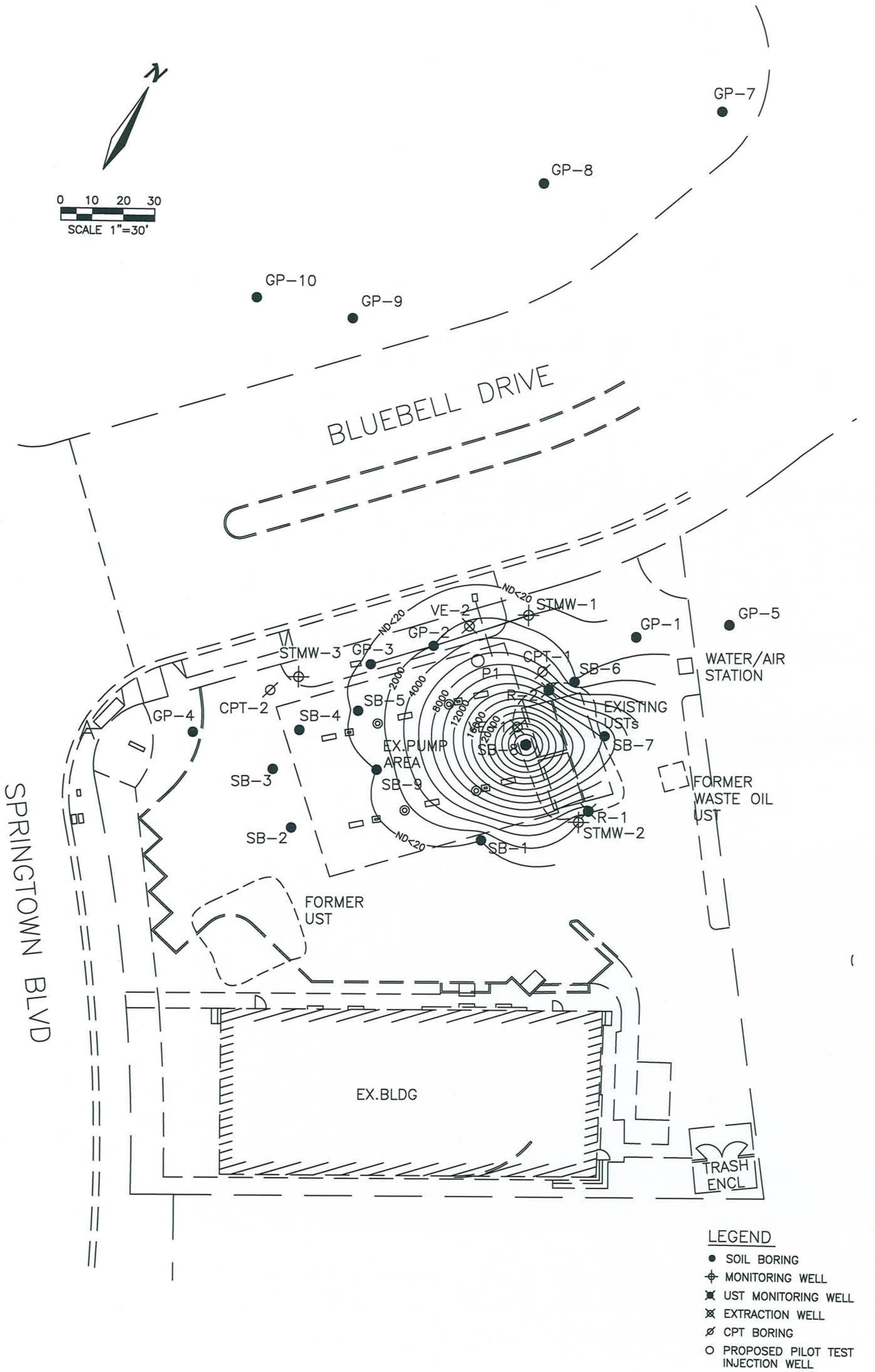
209.522.4227 (fax)

FIGURE 19: MTBE Plume in Soil

SPRINGTOWN GAS (BLUEBELL)
909 BLUEBELL DRIVE
LIVERMORE, CA



By:	TB
Job No: 1409.2	Date: 11/25/08
Scale:	1"=30'
File:	14092 site plan

Geological Technics, Inc.
1101 7th Street
Modesto, CA
95354
209.522.4119 (tel)
209.522.4227 (fax)

FIGURE 20: TBA Plume in Soil

SPRINGTOWN GAS (BLUEBELL)
909 BLUEBELL DRIVE
LIVERMORE, CA

Appendix A

Summary Data Tables

Table 1
Summary of Groundwater Elevation

Springtown Gas
909 Bluebell Drive
Livermore, California

Date		STMW-1	STMW1	STMW-2	STMW2	STMW-3	STMW3	Avg GW	GW Gradient	
		GW Elev	DTW	GW Elev	DTW	GW Elev	DTW	Elev	Slope	Direction
	*top of casing**	517.55		519.59		520.37			ft/ft	
9/4/2007		510.97	6.58	511.59	8.00	510.85	9.52	511.14	0.006	N66°W
12/10/07		511.29	6.26	511.59	8.00	511.25	9.12	511.38	0.004	N62°W
09/25/08		510.69	6.86	510.9	8.69	510.65	9.72	510.75	0.003	N54°W
Historical								511.09	0.004	N61°W

*TOC elevations surveyed in on 9/06/07 by Muir Consutling Inc. NAD 83 and NGVD 29
**Gradient and slope determined from computer generated contours

Table 2
Summary of Groundwater Analytical Data

Springtown Gas
909 Bluebell Drive
Livermore, California

DATE	MONITORING WELL	TPHg	B	T	E	X	MtBE	TBA	DIPE	EtBE	TAME	1,2-DCA	EDB	Methanol	Ethanol
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
9/4/2007	STMW-1	220	<10	<10	<10	<10	850	6,500	-	-	-	-	-	-	-
	STMW-2	<50	<0.5	<0.5	<0.5	<0.5	<1	42	-	-	-	-	-	-	-
	STMW-3	59	<1	<1	<1	<1	160	120	-	-	-	-	-	-	-
12/10/2007	STMW-1	210	<5	<5	<5	<5	540	4,200	-	-	-	-	-	-	-
	STMW-2	<50	<0.5	<0.5	<0.5	<0.5	<1	83	-	-	-	-	-	-	-
	STMW-3	<50	<0.5	<0.5	<0.5	<0.5	17	86	-	-	-	-	-	-	-
9/25/2008	STMW-1	230	<0.5	<0.5	<0.5	<1.0	204	704	<0.5	<0.5	0.6	<0.5	<0.5	<5	<20
	STMW-2	<50	<0.5	<0.5	<0.5	<1	<0.5	71	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<20
	STMW-3	<50	<0.5	<0.5	<0.5	<0.5	67	31.7	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<20

notes:

TPHg	Total petroleum hydrocarbons as gasoline
TPHd	Total petroleum hydrocarbons as diesel
B	Benzene
T	Toluene
E	Ethylbenzene
X	Total xylenes
MtBE	Methyl tertiary butyl ether
TBA	Tert-butyl alcohol
DIPE	Di-isopropyl ether
EtBE	Ethyl-tertiary butyl ether
TAME	Tert-amyl-methyl ether
1,2-DCA	1,2-Dichloroethane
EDB	1,2-Dibromoethane
bgs	below ground surface
ug/l	micrograms per liter
-	Not analyzed or not reported

Table 3
Groundwater Contaminants Mass Caculation

Springtown Gas
909 Bluebell Drive
Livermore, California

Contour Area	Cotour Concentration	Interval Area	Average Concentration	Volume of Soil	Volume of Water	Mass	Mass
Sq. Ft	µg/l	Sq. Ft	µg/l	Cu. Meter	Cu. Meter	KG	Pounds
7007	5	3354	2503	949.75	379.90	0.95	2.1
3653	5000	1200	7500	339.80	135.92	1.02	2.3
2453	10000	745	12500	210.96	84.38	1.05	2.3
1708	15000	522	17500	147.81	59.13	1.03	2.3
1186	20000	356	22500	100.81	40.32	0.91	2.0
830	25000	276	27500	78.15	31.26	0.86	1.9
554	30000	223	32500	63.15	25.26	0.82	1.8
331	35000	145	37500	41.06	16.42	0.62	1.4
186	40000	103	42500	29.17	11.67	0.50	1.1
83	45000	60	47500	16.99	6.80	0.32	0.7
23	50000	23	50000	6.51	2.61	0.13	0.3
TBA Total Mass						**8.21**	**18.1**
Contour Area	Cotour Concentration	Interval Area	Average Concentration	Volume of Soil	Volume of Water	Mass	Mass
Sq. Ft	µg/l	Sq. Ft	µg/l	Cu. Meter	Cu. Meter	KG	Pounds
15399	0.5	4151	25	1175.43	470.17	0.01	0.0
11248	50	2845	75	805.61	322.25	0.02	0.1
8403	100	219	125	62.01	24.81	0.00	0.0
8184	150	756	175	214.08	85.63	0.01	0.0
7428	200	643	225	182.08	72.83	0.02	0.0
6785	250	815	275	230.78	92.31	0.03	0.1
5970	300	1676	325	474.59	189.84	0.06	0.1
4294	350	1292	375	365.85	146.34	0.05	0.1
3002	400	771	425	218.32	87.33	0.04	0.1
2231	450	487	475	137.90	55.16	0.03	0.1
1744	500	364	525	103.07	41.23	0.02	0.0
1380	550	344	575	97.41	38.96	0.02	0.0
1036	600	358	625	101.37	40.55	0.03	0.1
678	650	315	675	89.20	35.68	0.02	0.1
363	700	224	725	63.43	25.37	0.02	0.0
139	750	107	775	30.30	12.12	0.01	0.0
32	800	32	800	9.06	3.62	0.00	0.0
MTBE Total Mass						**0.40**	**0.9**

Table 4
Soil Contaminants Mass Caculation

Springtown Gas
909 Bluebell Drive
Livermore, California

Contour Area	Cotour Concentration	Interval Area	Average Concentration	Volume of Soil	Soil Mass	Mass	Mass
Sq. Ft	µg/Kg	Sq. Ft	µg/Kg	Cu. Meter	Kg	KG	Pounds
7007	5	3354	2503	949.75	1519595.26	3.80	8.4
3653	5000	1200	7500	339.80	543683.45	4.08	9.0
2453	10000	745	12500	210.96	337536.81	4.22	9.3
1708	15000	522	17500	147.81	236502.30	4.14	9.1
1186	20000	356	22500	100.81	161292.76	3.63	8.0
830	25000	276	27500	78.15	125047.19	3.44	7.6
554	30000	223	32500	63.15	101034.51	3.28	7.2
331	35000	145	37500	41.06	65695.08	2.46	5.4
186	40000	103	42500	29.17	46666.16	1.98	4.4
83	45000	60	47500	16.99	27184.17	1.29	2.9
23	50000	23	50000	6.51	10420.60	0.52	1.2
TBA Total Mass						**32.85**	**72.5**
Contour Area	Cotour Concentration	Interval Area	Average Concentration	Volume of Soil	Soil Mass	Mass	Mass
Sq. Ft	µg/Kg	Sq. Ft	µg/Kg	Cu. Meter	Kg	KG	Pounds
15399	0.5	4151	25	1175.43	1880691.68	0.05	0.1
11248	50	2845	75	805.61	1288982.86	0.10	0.2
8403	100	219	125	62.01	99222.23	0.01	0.0
8184	150	756	175	214.08	342520.58	0.06	0.1
7428	200	643	225	182.08	291323.72	0.07	0.1
6785	250	815	275	230.78	369251.68	0.10	0.2
5970	300	1676	325	474.59	759344.56	0.25	0.5
4294	350	1292	375	365.85	585365.85	0.22	0.5
3002	400	771	425	218.32	349316.62	0.15	0.3
2231	450	487	475	137.90	220644.87	0.10	0.2
1744	500	364	525	103.07	164917.31	0.09	0.2
1380	550	344	575	97.41	155855.92	0.09	0.2
1036	600	358	625	101.37	162198.90	0.10	0.2
678	650	315	675	89.20	142716.91	0.10	0.2
363	700	224	725	63.43	101487.58	0.07	0.2
139	750	107	775	30.30	48478.44	0.04	0.1
32	800	32	800	9.06	14498.23	0.01	0.0
MTBE Total Mass						**1.60**	**3.5**

Table 5
Summary of Monitoring Well Completion Data

Springtown Gas
909 Bluebell Drive
Livermore, California

Well Number	Status	Date Drilled	Total Depth (ft)	Boring Diameter (in)	Well Casing Diameter (in)	Casing Type	Slot Size (in)	Sand Type	Well Screen		Filter Pack		Annular Seal		Grout Seal	
									From	To	From	To	From	To	From	To
STMW-1	Active	8/23/2007	20.00	10	2	PVC	0.02	#2/12	10	20	20	8	8	7	7	0
STMW-2	Active	8/23/2007	20.00	10	2	PVC	0.02	#2/12	10	20	20	8	8	7	7	0
STMW-3	Active	8/23/2007	20.00	10	2	PVC	0.02	#2/12	10	20	20	8	8	7	7	0
P1	Active	9/19/2008	20.00	10	4	PVC	0.02	#3/12	10	20	20	8	8	7	7	0

TABLE 1
SUMMARY OF GROUNDWATER SAMPLES ANALYTICAL RESULTS FROM CPT BOREHOLES

Date	Sample No.	Depth feet	TPHg µg/L	B µg/L	T µg/L	E µg/L	X µg/L	MTBE µg/L	Methanol mg/L	Ethanol µg/L	EPA 8260B µg/L
6/13/07	CPT1-34-38	34-38	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.4	ND<1	ND<200	Chloroform 1.2
	CPT1-64-68	64-68	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<1	ND<1	ND<200	None Detected<0.5
	CPT2-18-22	18-22	ND<50	ND<1	ND<1	ND<1	ND<1	89	ND<1	ND<400	None Detected<1
	CPT2-31-35	31-35	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<1	ND<1	ND<200	Chloroform 0.66 Tetrachloroethene 0.88
	CPT2-55-59	55-59	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<1	ND<1	ND<200	None Detected<0.5

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
µg/L – Microgram per Liter
ND – Not Detected (below laboratory detection limit)

BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
EPA 8260B – Other Fuel Hydrocarbon Oxygenates by 8260B
mg/L – Milligram per Liter

File No. 10-93-567-ST

TABLE 1
GROUNDWATER MONITORING DATA (feet) AND ANALYTICAL RESULTS

Date	Well No./ Elevation	Depth of Well	Depth to Perf.	Depth to Water	GW Elev.	Well Observation	TPHg µg/L	B µg/L	T µg/L	E µg/L	X µg/L	MTBE µg/L	Ethanol µg/L	Methanol mg/L	TBA µg/L	Other VOCs by EPA 8260B (µg/L)
9/04/07	STMW-1 (517.55)●	20	10-20	6.58]	510.97	Rainbow sheen No odor	220	ND <10	ND <10	ND <10	ND <10	850	ND <4000	ND <1	6500	None Detected<10
9/04/07	STMW-2 (519.59)●	20	10-20	8.30]	511.29	No sheen or odor	ND <50	ND <0.5	ND <0.5	ND <0.5	ND <0.5	ND <1	ND <200	ND <1	42	Tetrahydrofuran 49
9/04/07	STMW-3 (520.37)●	20	10-20	9.52]	510.85	No sheen or odor	59	ND <1	ND <1	ND <1	ND <1	160	ND <400	ND <1	120	None Detected<1

TPHg – Total Petroleum Hydrocarbons as gasoline
MTBE – Methyl Tertiary Butyl Ether
Perf. – Perforation
TBA – tert-Butanol
mg/L – Milligrams Per Liter
ND – Not Detected (below laboratory detection limit)
* Well screens are not submerged
● Mean Sea Level

BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
GW Elev. – Groundwater Elevation
PCE – Tetrachloroethene
TCE – Trichloroethene
µg/L – Micrograms Per Liter

] Well screens are submerged

TABLE 2
SUMMARY OF MONITORING WELLS DATA
IN FEET

Well No.	Well Diameter (inch)	Depth of Well	Depth of Perforation	Depth of Blank	Depth of Cement	Depth of Bentonite	Depth of Sand
STMW-1	2	20	10-20	0-10	0-7	7-8	8-20
STMW-2	2	20	10-20	0-10	0-7	7-8	8-20
STMW-3	2	20	10-20	0-10	0-7	7-8	8-20

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TABLE 3
SUMMARY OF SOIL SAMPLES ANALYTICAL RESULTS FROM GEOPROBE BOREHOLES

Date	Sample Number	Depth feet	TPHg mg/Kg	Methanol mg/Kg	B µg/Kg	T µg/Kg	E µg/Kg	X µg/Kg	MTBE µg/Kg	Ethanol µg/Kg	PCE µg/Kg	TBA µg/Kg	TCE µg/Kg	Other VOCs by 8260B µg/Kg
8/22/07	GP-1-5	5	ND<0.5	ND<5	ND<12	ND<12	ND<12	ND<25	ND<12	ND<1200	ND<12	1300	ND<12	Acetone 420
	GP-1-10	10	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-1-15	15	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<10	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-1-20	20	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<10	ND<500	ND<5	720	ND<5	Acetone 110 Carbon Disulfide 5.2
	GP-2-5	5	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<10	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-2-10	10	ND<0.5	5.2	ND<25	ND<25	ND<25	ND<50	39	ND<2500	ND<25	3700	ND<25	None Detected<25
	GP-2-15	15	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-2-20	20	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-3-5	5	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-3-10	10	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	12	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-3-15	15	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	490	ND<5	None Detected<5
	GP-3-20	20	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	34	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-4-5	5	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-4-10	10	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-4-15	15	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	GP-4-20	20	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
TBA – tert-Butanol
VOCs – Volatile Organic Compounds
mg/Kg – Milligram per Kilogram

BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
PCE – Tetrachloroethene
TCE - Trichloroethene
ND – Not Detected (below laboratory detection limit)
µg/Kg – Microgram per Kilogram

File No. 10-93-567-ST

TABLE 4
SUMMARY OF SOIL SAMPLES ANALYTICAL RESULTS FROM BOREHOLES OF MONITORING WELLS

Date	Sample Number	Depth feet	TPHg mg/Kg	Methanol mg/Kg	B µg/Kg	T µg/Kg	E µg/Kg	X µg/Kg	MTBE µg/Kg	Ethanol µg/Kg	PCE µg/Kg	TBA µg/Kg	TCE µg/Kg	Other VOCs by 8260B µg/Kg
8/23/07	STMW-1-5	5	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	STMW-1-10	10	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	760	ND<5	None Detected<5
	STMW-1-15	15	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	66	ND<500	ND<5	900	ND<5	None Detected<5
	STMW-1-20	20	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	570	ND<5	None Detected<5
	STMW-2-5	5	ND<0.5	8.9	ND<25	ND<25	ND<25	ND<50	460	ND<2500	ND<25	3700	ND<25	Acetone 950
	STMW-2-10	10	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	270	ND<5	None Detected<5
	STMW-2-15	15	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	STMW-2-20	20	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
8/28/07	STMW-3-5	5	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	STMW-3-10	10	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	STMW-3-15	15	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5
	STMW-3-20	20	ND<0.5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<500	ND<5	ND<40	ND<5	None Detected<5

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
TBA – tert-Butanol
VOCs – Volatile Organic Compounds
mg/Kg – Milligram per Kilogram

BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
PCE – Tetrachloroethene
TCE - Trichloroethene
ND – Not Detected (below laboratory detection limit)
µg/Kg – Microgram per Kilogram

TABLE 5
SUMMARY OF WATER SAMPLES ANALYTICAL RESULTS FROM GEOPROBE BOREHOLES

Date	Sample Number	TPHg µg/L	Methanol mg/L	B µg/L	T µg/L	E µg/L	X µg/L	MTBE µg/L	Ethanol µg/	PCE µg/L	TBA µg/L	TCE µg/L	Other VOCs by 8260B µg/L
8/22/07	GP-1-20W	ND<50	ND<1	ND<1	ND<1	ND<1	ND<1	61	ND<400	ND<1	110	ND<1	None Detected<1
	GP-2-20W	ND<50	1.7	ND<1	ND<1	ND<1	ND<1	81	ND<400	ND<1	540	ND<1	None Detected<1
	GP-3-20W	220a	ND<1	ND<2.5	ND<2.5	ND<2.5	ND<2.5	370	ND<1000	ND<2.5	230	ND<2.5	None Detected<2.5
	GP-4-20W	ND<50	ND<1	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<1	ND<200	ND<0.5	ND<10	ND<0.5	None Detected<0.5

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
TBA – tert-Butanol
VOCs – Volatile Organic Compounds
mg/L – Milligram per Liter
a – Not a gasoline pattern (value due to MTBE in sample)

BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
PCE – Tetrachloroethene
TCE - Trichloroethene
ND – Not Detected (below laboratory detection limit)
µg/L – Microgram per Liter

File No. 10-93-567-ST
July 1, 2008

TABLE 1
SUMMARY OF SOIL SAMPLES
ANALYTICAL RESULTS FROM GP BOREHOLES

Date	Sample No.	Depth feet	TPHg mg/Kg	B µg/Kg	T µg/Kg	E µg/Kg	X µg/Kg	MTBE µg/Kg	DIPE µg/Kg	ETBE µg/Kg	TAME µg/Kg	TBA µg/Kg	EDB µg/Kg	1,2-DCA µg/Kg
5/09/08	GP-5-5	5	ND<0.46	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-5-10	10	ND<0.48	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-5-15	15	ND<0.48	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-7-5	5	ND<0.48	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-7-10	10	ND<0.46	ND<5	ND<5	ND<5	ND<10	6.5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-7-15	15	ND<0.5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-8-5	5	ND<0.48	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-8-10	10	ND<0.5	ND<25	ND<25	ND<25	ND<50	440	ND<25	ND<25	ND<25	2300	ND<25	ND<25
	GP-8-15	15	ND<0.49	ND<5	ND<5	ND<5	ND<10	44	ND<5	ND<5	ND<5	270	ND<5	ND<5
	GP-9-5	5	ND<0.48	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-9-10	10	ND<0.49	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-9-15	15	ND<0.45	ND<5	ND<5	ND<5	ND<10	14	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-10-5	5	ND<0.49	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-10-10	10	ND<0.45	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
	GP-10-15	15	ND<0.46	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5
↓	GP-10-20	20	ND<0.49	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<5	ND<5	ND<40	ND<5	ND<5

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
ETBE – Tertiary Butyl Ethyl Ether
TBA – Tertiary Butanol
1,2-DCA – 1,2-Dichloroethane
µg/Kg – Microgram per Kilogram
ND – Not Detected (below laboratory detection limit)

BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
DIPE – Diisopropyl Ether
TAME – Tertiary Amyl Methyl Ether
EDB – 1,2-Dibromoethane

mg/Kg – Milligram per Kilogram

ENVIRO SOIL TECH CONSULTANTS

File No. 10-93-567-ST
July 1, 2008

TABLE 2
SUMMARY OF WATER SAMPLES ANALYTICAL RESULTS FROM GP BOREHOLES IN MICROGRAMS PER LITER (µg/L)

Date	Sample No.	TPHg	B	T	E	X	MTBE	DIPE	ETBE	TAME	TBA	EDB	1,2-DCA
5/09/08	GP-5-W	560a	ND<10	ND<10	ND<10	ND<20	ND<20	ND<100	ND<100	ND<100	ND<200	ND<10	ND<10
|	GP-7-W	ND<50	ND<0.5	1.7	ND<0.5	ND<1	40	ND<5	ND<5	ND<5	ND<10	ND<0.5	ND<0.5
|	GP-8-W	530a	ND<5	ND<5	ND<5	ND<10	970	ND<50	ND<50	ND<50	4100	ND<5	ND<5
|	GP-9-W	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<1	8.7	ND<5	ND<5	ND<5	ND<10	ND<0.5	ND<0.5
↓	GP-10-W	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<1	ND<1	ND<5	ND<5	ND<5	ND<10	ND<0.5	ND<0.5

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
ETBE – Tertiary Butyl Ethyl Ether
TBA – Tertiary Butanol
1,2-DCA – 1,2-Dichloroethane
ND – Not Detected (below laboratory detection limit)
a – A typical pattern

BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
DIPE – Diisopropyl Ether
TAME – Tertiary Amyl Methyl Ether
EDB – 1,2-Dibromoethane

TABLE 3
RESULTS OF LABORATORY ANALYSES
OF VAPOR SAMPLES

Date	Sample No.	TPHg mg/m^3	B mg/m^3	T mg/m^3	E mg/m^3	X mg/m^3	MTBE mg/m^3
6/06/08	VE-1	ND<20	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<2

TPHg: Total Petroleum Hydrocarbons as gasoline (analyzed by EPA Method 8015MOD)
BTEX: Benzene, Toluene, Ethylbenzene, Total Xylene Isomers (analyzed by EPA 8020)
mg/m^3: Concentrations reported in milligrams per cubic meter
ND: None detected (less than the laboratory detection limit)

File No. 10-93-567-ST

TABLE 1
SUMMARY OF SOIL SAMPLES ANALYTICAL RESULTS

Date	Sample Number	Depth feet	TPHg mg/Kg	TPHd mg/Kg	B µg/Kg	T µg/Kg	E µg/Kg	X µg/Kg	MTBE µg/Kg	PCE µg/Kg	TBA µg/Kg	TCE µg/Kg	Other VOCs by 8260B µg/Kg
2/02/07	SB-7-5	5	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-7-10	10	ND<0.5	ND<2.5a	ND<250	ND<250	ND<250	ND<500	ND<250	ND<250	27000	ND<250	None Detected<250
	SB-7-15	15	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	560	ND<5	None Detected<5
	SB-1-5	5	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-1-10	10	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	14	ND<5	ND<40	ND<5	None Detected<5
	SB-1-15	15	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-8-5	5	ND<0.5	ND<2.5a	ND<50	ND<50	ND<50	ND<100	200	ND<50	11000	ND<50	Acetone 1800
	SB-8-7	7	ND<0.5	ND<2.5	ND<1000	ND<1000	ND<1000	ND<2000	ND<1000	ND<1000	110000	ND<1000	None Detected<1000
	SB-8-10	10	ND<0.5	ND<2.5a	ND<25	ND<25	ND<25	ND<50	ND<25	ND<25	4200	ND<25	None Detected<25
	SB-8-15	15	ND<0.5	ND<2.5a	ND<12	ND<12	ND<12	ND<25	ND<12	ND<12	3000	ND<12	None Detected<12
	SB-9-5	5	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-9-10	10	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-9-15	15	ND<0.5	ND<2.5b	ND<5	ND<5	ND<5	ND<10	6.6	ND<5	ND<40	ND<5	None Detected<5
	SB-2-5	5	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-2-10	10	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-2-15	15	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	5	ND<5	ND<40	ND<5	None Detected<5
	SB-3-5	5	ND<0.5	ND<2.5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-3-10	10	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-3-15	15	ND<0.5	ND<2.5a	ND<5	ND<5	ND<5	ND<10	5.6	ND<5	ND<40	ND<5	None Detected<5
	SB-4-5	5	ND<0.5	ND<2.5c	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-4-10	10	ND<0.5	ND<2.5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-4-15	15	ND<0.5	ND<2.5	ND<5	ND<5	ND<5	ND<10	6.4	ND<5	ND<40	ND<5	None Detected<5
	SB-5-5	5	ND<0.5	ND<2.5	ND<5	ND<5	ND<5	ND<10	19	ND<5	100	ND<5	None Detected<5
	SB-5-10	10	ND<0.5	ND<2.5	ND<5	ND<5	ND<5	ND<10	150	ND<5	72	ND<5	n-Propylbenzene 7.9
	SB-5-15	15	ND<0.5	ND<2.5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	210	ND<5	None Detected<5
	SB-6-5	5	ND<0.5	ND<2.5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<5	ND<40	ND<5	None Detected<5
	SB-6-10	10	ND<0.5	ND<2.5	ND<25	ND<25	ND<25	ND<50	ND<25	ND<25	4000	ND<25	None Detected<25
	SB-6-15	15	ND<0.5	ND<2.5	ND<5	ND<5	ND<5	ND<10	13	ND<5	160	ND<5	None Detected<5

TABLE 1 CONT'D
SUMMARY OF SOIL SAMPLES ANALYTICAL RESULTS

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
TBA – tert-Butanol
VOCs – Volatile Organic Compounds
mg/Kg – Milligram per Kilogram
a – Hydrocarbon (C9-C28). No diesel pattern present
b – Discrete peaks of hydrocarbon compounds (C9-C28). No diesel pattern present
c – Hydrocarbon (C10-C28). No diesel pattern present

BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
PCE – Tetrachloroethene
TCE - Trichloroethene
ND – Not Detected (Below Laboratory Detection Limit)
µg/Kg – Microgram per Kilogram

TABLE 2
SUMMARY OF WATER SAMPLES FROM BOREHOLES
ANALYTICAL RESULTS
IN MICROGRAM PER LITER (µg/L)

Date	Sample No.	TPHg	TPHd	B	T	E	X	MTBE	PCE	TBA	TCE	Other VOCs by 8260B
2/02/07	SB-7	ND<50	ND<55	ND<10	ND<10	ND<10	ND<10	43	ND<10	7300	ND<10	None Detected<10
	SB-1	ND<50	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	2.6	ND<0.5	80	ND<0.5	None Detected<0.5
	SB-8	ND<50	ND<84**a**	ND<100	ND<100	ND<100	ND<100	ND<200	ND<100	56000	ND<100	None Detected<100
	SB-2	ND<50	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	37	ND<0.5	14	ND<0.5	None Detected<0.5
	SB-3	ND<50	ND<72**a**	ND<1	ND<1	ND<1	ND<1	79	ND<1	ND<20	ND<1	None Detected<1
	SB -4	ND<50	ND<62**a**	ND<0.5	ND<0.5	ND<0.5	ND<0.5	100	ND<0.5	ND<10	ND<0.5	None Detected<0.5
	SB-5	660	ND<72**b**	ND<1	ND<1	11	3.1	180	ND<1	180	ND<1	Isopropylbenzene 3.5 n-Propylbenzene 12
	SB-6	220	NA	ND<5	ND<5	ND<5	ND<5	740	ND<5	1600	ND<5	None Detected<5
	SB-9	ND<50	NA	ND<0.5	ND<0.5	ND<0.5	ND<0.5	21	ND<0.5	ND<10	ND<0.5	None Detected<0.5

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
TBA – tert-Butanol
VOCs – Volatile Organic Compounds
NA – Not Analyzed
BTEX – Benzene, Toluene, Ethylbenzene, Total Xylenes
PCE – Tetrachloroethene
TCE – Trichloroethene
ND – Not Detected (Below Laboratory Detection Limit)
a – The reporting limits are increased due to a high level of sediment
b – Hydrocarbon (C9-C18). No diesel pattern present. The reporting limits are increased due to high level of sediment

TABLE 4
SUMMARY OF SOIL SAMPLES ANALYTICAL RESULTS OF FORMER DISPENSER & FUEL PIPELINE COLLECTED BY H_2OGEOL

Date	Sample Number	Depth feet	TPHg mg/Kg	TPHd mg/Kg	B µg/Kg	T µg/Kg	E µg/Kg	X µg/Kg	MTBE µg/Kg	EtBE µg/Kg	DIPE µg/Kg	TAME µg/Kg	TBA µg/Kg
6/29/05	1-2/0.5	0.5	ND<4900	110	ND<25	ND<25	ND<25	ND<25	390	ND<25	ND<49	ND<25	6500
	1-2/3	3	220000	1600	ND<500	ND<500	ND<500	ND<500	ND<500	ND<500	ND<1000	ND<500	ND<2500
	1-2/7	7	ND<1000	ND<1	ND<5	ND<5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<10
	3-4/0.5	0.5	ND<1000	ND<1	ND<5	ND<5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<10
	5-6/0.5	0.5	ND<1000	ND<1	ND<24	ND<24	ND<24	ND<24	490	ND<24	ND<48	ND<24	8400
	7-8/0.5	0.5	ND<1000	ND<1	ND<5	ND<5	ND<5	ND<5	38	ND<5	ND<10	ND<5	400
	PL1/1	1	ND<4900	ND<1	ND<25	ND<25	ND<25	ND<25	1100	ND<25	ND<49	ND<25	7600
	PL1/6	6	ND<1000	2.1	ND<5	ND<5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<10
	PL2/.05	0.5	ND<1000	ND<1	ND<5	ND<5	ND<5	ND<5	61	ND<5	ND<10	ND<5	1400
	PL3/0.5	0.5	ND<1000	ND<1	ND<5	ND<5	ND<5	ND<5	140	ND<5	ND<10	ND<5	1000
	PL4/2*	2	ND<1000	ND<1	ND<5	ND<5	ND<5	ND<5	8.9	ND<5	ND<10	ND<5	160
	PL5/.05	0.5	3400	1.7	ND<500	ND<500	ND<500	ND<500	4200	ND<500	ND<1000	ND<500	120000
	SCort-1-2/6	6	ND<1000	ND<1	ND<5	ND<5	ND<5	ND<5	ND<5	ND<5	ND<10	ND<5	ND<10
	NCort-1-2/6	6	4200	150	ND<5	ND<5	ND<5	ND<5	80	ND<5	ND<10	ND<5	46

TPHg – Total Petroleum Hydrocarbon as gasoline
MTBE – Methyl Tertiary Butyl Ether
DIPE – Di-isopropyl Ether
TBA – tert-Butanol
mg/Kg – Milligram per Kilogram
ND – Not Detected (Below Laboratory Detection Limit)
* Labeled as PL1/2

BTEX - Benzene, Toluene, Ethylbenzene, Total Xylenes
EtBE – Ethyl tert-Butyl Ether
TAME – tert-Butyl Methyl Ether
TCE - Trichloroethene
µg/Kg – Microgram per Kilogram

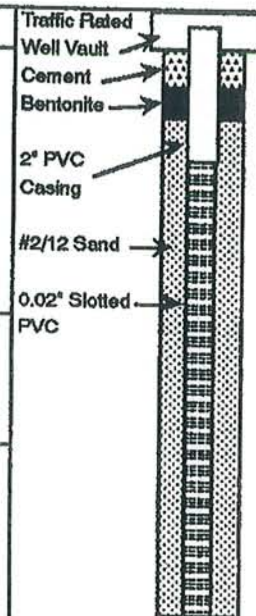
Appendix B

Boring Logs

BORING LOG MW-1

DATE: 7/11/96
LOGGED BY: M. Cline
WATER LEVEL: 9.5 feet at time of drilling
ELEVATION: --
EQUIPMENT: Mobile Drill B-53, 8" Hollow Stem Auger

Depth	PID READING (PPM)	SAMPLE INTERVAL	BLOWS/FOOT	TYPE OF SAMPLER	SYMBOLS	DESCRIPTION
0					PMT	6" Asphalt concrete over aggregate baserock
					CL	SILTY CLAY: Brown,moist
5	0	■	18	CS		SILTY CLAY: Light yellow brown, moist, no odor
10	0	■	53	CS	SM	SILTY SAND : Brown, wet, no odor
15	0	■	20	CS	CL	SANDY CLAY: Light olive gray, very moist to wet in lenses, clayey sand lenses, no odor
20	0	■	21	CS		SILTY CLAY with sand: Light brown, moist, carbonates in nodules, trace pebbles, no odor



NOTES:

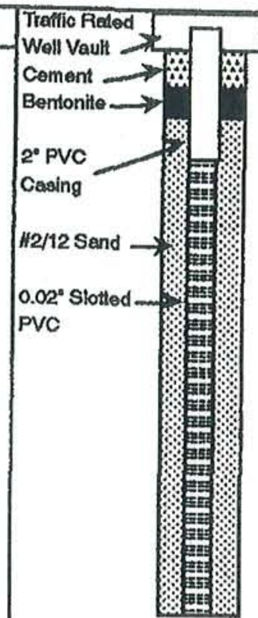
1. Boring completed at a depth of 21.5 feet on 7/11/95.
2. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
3. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was driven.

GROUNDWATER INVESTIGATION UNDERGROUND STORAGE TANK SITE 909 BLUEBELL LIVERMORE, CALIFORNIA	BSK Job No. 04400072 Figure 4	BSK & ASSOCIATES

BORING LOG MW-2

DATE: 7/11/96
LOGGED BY: M. Cline
WATER LEVEL: 10 feet at time of drilling
ELEVATION: --
EQUIPMENT: Mobile Drill B-53, 8" Hollow Stem Auger

Depth	PID READING (PPM)	SAMPLE INTERVAL	BLOWS/FOOT	TYPE OF SAMPLER	SYMBOLS	DESCRIPTION
0					PMT	6" Asphalt concrete over aggregate baserock
					CL	SILTY CLAY: Dark gray brown,moist, no odor
5	0	■	61	CS		SILTY CLAY: Light brown, moist, trace sand and gravel, no odor
10	0	■	19	CS		wet clayey sand lenses
15	0	■	14	CS		grades wet in pores, trace carbonates
20	0	■	18	CS		grades very moist in pockets



NOTES:

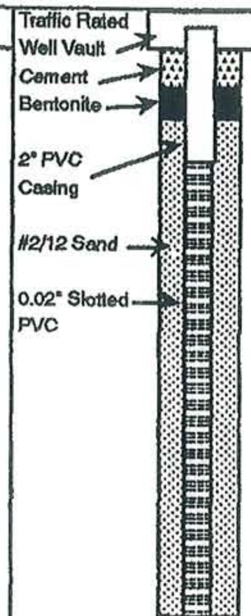
1. Boring completed at a depth of 21.5 feet on 7/12/95.
2. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
3. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was driven.

GROUNDWATER INVESTIGATION UNDERGROUND STORAGE TANK SITE 909 BLUEBELL LIVERMORE, CALIFORNIA	BSK Job No. 04400072 Figure 5	BSK & ASSOCIATES

BORING LOG MW-3

DATE: 7/12/96
LOGGED BY: M. Cline
WATER LEVEL: 11 feet at time of drilling
ELEVATION: --
EQUIPMENT: Mobile Drill B-53, 8" Hollow Stem Auger

Depth	PID READING (PPM)	SAMPLE INTERVAL	BLOWS/FOOT	TYPE OF SAMPLER	SYMBOLS	DESCRIPTION
0					PMT	6" Asphalt concrete over aggregate baserock
					CL	SILTY CLAY: Dark gray brown, moist, no odor
5	0	■	25	CS		SILTY CLAY: Light brown to whitish brown, moist, cemented, no odor
10	0	■	14	CS		SANDY CLAY: Brown to motlled olive brown, very moist to wet in pores, very faint odor
15	0	■		CS		grades brown, very moist to wet
20	0	■		CS		



NOTES:

1. Boring completed at a depth of 21.5 feet on 7/12/95.
2. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
3. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was driven.

GROUNDWATER INVESTIGATION UNDERGROUND STORAGE TANK SITE 909 BLUEBELL LIVERMORE, CALIFORNIA	BSK Job No. 04400072 Figure 6	BSK & ASSOCIATES

COPY

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 8/23/07 DATE FINISHED: 8/23/07	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft) 20'	
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING	PVC Schedule 40, 0.020			NUMBER OF SAMPLES BULK: 4	DRIVE:
TYPE OF PERFORATION	PVC	FROM 10 feet	TO 20 feet	WATER DEPTH FIRST:	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK	Sand #2/12	FROM 8'	TO 20'	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	7'	No. 3:		
	No. 2: Bentonite	7'	8'	No. 4:		

LOG OF BORING STMW-1

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	8-inch to 10-inch Concrete.						0							
	12-inch gray clayey sandy Gravel (baserock).	GC-SC												
	Black silty Clay, moist, stiff.	CL-ML												
5							5	1-5						
	Gray silty Clay, moist, stiff.	CL-ML												
	Light greenish-gray silty Clay, moist, very stiff.	CL-ML												
10							10	1-10						
	Light brown sandy Clay with few pea gravel, moist, very stiff.	CL												
	Light brown clayey Sand with few pea gravel, moist, stiff.	SC												
15						▽	15	1-15						
	Light gray to brown silty Clay, moist, very stiff.	CL-ML												
20	Boring terminated.						20	1-20						
25							25							
30							30							
35							35							

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

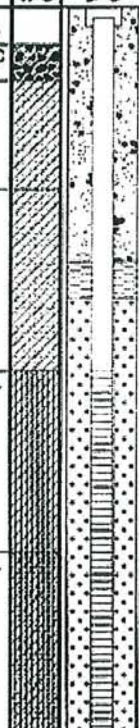
ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 8/23/07 DATE FINISHED: 8/23/07	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft)	20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING	PVC Schedule 40, 0.020			NUMBER OF SAMPLES	BULK: 4 DRIVE:
TYPE OF PERFORATION	PVC	FROM 10 feet	TO 20 feet	WATER FIRST: DEPTH	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK	Sand #2/12	FROM 8'	TO 20'	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	7'	No. 3:		
	No. 2: Bentonite	7'	8'	No. 4:		

LOG OF BORING STMW-2

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch Concrete.						0						
	12-inch gray clayey sandy Gravel (baserock).	GC-SC											
	Black sandy Clay, moist, stiff.	CL											
5	Light gray sandy Clay, moist, very stiff.	CL					5	2-5					
10	Grayish-brown silty Clay, moist, stiff.	CL-ML					10	2-10					
15	Grayish-brown sandy silty Clay, moist, stiff.	CL-ML				∇	15	2-15					
20	Boring terminated.						20	2-20					
25							25						
30							30						
35							35						



SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

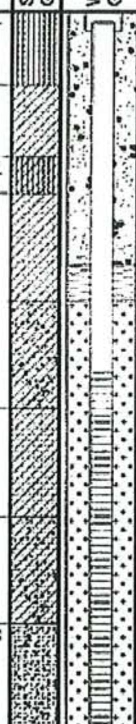
ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 8/28/07 DATE FINISHED: 8/28/07	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft) 20'	
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING	PVC Schedule 40, 0.020			NUMBER OF SAMPLES BULK: 4	DRIVE:
TYPE OF PERFORATION	PVC	FROM 10 feet	TO 20 feet	WATER FIRST: DEPTH	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK	Sand #2/12	FROM 8'	TO 20'	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	7'	No. 3:		
	No. 2: Bentonite	7'	8'	No. 4:		

LOG OF BORING STMW-3

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Black sandy Silt (landscaping material), soft, moist.	ML					0							
	Black sandy Clay, moist, stiff.	CL												
	Black sandy silty Clay, moist, very stiff.	CL-ML												
5	Brown sandy Clay, moist, very dense.	CL					5	3-5						
	Olive-brown gravelly sandy Clay, moist, stiff.	CL												
10							10	3-10						
	Brown/gray sandy Clay to clayey Sand, moist, stiff, dense.	SC												
	Light brown clayey Sand with some gravel, moist, stiff, dense.	SC												
15						▽	15	3-15						
	Light brown to light gray gravelly Sand with some clay.	SP-SC												
20	Boring terminated.						20	3-20						
25							25							
30							30							
35							35							



SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 5/07/08 DATE FINISHED: 5/07/08	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft) 10'	
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING	4-inch PVC Schedule 40			NUMBER OF SAMPLES BULK:	DRIVE:
TYPE OF PERFORATION	0.020-inch PVC Schedule 40	FROM 3'	TO 10'	WATER FIRST: DEPTH COMPL.:	24 hrs.
SIZE AND TYPE OF PACK	Sand #3	FROM 2½'	TO 10'	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	1'	No. 3:		
	No. 2: Bentonite	1'	2½'	No. 4:		

LOG OF BORING VE-1

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN, tsf	BLOWS/foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced Concrete.						0						
	6-inch gray Baserock.												
	Black Clay (medium to high PI), damp, stiff.	CL-CH											
5	Black silty Clay, very stiff, damp.	CL-ML					5						
	Dark gray sandy silty Clay with few small size pea gravel, very stiff, damp.	CL-ML											
	Very dark brown silty Clay with minor sand	CL-ML											
10	Light brown silty Sand (medium size sand), dense, moist. Boring terminated	SM					10						
15							15						
20							20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 5/07/08 DATE FINISHED: 5/07/08	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft)	10'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING	4-inch PVC Schedule 40			NUMBER OF SAMPLES	BULK: DRIVE:
TYPE OF PERFORATION	0.020-inch slotted PVC Schedule 40	FROM 3'	TO 10'	WATER DEPTH FIRST:	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK	Sand #3	FROM 2½'	TO 10'	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	1'	No. 3:		
	No. 2: Bentonite	1'	2½'	No. 4:		

LOG OF BORING VE-2

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	SAMPLES: POCKET PEN, tsf	SAMPLES: BLOWS/ foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	INDEX PROPERTIES: DRY DENSITY (pcf)	INDEX PROPERTIES: UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Black clayey Silt (landscaping material), soft, moist.	ML					0						
	Black silty Clay, moist, stiff.	CL-ML											
5							5						
	Gray silty Clay, moist, stiff.	CL-ML											
	Light greenish-gray silty Clay, moist, very stiff.	CL-ML											
10	Boring terminated.						10						
15							15						
20							20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA	GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc. DRILLER J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07	
DRILLING EQUIPMENT	Geoprobe	COMPLETION DEPTH (ft)	20'
DRILLING METHOD	Rapid push hollow-stem auger DRILL BIT	HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING		NUMBER OF SAMPLES	BULK: 3 DRIVE:
TYPE OF PERFORATION	FROM TO	WATER DEPTH FIRST:	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK	FROM TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING SB-1

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced concrete.						0							
	6-inch gray baserock.													
	Black Clay (medium to high PI), damp to moist.	CL-CH												
5	Black silty Clay (medium to high PI) with miner small gravel, very stiff, damp.	CL-CH					5	1-5	X					
10	Light brown silty Clay, damp, stiff.	CL-ML					10	1-10	X					
15	Light brown silty Clay (more clay content) (medium to high pl), moist, stiff.	CL-CH				▽	15	1-15	X					
20	Boring terminated.						20							
25							25							
30							30							
35							35							

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA		GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:
DRILLING AGENCY	Vironex, Inc.	DRILLER J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07
DRILLING EQUIPMENT	Geoprobe		COMPLETION DEPTH (ft) 20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT	HAMMER / SAMPLER 2" polyethene
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES BULK: 3 DRIVE:
TYPE OF PERFORATION		FROM TO	WATER DEPTH FIRST: / COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM TO	LOGGED BY Frank Hamedi / CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING SB-2

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	POCKET PEN. tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced concrete.						0							
	6-inch gray baserock.													
	Black Clay (medium to high PI), damp to moist.	CL-CH												
5	Black silty Clay (medium to high PI), very stiff, damp.	CL-CH					5	2-5	X					
10	Light brown silty Clay, stiff, damp.	CL-ML					10	2-10	X					
15	Light olive-brown silty Clay (medium to high PI), stiff to very stiff, damp to moist.	CL-CH					15	2-15	X					
	Light olibe-brown silty Clay (more clay content) (medium to high PI), stiff to very stiff, damp to moist.					▽								
20	Boring terminated.						20							
25							25							
30							30							
35							35							

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft) 20'	
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING				NUMBER OF SAMPLES BULK: 3	DRIVE:
TYPE OF PERFORATION		FROM	TO	WATER DEPTH FIRST:	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM	TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING SB-3

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER TYPE	POCKET PEN. tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced concrete.						0						
	6-inch gray baserock.												
5	Light brown silty Clay with miner small size gravel, stiff, damp.	CL-ML					5	3-5 ☒					
10	Light brown silty Clay with miner small pea gravel, damp to moist, stiff.	CL-ML					10	3-10 ☒					
	Light brown sandy silty Clay (medium size sand), dense, moist.	CL-ML											
15	Light olive-brown silty Sand (fine sand), very dense, moist to wet.	SM				▽	15	3-15 ☒					
20	Light brown sandy silty Clay, stiff, wet.	CL-ML					20						
	Boring terminated.												
25							25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA		GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:
DRILLING AGENCY	Vironex, Inc.	DRILLER J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07
DRILLING EQUIPMENT	Geoprobe		COMPLETION DEPTH (ft) 20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT	HAMMER / SAMPLER 2" polyethene
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES BULK: 3 DRIVE:
TYPE OF PERFORATION		FROM TO	WATER DEPTH FIRST: COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM TO	LOGGED BY Frank Hamedi / CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING SB-4

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN. tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced concrete.						0						
	6-inch gray baserock.												
	Black Clay (medium to high PI), damp, stiff.	CL-CH											
5	Dark gray silty Clay with miner small size gravel, stiff. damp.	CL-ML					5	4-5 ☒					
10	Light brown silty Clay to clayey Sill, stiff, damp to moist.	CL-ML					10	4-10 ☒					
	Light brown silty Sand (fine sand), dense, moist.	SM											
15							15	4-15 ☒					
	Light brown silty Sand (medium coarse sand with small pea gravel), wet, dense.					▽							
20	Boring terminated.						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA		GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:
DRILLING AGENCY	Vironex, Inc.	DRILLER J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07
DRILLING EQUIPMENT	Geoprobe		COMPLETION DEPTH (ft) 20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT	HAMMER — SAMPLER 2" polyethene
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES BULK: 3 DRIVE:
TYPE OF PERFORATION		FROM TO	WATER DEPTH FIRST: COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM TO	LOGGED BY Frank Hamedi CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING SB-5

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	SAMPLES: POCKET PEN. tsf	SAMPLES: BLOWS/foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	INDEX PROPERTIES: DRY DENSITY (pcf)	INDEX PROPERTIES: UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced concrete.						0						
	6-inch gray baserock.												
	Black Clay (medium to high PI), damp, stiff.	CL-CH											
5	Dark gray silty Clay, very stiff, damp.	CL-ML					5	5-5 ☒					
10	Light gray sandy silty Clay with miner small size gravel, stiff, damp to moist.	CL-ML					10	5-10 ☒					
	Olive-gray silty Clay, moist, stiff.	CL-ML											
15							15	5-15 ☒					
	Light olive-brown sandy Silt (fine sand) with miner clay,	ML				∇							
20	Boring terminated.						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA		GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:
DRILLING AGENCY	Vironex, Inc.	DRILLER J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07
DRILLING EQUIPMENT	Geoprobe		COMPLETION DEPTH (ft) 20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT	HAMMER SAMPLER 2" polyethene
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES BULK: 3 DRIVE:
TYPE OF PERFORATION		FROM TO	WATER DEPTH FIRST: COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM TO	LOGGED BY Frank Hamedi CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No 1:			No. 3:		
	No 2:			No. 4:		

LOG OF BORING SB-6

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced concrete.						0							
	6-inch gray baserock.													
	Black Clay (medium to high PI), damp, stiff.	CL-CH												
5	Black silty Clay with minor small size gravel, very stiff, damp.	CL-ML					5	6-5	X					
10	Light gray silty Clay, damp, stiff.	CL-ML					10	6-10	X					
15	Light brown silty Clay, damp to moist, stiff.	CL-ML					15	6-15	X					
						▽								
20	Boring terminated.						20							
25							25							
30							30							
35							35							

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft) 20'	
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING				NUMBER OF SAMPLES BULK: 3	DRIVE:
TYPE OF PERFORATION		FROM	TO	WATER DEPTH FIRST:	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM	TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING SB-7

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN. tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced concrete.						0						
	6-inch gray baserock.												
	Black Clay (medium to high PI), damp to moist, stiff.	CL-CH											
5	Black silty Clay, very stiff, damp.	CL-ML					5	7-5 ☒					
	Light gray sandy silty Clay with few pea gravel, damp to moist.	CL-ML											
10	Light olive-brown silty Clay with few small size gravel, stiff, damp.	CL-ML					10	7-10 ☒					
15	Light grayish-brown sandy silty Clay, moist, stiff.	CL-ML					15	7-15 ☒					
						▽							
20	Boring terminated						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft) 20'	
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING				NUMBER OF SAMPLES BULK: 4	DRIVE:
TYPE OF PERFORATION		FROM	TO	WATER FIRST DEPTH	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM	TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING SB-8

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced concrete.						0						
	6-inch gray baserock.												
	Black Clay (medium to high PI), damp, stiff.	CL-CH											
5	Black silty Clay, very stiff, damp.	CL-ML					5	8-5 ☒					
	Dark gray sandy silty Clay with few small size pea gravel, very stiff, damp.	CL-ML						8-7 ☒					
	Very dark brown silty Clay with miner sand.	CL-ML											
10	Light brown silty Sand (medium size sand), dense, moist.	SM					10	8-10 ☒					
	Dark brown silty Clay (medium to high PI), damp to moist, stiff to very stiff.	CL-CH											
	Light brown silty Clay (medium to high PI), damp to moist, stiff to very stiff.												
15	Brown sandy silty Clay, stiff, moist.	CL-ML				∇	15	8-15 ☒					
	Light brown and black medium to coarse Sand with niner clay, wet, dense.	SP-SC											
	Light brown sandy silty Clay, wet, stiff.	CL-ML											
20	Boring terminated.						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 2/02/07 DATE FINISHED: 2/02/07
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft) 20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER / SAMPLER 2" polyethene
SIZE AND TYPE OF CASING				NUMBER OF SAMPLES BULK: 3 DRIVE:
TYPE OF PERFORATION		FROM	TO	WATER DEPTH FIRST: COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM	TO	LOGGED BY Frank Hamedi CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING SB-9

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN. tsf	BLOWS/foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-reinforced concrete.						0						
	6-inch gray baserock.												
	Brown sandy gravely Clay, damp, stiff.	CL											
	Black Clay (high PI), damp, stiff.	CH											
5	Black silty Clay, damp, very stiff.	CL-ML					5	9-5 ☒					
	Olive-gray sandy Clay, damp, stiff.	CL											
10	Olive-gray silty Clay, damp, very stiff.	CL-ML					10	9-10 ☒					
	Light brown silty Clay (medium to high PI), moist, stiff to very stiff.	CL-CH											
15	Light brown sandy clayey Silt to silty sandy Clay (very fine sand), damp to moist, stiff.	CL-ML					15	9-15 ☒					
	Light brown silty Clay (medium PI), very stiff, moist.	CL-CH				▽							
20	Boring terminated.						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGU.

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA	GROUND SURFACE ELEVATION:	
		TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc. DRILLER J. McAssey	DATE STARTED:	8/22/07
		DATE FINISHED:	8/22/07
DRILLING EQUIPMENT	Geoprobe	COMPLETION DEPTH (ft)	20'
DRILLING METHOD	Rapid push hollow-stem auger DRILL BIT	HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING		NUMBER OF SAMPLES	BULK: 4 DRIVE:
TYPE OF PERFORATION	FROM TO	WATER FIRST: DEPTH	COMPL.: 24 hrs
SIZE AND TYPE OF PACK	FROM TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL: TYPE FR TO; No. 1: ; No. 2: ; No. 3: ; No. 4:

LOG OF BORING GP-1

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	8-inch Concrete.						0						
	12-inch grayish-green gravely Sand (baserock).	GP-SP											
	Black silty Clay, damp, stiff.	CL-ML											
5	Green sandy silty Clay, moist, stiff.	CL-ML					5	1-5					
	Light gray to brown silty Clay, moist, stiff.	CL-ML											
10							10	1-10					
	Light brown gravely sandy Clay, moist, stiff.	CL											
15	Light brown silty Clay, wet, medium stiff.	CL-ML					15	1-15					
20	Boring terminated.						20	1-20					
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA	GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Virenex, Inc. DRILLER J. McAssey	DATE STARTED: 8/22/07 DATE FINISHED: 8/22/07	
DRILLING EQUIPMENT	Geoprobe	COMPLETION DEPTH (ft)	20'
DRILLING METHOD	Rapid push hollow-stem auger DRILL BIT	HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING		NUMBER OF SAMPLES	BULK: 4 DRIVE:
TYPE OF PERFORATION	FROM TO	WATER FIRST: DEPTH	COMPL.: 24 hrs
SIZE AND TYPE OF PACK	FROM TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING GP-2

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Black clayey Silt (landscaping material), soft, moist.	ML					0							
	Black silty Clay, moist, stiff.	CL-ML												
5							5	2-5						
	Gray silty Clay, moist, stiff.	CL-ML												
	Light greenish gray silty Clay, moist, very stiff.													
10							10							
	Light brown sandy Clay with few pea gravel, moist, very stiff.	CL												
	Light brown clayey Sand with few pea gravel, moist, stiff.	SC												
15							15	2-15						
	Light gray to brown silty Clay, moist, very stiff.	CL-ML												
20	Boring terminated.						20	2-20						
25							25							
30							30							
35							35							

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 8/22/07 DATE FINISHED: 8/22/07	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft) 20'	
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING				NUMBER OF SAMPLES BULK: 4	DRIVE:
TYPE OF PERFORATION		FROM	TO	WATER DEPTH FIRST:	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM	TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING GP-3

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER TYPE	POCKET PEN. tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Black sandy Silt (landscaping material), moist, stiff.	ML					0						
	Black sandy Clay, moist, stiff.	CL											
	Black sandy silty Clay, moist, very stiff.	CL-ML											
5	Brown sandy Clay, moist, very dense.	CL					5	3-5					
	Olive-brown gravely sandy Clay, moist, stiff	CL											
10							10	3-10					
	Brown/gray sandy Clay to clayey Sand, moist, stiff, dense	SC											
15	Light brown clayey Sand with some gravel, moist, stiff, dense.	SC					15	3-15					
	Light brown to light gray gravely Sand with some clay.	SP-SC											
20	Boring terminated.						20	3-20					
25							25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA		GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:
DRILLING AGENCY	Vironex, Inc.	DRILLER J. McAssey	DATE STARTED: 8/22/07 DATE FINISHED: 8/22/07
DRILLING EQUIPMENT	Geoprobe		COMPLETION DEPTH (ft) 20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT	HAMMER / SAMPLER 2" polyethene
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES BULK: 4 DRIVE:
TYPE OF PERFORATION		FROM TO	WATER DEPTH FIRST / COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM TO	LOGGED BY Frank Hamedi / CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING GP-4

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN. tsf	BLOWS/foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Black sandy clayey Silt (landscaping material), moist, stiff.	ML					0						
	Black clayey Silt with some gravel, moist, stiff.	ML											
	Black silty Clay with some gravel, moist, stiff.	CL-ML											
	Light brown gravely sandy Clay, moist, stiff.	CL											
5	Brown sandy Clay, moist, stiff.	CL					5	4-5					
	Dark brown gravely sandy Clay, moist, stiff.	CL											
10							10	4-10					
	Brown silty Sand (well graded), dense, moist	SW											
	Brown gravely Sand (well graded), dense, moist.	SW											
15							15	4-15					
	Brown sandy Gravel (well graded), dense, moist.	GW											
	Light brown silty Sand with minor gravel, dense, moist.	SM											
20	Boring terminated.						20	4-20					
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

Geological Technics Inc.

Borehole Log

Project Name: Springtown Gas — Borehole No.: P1 — Page 1 of 1

Project No.: 1409.2 — Date: 9/19/2008 — Contractor: RSI Drilling

Area & County: Livermore, Alameda County, California

Field Geo/Eng: Matt Spielmann/Ezaria Nonna — Drilling Method: Hollow Stem Auger

Borehole Dia. 8" — Tot. Depth 20' — Tot. Casing Depth 20' — Casing Dia. 4" — Screened Interval 15–20'

Filter Pack 8–20' — Annular Seal 6–8' — Slot Size 0.020" — Grout 6–0' — Water Depth NM

Depth feet	Smpl. Intrvl	Sample No.	Time	Blow Count/6"	Well Details	Columnar Section	USCS Sym.	Description	Remarks OVM (ppm)
0			0810				ML	Top Soil, Silty Clay, black, moist fine grained	No Odor 0
5			0825				ML	Silty Clay, dark gray, moist, fine Grained	No Odor 0
			0840				CL	Clayey sand, dark gray, 70% fine grained, 30%medium grained, subrounded and very moist	No Odor 0
10			0850				CL	Clayey sand, olive brown, poorly graded, quartz rich with occasional gravel	No Odor 0
			0910				CL	Clayey sand with gravel, light olive brown, wet, poorly sorted	No Odor 0
			0925				SW	Gravelly sand, light olive brown, wet, quartz rich, 50% fine grained	No Odor 0
15			0940				SP	Gravelly sand, light olive brown, wet, quartz rich, subrounded	No Odor 0
			0955				CL	Clayey silt with 5% sand, olive brown, wet, fine grained	No Odor 0
20			1010				ML	Silty Clay, gray, moist, fine Grained	No Odor
25									
30									

Notes: Sand; Silt; Clay; Screen; Annular Seal; Gravel; Grout

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA	GROUND SURFACE ELEVATION:	
		TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc. DRILLER J. McAssey	DATE STARTED:	5/07/08
		DATE FINISHED:	5/07/08
DRILLING EQUIPMENT	Geoprobe	COMPLETION DEPTH (ft)	10'
DRILLING METHOD	Rapid push hollow-stem auger DRILL BIT	HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING	4-inch PVC Schedule 40	NUMBER OF SAMPLES	BULK: DRIVE:
TYPE OF PERFORATION	0.020-inch PVC Schedule 40 FROM 3' TO 10'	WATER DEPTH	FIRST: COMPL.: 24 hrs.
SIZE AND TYPE OF PACK	Sand #3 FROM 2½' TO 10'	LOGGED BY	Frank Hamedi CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	1'	No. 3:		
	No. 2: Bentonite	1'	2½'	No. 4:		

LOG OF BORING VE-1

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES NUMBER TYPE	POCKET PEN, tsf	BLOWS/foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	12-inch reinforced Concrete.						0						
	6-inch gray Baserock.												
	Black Clay (medium to high PI), damp, stiff.	CL-CH											
5	Black silty Clay, very stiff, damp.	CL-ML					5						
	Dark gray sandy silty Clay with few small size pea gravel, very stiff, damp.	CL-ML											
	Very dark brown silty Clay with minor sand	CL-ML											
10	Light brown silty Sand (medium size sand), dense, moist. Boring terminated	SM					10						
15							15						
20							20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	909 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 5/07/08 DATE FINISHED: 5/07/08	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft)	10'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING	4-inch PVC Schedule 40			NUMBER OF SAMPLES	BULK: DRIVE:
TYPE OF PERFORATION	0.020-inch slotted PVC Schedule 40	FROM 3'	TO 10'	WATER DEPTH FIRST:	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK	Sand #3	FROM 2½'	TO 10'	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	1'	No. 3:		
	No. 2: Bentonite	1'	2½'	No. 4:		

LOG OF BORING VE-2

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN. tsf	BLOWS/ foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Black clayey Silt (landscaping material), soft, moist.	ML					0						
	Black silty Clay, moist, stiff.	CL-ML											
5							5						
	Gray silty Clay, moist, stiff.	CL-ML											
	Light greenish-gray silty Clay, moist, very stiff.	CL-ML											
10	Boring terminated.						10						
15							15						
20							20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	933 Bluebell Drive, Livermore, CA			GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc.	DRILLER	J. McAssey	DATE STARTED: 5/09/08 DATE FINISHED: 5/09/08	
DRILLING EQUIPMENT	Geoprobe			COMPLETION DEPTH (ft)	25'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT		HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING				NUMBER OF SAMPLES	BULK: 3 DRIVE:
TYPE OF PERFORATION		FROM	TO	WATER FIRST: DEPTH	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM	TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING GP-5

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Light brown sandy silty Clay, moist, stiff.	CL-ML					0						
	Black silty Clay, moist, stiff.	CL-ML											
5							5	5-5					
	Dark brown silty Clay, moist, stiff.												
	Light brown silty Clay, moist, stiff.												
10							10	5-10					
	Light brown to light gray silty Clay (high PI), moist, stiff.	CL-ML											
15							15	5-15					
						▽							
	Light brown silty Clay (high PI), very stiff, moist.												
20							20						
25	Boring terminated.						25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION: 940 Larkspur Drive, Livermore, CA		GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY: Vironex, Inc.	DRILLER: J. McAssey	DATE STARTED: 5/09/08 DATE FINISHED: 5/09/08	
DRILLING EQUIPMENT: Geoprobe		COMPLETION DEPTH (ft): 20'	
DRILLING METHOD: Rapid push hollow-stem auger	DRILL BIT	HAMMER	SAMPLER: 2" polyethene
SIZE AND TYPE OF CASING		NUMBER OF SAMPLES: BULK: 3	DRIVE:
TYPE OF PERFORATION	FROM TO	WATER FIRST: DEPTH	COMPL.: 24 hrs.
SIZE AND TYPE OF PACK	FROM TO	LOGGED BY: Frank Hamedi	CHECKED BY: Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING GP-7

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN, tsf	BLOWS/ foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Black silty Clay (high PI), very stiff, moist.	CL-ML					0						
	Light brown silty Clay, moist, stiff.												
5							5	7-5					
10	Dark brown silty Clay, moist, stiff.	CL-ML					10	7-10					
	Light brown sandy silty Clay, moist, stiff.	CL-ML				▽							
15	Gray/white coarse Sand with some small pea gravel, dense, wet.	SP					15	7-15					
	Light brown sandy silty Clay, moist, stiff.	CL-ML											
20	Boring terminated.						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	940 Larkspur Drive, Livermore, CA		GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:
DRILLING AGENCY	Vironex, Inc.	DRILLER J. McAssey	DATE STARTED: 5/09/08 DATE FINISHED: 5/09/08
DRILLING EQUIPMENT	Geoprobe		COMPLETION DEPTH (ft) 20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT	HAMMER SAMPLER 2" polyethene
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES BULK: 3 DRIVE:
TYPE OF PERFORATION		FROM TO	WATER DEPTH FIRST: COMPL.: 24 hrs.
SIZE AND TYPE OF PACK		FROM TO	LOGGED BY Frank Hamedi CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING GP-8

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN, tsf	BLOWS/foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Light brown silty Sand, dry, dense.	SM					0						
	Black silty Clay, moist, stiff.	CL-ML											
	Light brown silty Clay, very moist, stiff.												
5							5	B-5					
10	Light brown sandy Silt to silty Sand, dense, wet	SM					10	B-10					
						▽							
15							15	B-15					
20	Boring terminated.						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	940 Larkspur Drive, Livermore, CA	GROUND SURFACE ELEVATION:	
		TOP OF WELL CASING ELEVATION:	
DRILLING AGENCY	Vironex, Inc. DRILLER J. McAssey	DATE STARTED:	5/09/08
		DATE FINISHED:	5/09/08
DRILLING EQUIPMENT	Geoprobe	COMPLETION DEPTH (ft)	20'
DRILLING METHOD	Rapid push hollow-stem auger DRILL BIT	HAMMER	SAMPLER 2" polyethene
SIZE AND TYPE OF CASING		NUMBER OF SAMPLES	BULK: 3 DRIVE:
TYPE OF PERFORATION	FROM TO	WATER FIRST: DEPTH	COMPL.: 24 hrs
SIZE AND TYPE OF PACK	FROM TO	LOGGED BY Frank Hamedi	CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING GP-9

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	POCKET PEN, tsf	BLOWS/ foot	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Chocolate-brown to black silty Clay, moist, stiff.	CL-ML					0						
	Light brown gravely sandy Silt, dense, moist.	ML											
5							5	9.5					
	Light brown silty Clay, moist, stiff.	CL-ML											
10							10	9.10					
						▽							
15							15	9.15					
	Light brown sandy Gravel, dense, moist.	GP											
20	Boring terminated.						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS | PROJECT NO. 10-93-567-ST | FIGURE:

ENVIRO SOIL TECH CONSULTANTS

BORING LOCATION	940 Larkspur Drive, Livermore, CA		GROUND SURFACE ELEVATION: TOP OF WELL CASING ELEVATION:
DRILLING AGENCY	Vironex, Inc.	DRILLER J. McAssey	DATE STARTED: 5/09/08 DATE FINISHED: 5/09/08
DRILLING EQUIPMENT	Geoprobe		COMPLETION DEPTH (ft) 20'
DRILLING METHOD	Rapid push hollow-stem auger	DRILL BIT	HAMMER SAMPLER 2" polyethene
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES BULK: 3 DRIVE:
TYPE OF PERFORATION		FROM TO	WATER DEPTH FIRST: COMPL.: 24 hrs
SIZE AND TYPE OF PACK		FROM TO	LOGGED BY Frank Hamedi CHECKED BY Lawrence Koo

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF BORING GP-10

DEPTH (feet)	MATERIAL DESCRIPTION	USCS	SOIL GRAPHIC	WELL GRAPHIC	PID, ppm	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER TYPE	SAMPLES: POCKET PEN, tsf	SAMPLES: BLOWS/ foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	INDEX PROPERTIES: DRY DENSITY (pcf)	INDEX PROPERTIES: UNCONFINED COMPRESSIVE STRENGTH (psf)
0	Light brown silty Sand, dry, dense.	SM					0						
	Black silty Clay, moist, stiff.	CL-ML											
	Light brown silty Clay, moist, stiff.	CL-ML											
5							5	10-5					
10	Light brown sandy silty Clay, moist, stiff.	CL-ML					10	10-10					
						▽							
15	Light brown silty Clay (high PI), moist, very stiff.	CL-ML					15	10-15					
20	Boring terminated.						20						
25							25						
30							30						
35							35						

SPRINGTOWN GAS	PROJECT NO. 10-93-567-ST	FIGURE:

Appendix C

Chemical of Concern Data Sheets

Chemical Fact Sheet

Chemical Abstract Number (CAS #)	1634044
Synonyms	Methyl tert-butyl ether
	MTBE
Analytical Method	EPA Method 524.2
Molecular Formula	$C_5H_{12}O$
Use	Octane booster in gasoline. Manufacture of isobutene Unleaded gasoline usually contains additives for octane improvement including methyl tert-butyl ether (MTBE).
Consumption Patterns	Gasoline octane component, 100%. CHEMICAL PROFILE: Methyl tert-butyl ether. Demand: 1988: 65,500 barrels per day; 1989: 72,500 barrels per day; 1993 projected/: 90,000 barrels per day (average daily consumption; foreign trade is negligible).
Apparent Color	Colorless liquid
Boiling Point	55.2 DEG C
Melting Point	FP: -109 DEG C
Molecular Weight	88.15
Density	0.7405 @ 20 DEG C/4 DEG C
Environmental Impact	t-Butyl methyl ether may be released as a result of its use as an octane booster for unleaded gasoline and its use in the manufacture of isobutene. If t-butyl methyl ether is released to soil, it will be subject to volatilization. It will be expected to exhibit very high mobility in soil and, therefore, it may leach to groundwater. It will not be expected to hydrolyze in soil. If t-butyl methyl ether is released to water, it will not be expected to significantly adsorb to sediment or suspended particulate matter, bioconcentrate in aquatic organisms, hydrolyze, directly photolyze, or photooxidize via reaction with photochemically produced hydroxyl radicals in the water, based upon estimated physical-chemical properties or analogies to other structurally related aliphatic ethers. t-Butyl methyl ether in surface water will be subject to rapid volatilization with estimated half-lives of 4.1 hr and 2.0 days for volatilization from a river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec and a model pond, respectively. It may be resistent to biodegradation in environmental media based upon screening test data from a study using activated sludge inocula. Many ethers are known to be resistant to biodegradation. If t-butyl methyl ether is released to the atmosphere, it will be expected to exist almost entirely in the vapor phase based on its vapor pressure. It will be susceptible to photoxidation via vapor phase reaction with photochemically produced hydroxyl radicals with an estimated half-life of 5.6 days for this process. Direct photolysis will not be an important removal process since aliphatic

	ethers do not adsorb light at wavelenghts >290 nm. The most probable route of general population exposure to t-butyl methyl ether is probably via inhalation of contaminated air. Exposures through dermal contact may occur in occupational settings. .
Environmental Fate	TERRESTRIAL FATE: If t-butyl methyl ether is released to soil, it will be subject to volatilization based upon a reported Henry's Law constant of 5.87X10-4 atm-cu m/mole and vapor pressure of 249 mm Hg at 25 deg C . It will be expected to exhibit very high mobility(5,SRC) in soil and, therefore, it may leach to groundwater, based upon an estimated Koc of 11.2(3,4,SRC). It will not be expected to hydrolyze in soil . Butyl methyl ether may be resistent to biodegradation in soil based upon screening test data from a study using activated sludge inocula(6,SRC). Many ethers are known to be resistant to biodegradation(7). AQUATIC FATE: If t-butyl methyl ether is released to water, it will not be expected to significantly adsorb to sediment or suspended particulate matter(1,2,SRC), bioconcentrate in aquatic organisms(1,2,SRC), hydrolyze , directly photolyze , or photooxidize via reaction with photochemically produced hydroxyl radicals in the water , based upon estimated physical-chemical properties or analogies to other structurally related aliphatic ethers(1-3,SRC). t-Butyl methyl ether in surface water will be subject to rapid volatilization(2,5,SRC). Using a reported Henry's Law constant of 5.87X10-4 atm-cu m/mole , a half-life for volatilization of t-butyl methyl ether from a river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec has been estimated to be 4.1 hr at 25 deg C(2,SRC). The volatilization half-life from a model pond, which considers the effect of adsorption, has been estimated to be 2.0 days(6). t-Butyl methyl ether may be resistent to biodegradation in environmental media based upon screening test data from a study using activated sludge inocula (7,SRC). Many ethers are known to be resistant to biodegradation(8). ATMOSPHERIC FATE: If t-butyl methyl ether is released to the atmosphere, it will be expected to exist almost entirely in the vapor phase based upon a reported vapor pressure of 249 mm Hg at 25 deg C . It will be susceptible to photooxidation via vapor phase reaction with photochemically produced hydroxyl radicals. An atmospheric half-life of 5.6 days at an atmospheric concentration of 5X10 5 hydroxyl radicals per cu cm has been calculated for this process based upon a measured rate constant(1,SRC). Direct photolysis will not be an important removal process since aliphatic ethers do not absorb light at wavelengths >290 nm .
Drinking Water Impact	GROUNDWATER: t-Butyl methyl ether has been detected at concn up to 50 ppb in the Old Bridge aquifer under an industrial plant in South Brunswick Township, NJ (no sampling dates specified) . A contamination abatement system installed at this aquifer, including 7 extraction wells and a water treatment facility, reduced the t-butyl methyl ether concn by an estimated 26% .

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OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR tert-BUTYL ALCOHOL

INTRODUCTION

This guideline summarizes pertinent information about tert-butyl alcohol for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

* Formula

C(4)H(10)O

* Structure

(For Structure, see paper copy)

* Synonyms

tert-Butanol; 2-methyl-2-propanol; TBA; t-butyl hydroxide; 1,1-dimethylethanol; trimethylmethanol; trimethylcarbinol.

* Identifiers

1. CAS 75-65-0.

2. RTECS EO1925000.

3. DOT UN: 1120 26.

4. DOT label: Flammable Liquid.

* Appearance and odor

At room temperature, tert-butyl alcohol is a colorless, crystalline solid that has a camphor-like odor; this substance melts to form a volatile liquid at 25.6 degrees C (78.1 degrees F).

CHEMICAL AND PHYSICAL PROPERTIES

* Physical data

1. Molecular weight: 74.1.

2. Boiling point (760 torr): 82.4 degrees C (180 degrees F).

3. Specific gravity (water = 1): 0.79 at 20 degrees C (68 degrees F).

4. Vapor density (air = 1 at boiling point of tert-butyl alcohol): 2.55.

5. Melting point: 25.6 degrees C (78.1 degrees F).

6. Vapor pressure at 20 degrees C (68 degrees F): 13 torr.

7. Solubility: Soluble in water; miscible with alcohol and ether.

8. Evaporation rate (butyl acetate = 1): 1.05.

* Reactivity

1. Conditions contributing to instability: Heat, sparks, and open flame.

2. Incompatibilities: Contact of tert-butyl alcohol with oxidizing agents, strong mineral acids, or strong hydrochloric acid causes fires and explosions.

3. Hazardous decomposition products: Toxic gases (such as carbon monoxide or isobutylene) may be released when tert-butyl alcohol decomposes in contact with strong mineral acids.

4. Special precautions: None.

* Flammability

The National Fire Protection Association has assigned a flammability rating of 3 (dangerous fire hazard) to tert-butyl alcohol.

1. Flash point: 11 degrees C (52 degrees F).

2. Autoignition temperature: 478 degrees C (892 degrees F).

3. Flammable limits in air (percent by volume): Lower, 2.4; upper, 8.0.

4. Extinguishant: Use dry chemical, carbon dioxide, alcohol foam, or water fog to fight fires involving tert-butyl alcohol. Blanket the fire to smother it. Water may be ineffective in extinguishing the fire, but a water spray may be used to cool fire-exposed containers. If a leak or spill has not ignited, water spray may be used to disperse vapors and to dilute spills to a nonflammable mixture.

Fires involving tert-butyl alcohol should be fought upwind and from the maximum distance possible. Keep unnecessary people away; isolate hazard area and deny entry. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Vapors may travel to a source of ignition and then flash back. Vapor explosions may occur indoors, outdoors, or in sewers. Containers of tert-butyl alcohol may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if a rising sound from a venting safety device is heard or if there is discoloration of a container due to fire. Dikes should be used to contain fire-control water for later disposal. If a tank car or truck is involved in a fire, personnel should isolate an area of a half a mile in all directions. Firefighters should wear a full set of protective clothing, including a self-contained breathing apparatus, when fighting fires involving tert-butyl alcohol. Firefighters' protective clothing may provide limited protection against fires involving tert-butyl alcohol.

* Warning properties

The average air odor detection threshold for tert-butyl alcohol is 960 parts per million (ppm) parts of air. Because this value is above the Occupational Safety and Health Administration (OSHA) current permissible exposure limit (PEL) of 100 ppm [29 CFR 1910.1000, Table Z-1-A], tert-butyl alcohol is considered to have inadequate warning properties for the purpose of respirator selection.

* Eye irritation properties

No information is available on the specific concentration of tert-butyl alcohol that causes eye irritation in humans; however, this substance is known to cause eye irritation at high but unspecified concentrations.

EXPOSURE LIMITS

The current OSHA PEL for tert-butyl alcohol is 100 ppm (300 milligrams per cubic meter (mg/m^3)) as an 8-hour time-weighted average (TWA) concentration and 150 ppm (450 mg/m^3) as a 15-minute short-term exposure limit (STEL). A STEL is the maximum 15-minute concentration to which workers may be exposed during any 15-minute period of the working day [29 CFR 1910.1000, Table Z-1-A]. The National Institute for Occupational Safety and Health (NIOSH) has not issued a recommended exposure limit (REL) for tert-butyl alcohol; however, NIOSH concurs with the PEL established for this substance by OSHA [NIOSH 1988]. The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned tert-butyl alcohol a threshold limit value (TLV) of 100 ppm (303 mg/m^3) as a TWA for a normal 8-hour workday and a 40-hour workweek and a short-term exposure limit (STEL) of 150 ppm (455 mg/m^3) for periods not to exceed 15 minutes [ACGIH 1989, p. 14]. The OSHA and ACGIH limits are based on the risk of narcotic effects associated with exposure to tert-butyl alcohol.

HEALTH HAZARD INFORMATION

* Routes of exposure

Exposure to tert-butyl alcohol can occur via inhalation, ingestion, and eye or skin contact.

* Summary of toxicology

1. Effects on Animals: tert-Butyl alcohol causes narcosis in animals exposed to high concentrations. The oral LD(50) in rats is 3500 mg/kg [RTECS 1990]. Acutely poisoned animals showed behavioral effects, ataxia, and other narcotic signs before death [RTECS 1990; Proctor, Hughes, and Fischman 1988, p. 108]. tert-Butyl alcohol is reported to have a stronger narcotic effect on mice than other butyl alcohols [ACGIH 1986, p. 78]. Rats given nontoxic doses of tert-butyl alcohol (0.0163 mol/kg) showed a marked decline in performance test scores; tert-butyl alcohol caused a narcotic effect estimated to be 4.8 times greater than that of ethanol [Clayton and Clayton 1982, p. 4587]. Prolonged contact of tert-butyl alcohol with the skin of rabbits caused no irritation [Clayton and Clayton 1982, p. 4587]. Long-term exposure to low (not further specified) concentrations of tert-butyl alcohol caused no observable effects in experimental animals [ACGIH 1986, p. 78].

2. Effects on Humans: tert-Butyl alcohol causes eye, skin, and mucous membrane irritation in humans; at high concentrations, it causes narcosis. In contact with the skin of humans, tert-butyl alcohol caused slight redness and hyperemia; prolonged skin contact may cause contact dermatitis [Clayton and Clayton 1982, p. 4587; HSDB 1985]. Exposure to "excessive" (not further specified) concentrations is reported to have caused eye, nose, and throat irritation, headache, nausea, fatigue, and dizziness in humans [Clayton and Clayton 1982, p. 4587].

* Signs and symptoms of exposure

1. Acute exposure: The signs and symptoms of acute exposure to tert-butyl alcohol include irritation and redness of the eyes, runny nose, and scratchy throat; headache; nausea; fatigue; dizziness; and redness and drying of the skin.

2. Chronic exposure: The signs and symptoms of chronic exposure to tert-butyl alcohol include defatting of the skin and dermatitis.

* Emergency procedures:

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate the following emergency procedures:

1. Eye exposure: If tert-butyl alcohol or a solution containing this substance gets into the eyes, immediately flush the eyes with large amounts of water for a minimum of 15 minutes, lifting the lower and upper lids occasionally. If irritation persists, get medical attention as soon as possible.

2. Skin exposure: If tert-butyl alcohol or a solution containing this substance contacts the skin, the contaminated skin should be washed with soap and water. If irritation persists, get medical attention.

3. Inhalation: If the vapors of tert-butyl alcohol are inhaled, move the victim at once to fresh air and get medical care as soon as possible. If the victim is not breathing, perform cardiopulmonary resuscitation; if breathing is difficult, give oxygen. Keep the victim warm and quiet until medical help arrives.

4. Ingestion: If tert-butyl alcohol or a solution containing this substance is ingested, give the victim several glasses of water to drink and then induce vomiting by having the victim touch the back of the throat with the finger or by giving syrup of ipecac as directed on the package. Do not force an unconscious or convulsing person to drink liquids or to vomit. Get medical help immediately. Keep the victim warm and quiet until medical help arrives.

5. Rescue: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the Material Safety Data Sheet required by OSHA's Hazard Communication Standard, 29 CFR 1910.1200). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve tert-butyl alcohol and lead to worker exposures to this substance:

* Use as a solvent for paints, lacquers, varnishes, natural and synthetic resins, gums, vegetable oils, dyes, camphor, and alkaloids, and as an octane booster in unleaded gasoline
* Manufacture of artificial leather, safety glass, rubber and plastic cements, shellac, raincoats, photographic films, flotation agents, fruit essences, perfumes, cellulose esters, lacquers, paint removers, and plastics
* Use as a denaturant for alcohol and as a chemical intermediate in the manufacture of methyl methacrylate and pharmaceuticals

Methods that are effective in controlling worker exposures to tert-butyl alcohol, depending on the feasibility of implementation, are

* Process enclosure,
* Local exhaust ventilation,
* General dilution ventilation, and
* Personal protective equipment.

The following publications are good sources of information on control methods:

1. ACGIH [1986]. Industrial ventilation--a manual of recommended practice. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

2. Burton DJ [1986]. Industrial ventilation--a self study companion. Cincinnati, OH:

American Conference of Governmental Industrial Hygienists.

3. Alden JL, Kane JM [1982]. Design of industrial ventilation systems. New York, NY: Industrial Press, Inc.

4. Wadden RA, Scheff PA [1987]. Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.

5. Plog BA [1988]. Fundamentals of industrial hygiene. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety or health, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the period of employment, and (3) at the time of job transfer or termination.

* Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to tert-butyl alcohol, the examining physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, and respiratory tract. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by NIOSH and the American Thoracic Society.

A preplacement medical evaluation is recommended to assess an individual's suitability for employment at a specific job and to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to tert-butyl alcohol at or below the prescribed exposure limit. The examining physician should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the eyes, skin, or respiratory tract.

* Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to tert-butyl alcohol exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of tert-butyl alcohol on the eyes, skin, or respiratory system. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for tert-butyl alcohol.

* Medical examinations recommended at the time of job transfer or termination

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT PROCEDURES

Determination of a worker's exposure to airborne tert-butyl alcohol is made using charcoal tubes (100/50 mg sections, 20/40 mesh). Samples are collected at a maximum flow rate of 0.2 liter per minute until a maximum air volume of 10 liters is collected (for TWA monitoring) or a maximum air volume of 3 liters is collected (for STEL monitoring). The sample is then desorbed with carbon disulfide/2-butanol (99:1) or with carbon disulfide/dimethylformamide (99:1) to extract the tert-butyl alcohol. Analysis is conducted by gas chromatography using a flame ionization detector. The limit of detection for this procedure is 0.01 mg per sample. This method is described in the **OSHA Computerized Information System** [OSHA 1990] and in NIOSH Method 1400 [Alcohols I] [NIOSH 1984].

PERSONAL HYGIENE PROCEDURES

If tert-butyl alcohol contacts the skin, workers should flush the affected areas immediately with plenty of water for 15 minutes, followed by washing with soap and water.

Clothing contaminated with tert-butyl alcohol should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of tert-butyl alcohol, particularly its potential to be irritating to the skin.

A worker who handles tert-butyl alcohol should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, or using toilet facilities.

Workers should not eat, drink, or use tobacco products in areas where tert-butyl alcohol is handled, processed, or stored.

STORAGE

tert-Butyl alcohol should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's Hazard Communication Standard [29 CFR 1910.1200]. Containers of tert-butyl alcohol should be protected from physical damage and should be stored separately from strong oxidizers, strong mineral acids, strong hydrochloric acid, heat, sparks, and open flame. Drums must be equipped with self-closing valves, pressure-vacuum bungs, and flame arrestors. Only nonsparking tools and equipment may be used to handle tert-butyl alcohol. To prevent static sparks, containers of tert-butyl alcohol should be grounded and bonded for transfers. Because containers that formerly contained tert-butyl alcohol may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving tert-butyl alcohol, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.

2. Notify safety personnel.

3. Remove all sources of heat and ignition.

4. Ventilate potentially explosive atmospheres.

5. Water spray may be used to reduce vapors, but the spray may not prevent ignition in closed spaces.

6. For small liquid spills, take up with sand or other noncombustible absorbent material and place into closed containers for later disposal.

7. For large liquid spills, build dikes far ahead of the spill to contain the tert-butyl alcohol for later reclamation or disposal.

EMERGENCY PLANNING, COMMUNITY RIGHT-TO-KNOW, AND HAZARDOUS WASTE

MANAGEMENT REQUIREMENTS

The Environmental Protection Agency's (EPA's) regulatory requirements for emergency planning, community right-to-know, and hazardous waste management may vary over time. Users are therefore advised to determine periodically whether new information is available.

* Emergency planning requirements

tert-Butyl alcohol is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) (Title III).

* Reportable quantity requirements (releases of hazardous substances)

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR Part 355.40] to notify the National Response Center of an accidental release of tert-butyl alcohol; there is no reportable quantity for this substance.

* Community right-to-know requirements

Employers who own or operate facilities in SIC codes 20-39 that employ 10 or more employees and that manufacture 25,000 pounds or more of tert-butyl alcohol per calendar year or otherwise use 10,000 pounds or more of tert-butyl alcohol per calendar year are required by EPA [40 CFR Part 372.30] to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of tert-butyl alcohol emitted or released from their facility annually.

* Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity, as defined in 40 CFR 261.21-261.24. Under the Resource Conservation and Recovery Act (RCRA), EPA has specifically listed many chemical wastes as hazardous. Although tert-butyl alcohol is not specifically listed as a hazardous waste under RCRA, EPA requires employers to treat any waste as hazardous if it exhibits any of the characteristics discussed above.

Providing more information about the removal and disposal of specific chemicals is beyond the scope of this guideline. EPA, U.S. Department of Transportation, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (202) 382-3000 (in Washington, D.C.) or toll-free at (800) 424-9346 (outside Washington, D.C.). In addition, relevant State and local authorities should be contacted for information on any requirements they may have for the waste removal and disposal of this substance.

RESPIRATORY PROTECTION

* Conditions for respirator use

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of tert-butyl alcohol exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

* Respiratory protection program

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's Respiratory Protection Standard [29 CFR 1910.134]. Such a program must include respirator selection (see Table 1), an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information on the selection and use of respirators and on the medical screening of respirator users, consult the **NIOSH Respirator Decision Logic** and the **NIOSH Guide to Industrial Respiratory Protection**.

Table 1 lists the respiratory protection that NIOSH recommends for workers exposed to tert-butyl alcohol. The recommended protection may vary over time because of changes in the exposure limit for tert-butyl alcohol or in respirator certification requirements. Users are therefore advised to determine periodically whether new information is available.

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent skin contact with tert-butyl alcohol. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. Butyl rubber has been recommended for use against permeation by tert-butyl alcohol and may provide protection for periods greater than 8 hours. Polyethylene ethylene/vinyl alcohol may withstand permeation for more than 4 but fewer than 8 hours.

If tert-butyl alcohol is dissolved in water or an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or faceshields should be worn during operations in which tert-butyl alcohol might contact the eyes (e.g., through splashes of solution). Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with tert-butyl alcohol. Contact lenses should not be worn if the potential exists for tert-butyl alcohol exposure.

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Table 1.
NIOSH recommended respiratory protection for workers exposed to tert-butyl alcohol*

Condition	Minimum respiratory protection**
Airborne concentration of tert-butyl alcohol:	
100 to 1000(+) ppm (10 × PEL)	Any supplied-air respirator equipped with a half mask and operated in a demand (negative-pressure) mode
100 to 2500 ppm (25 × PEL)	Any supplied-air respirator equipped with a hood or helmet and operated in a continuous-flow mode
100 to 5000(++) ppm (50 × PEL)	Any supplied-air respirator equipped with a full facepiece and operated in a demand (negative-pressure) mode, or Any supplied-air respirator equipped with a tight-fitting facepiece and operated in a continuous-flow mode, or Any self-contained respirator equipped with a full facepiece and operated in a demand (negative-pressure) mode, or Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode
Entry into unknown concentrations	Any self-contained respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode, or Any supplied-air respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure

	mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode
Firefighting	Any self-contained respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode
Escape	Any air-purifying, full-facepiece respirator equipped with an organic vapor canister, or Any escape-type, self-contained breathing apparatus with a suitable service life (number of minutes required to escape the environment)

* The OSHA PEL is 100 ppm (300 mg/m^3) as an 8-hour TWA. No NIOSH REL has been issued.
** Only NIOSH/MSHA-approved equipment should be used. Also note the following:

1. Respirators accepted for use at higher concentrations may be used at lower concentrations; respirators must not, however, be used at concentrations higher than those for which they are approved.

2. Air-purifying respirators may not be used in oxygen-deficient atmospheres.

(+) tert-Butyl alcohol is reported to cause eye irritation or damage; eye protection may be required.
(++) Represents 25 percent of the lower explosive limit.

Occupational Safety & Health Administration
200 Constitution Avenue, NW
Washington, DC 20210

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

CONTENTS

RELATED RESOURCES

ToxFAQ™ 47k
ToxFAQ™ en Español 25k
Public Health Statement 114k
Toxicological Profile 8.3MB

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ATSDR RESOURCES

ToxFAQs™
ToxFAQs™ en Español
Public Health Statements
Toxicological Profiles

August 1999

ToxFAQs™
for
Total Petroleum Hydrocarbons (TPH)

(Hidrocarburos Totales de Petróleo (TPH))

This fact sheet answers the most frequently asked health questions about total petroleum hydrocarbons (TPH). For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: TPH is a mixture of many different compounds. Everyone is exposed to TPH from many sources, including gasoline pumps, spilled oil on pavement, and chemicals used at home or work. Some TPH compounds can affect your nervous system, causing headaches and dizziness. TPH has been found in at least 23 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are total petroleum hydrocarbons (TPH)?

Total petroleum hydrocarbons (TPH) is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil. Crude oil is used to make petroleum products, which can contaminate the environment. Because there are so many different chemicals in crude oil and in other petroleum products, it is not practical to measure each one separately. However, it is useful to measure the total amount of TPH at a site.

TPH is a mixture of chemicals, but they are all made mainly from hydrogen and carbon, called hydrocarbons. Scientists divide TPH into groups of petroleum hydrocarbons that act alike in soil or water. These groups are called petroleum hydrocarbon fractions. Each fraction contains many individual chemicals.

Some chemicals that may be found in TPH are hexane, jet fuels, mineral oils, benzene, toluene, xylenes, naphthalene, and fluorene, as well as other petroleum products and gasoline components.

Minimum Risk Levels
MMGs
MHMIs
Interaction Profiles
Priority List of Hazardous Substances
Division of Toxicology

However, it is likely that samples of TPH will contain only some, or a mixture, of these chemicals.

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What happens to total petroleum hydrocarbons (TPH) when they enter the environment?

- TPH may enter the environment through accidents, from industrial releases, or as byproducts from commercial or private uses.
- TPH may be released directly into water through spills or leaks.
- Some TPH fractions will float on the water and form surface films.
- Other TPH fractions will sink to the bottom sediments.
- Bacteria and microorganisms in the water may break down some of the TPH fractions.
- Some TPH fractions will move into the soil where they may stay for a long time.

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How might I be exposed to total petroleum hydrocarbons (TPH)?

- Everyone is exposed to TPH from many sources.
- Breathing air at gasoline stations, using chemicals at home or work, or using certain pesticides.
- Drinking water contaminated with TPH.
- Working in occupations that use petroleum products.
- Living in an area near a spill or leak of petroleum products.
- Touching soil contaminated with TPH.

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How can total petroleum hydrocarbons (TPH) affect my health?

Some of the TPH compounds can affect your central nervous system. One compound can cause headaches and dizziness at high levels in the air. Another compound can cause a nerve disorder called "peripheral neuropathy," consisting of numbness in the feet and legs. Other TPH compounds can cause effects on the blood, immune system, lungs, skin, and eyes.

Animal studies have shown effects on the lungs, central nervous system, liver, and kidney from exposure to TPH compounds. Some TPH compounds have also been shown to affect reproduction and the developing fetus in animals.

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How likely are total petroleum hydrocarbons (TPH) to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that one TPH compound (benzene) is carcinogenic to humans. IARC has determined that other TPH compounds (benzo

[a]pyrene and gasoline) are probably and possibly carcinogenic to humans. Most of the other TPH compounds are considered not to be classifiable by IARC.

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Is there a medical test to show whether I've been exposed to total petroleum hydrocarbons (TPH)?

There is no medical test that shows if you have been exposed to TPH. However, there are methods to determine if you have been exposed to some TPH compounds. Exposure to kerosene can be determined by its smell on the breath or clothing. Benzene can be measured in exhaled air and a breakdown product of benzene can be measured in urine. Other TPH compounds can be measured in blood, urine, breath, and some body tissues.

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Has the federal government made recommendations to protect human health?

There are no regulations or advisories specific to TPH. The following are recommendations for some of the TPH fractions and compounds:

The EPA requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the EPA.

The Occupational Safety and Health Administration has set an exposure limit of 500 parts of petroleum distillates per million parts of air (500

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Glossary

Carcinogenicity: Ability to cause cancer.

CAS: Chemical Abstracts Service.

Immune system: Body organs and cells that fight disease.

Pesticides: Chemicals used to kill pests.

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References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological Profile for total petroleum hydrocarbons (TPH). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 1-888-42-ATSDR (1-888-422-8737)
FAX: (770)-488-4178
Email: ATSDRIC@cdc.gov

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ATSDR Information Center / ATSDRIC@cdc.gov / 1-888-422-8737

This page was updated on August , 2008

Appendix D

Receptor Well Survey Data

STATE OF CALIFORNIA – THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF WATER RESOURCES

CENTRAL DISTRICT
901 P STREET, 3RD FLOOR
SACRAMENTO, CA 95814-6424

November 17, 2008

Ms. Viola Duran
Geological Technics Incorporated
1101 7th Street
Modesto, California 95354

To Ms. Duran:

In response to your request, enclosed is a copy of the Well Completion Report for the well at the following location:

Township 03 South, Range 02 East, Section 3 (H5)

Number E067945

If you need any additional information or have any questions, please contact Anne Roth at (916) 651-0753 or fax (916) 651-0726.

Sincerely,

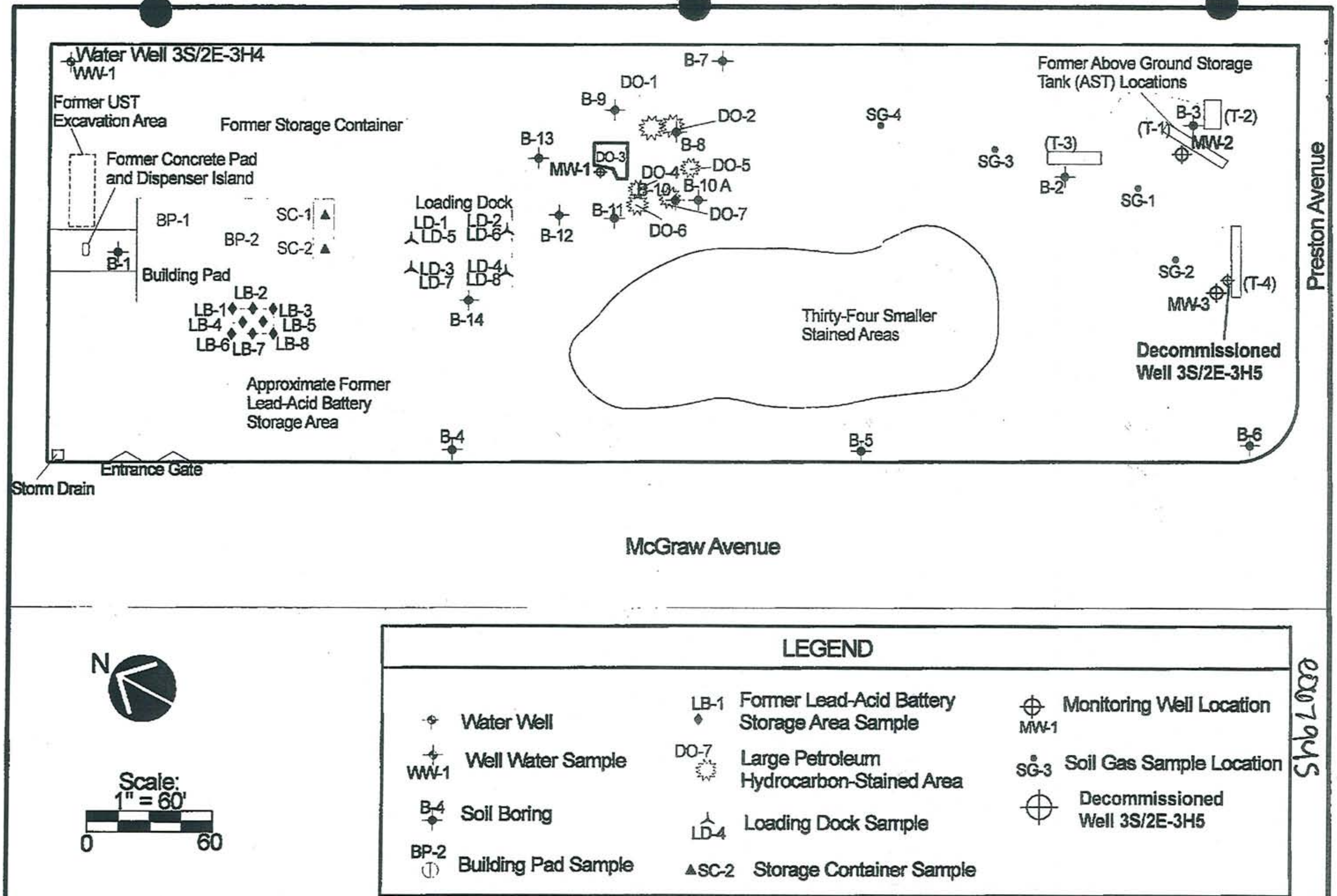
Juan M. Escobar, Chief
Groundwater Supply Assessment and
Special Studies Section

Enclosures

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED



Environmental Investigation Services, Inc.
170 Knowles Drive, Suite 212, Los Gatos, California 95032
Phone: (408) 871-1470 Fax: (408) 871-1520

Project Number 717-3I

January 31, 2008

Figure 1

Site Plan with Decommissioned Well
461 McGraw Avenue
Livermore, California

Liz Emmons

From: Hong, Wyman [WHong@zone7water.com]
Sent: Thursday, November 13, 2008 3:13 PM
To: Liz Emmons
Subject: Well Location Map
Attachments: 909 Bluebell Dr.pdf

Liz,

Attached is a well location map for the area near (2000 ft. radius) 909 Bluebell Drive in Livermore that you requested.

Legend
Blue triangle – water supply well
Red diamond – monitoring well
Blue dot circle – cathodic protection or unknown
Yellow cross – abandoned well
All open symbols – destroyed wells

Wyman Hong
Water Resources Specialist
Zone 7 Water Agency
100 North Canyons Parkway
Livermore, CA 94551
Direct Phone: (925) 454-5056
Mobile Phone: (925) 998-2350

	ZONE 7 WATER AGENCY **100 NORTH CANYONS PARKWAY** **LIVERMORE, CA 94551**	**WELL LOCATION MAP**	**SCALE: 1"= 700 ft** **DATE: 11/13/08** **909 BLUEBELL DR**

DRILLER NA	DATE COMPL	SEAL DEPTH	LOG	PERF U	PERF L	DEPTH DRIL	DATE DESTR
USGS HEW		0	1	44.0	49.0	0.0	
GW TECHNOLOGY	12/6/1989	0	1	5.0	20.0	20.0	1/19/1996
GW TECHNOLOGY	12/6/1989	4	1	4.5	24.0	25.0	12/19/2002
WEISS ASSOCIATES	10/20/1992	0	0	8.0	33.0	33.0	
WEISS ASSOCIATES	10/20/1992	0	0	7.0	12.0	19.0	
WEISS ASSOCIATES	10/20/1992	0	0	16.0	18.0	19.0	
ACME DRILLING	3/25/1956	0	2	30.0	135.0	240.0	4/18/1986
EARTH SYSTEMS	6/7/1994	0	0	10.0	20.0	20.0	8/10/1995
USGS HEW		0	1	50.0	55.0	0.0	
KAPREALIAN	10/26/1989	0	0	0.0	0.0	28.0	
KAPREALIAN	10/26/1989	0	0	0.0	0.0	27.0	
KAPREALIAN	10/26/1989	0	0	0.0	0.0	26.0	
KAPREALIAN	10/26/1989	0	0	0.0	0.0	26.0	
KALDVEER ASSOCIATES	11/20/1989	0	0	0.0	0.0	32.0	
GRNDWTR. TECH.	10/2/1995	0	1	10.0	25.0	26.5	12/11/2006
GRNDWTR. TECH.	10/2/1995	0	1	10.0	25.0	26.5	12/11/2006
GW TECHNOLOGY	11/10/1986	0	1	5.0	25.0	25.0	1/19/1996
GROUNDWATER TEC	9/10/1985	4	1	5.0	20.0	27.0	12/19/2002
GROUNDWATER TEC	6/20/1985	3	1	5.0	20.0	25.0	12/19/2002
GROUNDWATER TEC	6/20/1985	3	1	4.0	20.0	25.0	12/19/2002
GROUNDWATER TEC	6/20/1985	3	1	4.0	20.0	25.0	12/19/2002
GROUNDWATER TEC	11/10/1986	4	1	5.0	30.0	30.0	12/19/2002
		0	0	0.0	0.0	0.0	
		0	0	0.0	0.0	0.0	12/11/2006
EMCON		0	1	0.0	0.0	23.0	11/29/2001
MALCOLM	1/16/1985	0	1	0.0	0.0	0.0	
GROUNDWATER TEC	3/29/1985	0	1	0.0	0.0	0.0	
GROUNDWATER TEC	3/29/1985	0	1	0.0	0.0	0.0	11/29/2001
		0	0	0.0	0.0	0.0	
GETTLER-RYAN	12/21/1984	8	1	0.0	0.0	0.0	11/29/2001
GETTLER-RYAN	12/21/1984	6	1	0.0	0.0	0.0	11/29/2001
GETTLER-RYAN	12/21/1984	0	1	0.0	0.0	0.0	11/29/2001
GETTLER-RYAN	1/3/1985	6	1	7.0	22.0	0.0	11/29/2001
GETTLER-RYAN	1/3/1985	0	1	0.0	0.0	0.0	12/11/2006
GETTLER-RYAN	1/3/1985	0	1	0.0	0.0	0.0	
		0	0	0.0	0.0	0.0	12/11/2006
GETTLER-RYAN	1/10/1985	0	1	0.0	0.0	0.0	12/11/2006
EMCON	1/10/1985	0	1	0.0	0.0	0.0	11/29/2001
GETTLER-RYAN	1/15/1985	9	1	10.0	20.0	35.0	11/29/2001
GETTLER-RYAN	1/15/1985	0	1	0.0	0.0	36.5	
GETTLER-RYAN	1/15/1985	0	1	0.0	0.0	0.0	11/29/2001
		0	0	0.0	0.0	0.0	12/11/2006
KAPREALIAN	4/2/1991	6	1	10.0	24.0	25.0	
KAPREALIAN	4/2/1991	6	1	10.0	24.0	24.0	
KAPREALIAN	4/2/1991	6	1	10.0	24.0	24.5	
BSK ASSOCIATES	7/11/1996	3	1	5.0	20.0	21.5	8/23/1999
BSK ASSOCIATES	7/12/1996	3	1	5.0	20.0	21.5	8/23/1999
BSK ASSOCIATES	7/12/1996	3	1	5.0	20.0	21.5	8/23/1999
		0	0	0.0	0.0	0.0	
		0	0	0.0	0.0	0.0	
		0	0	0.0	0.0	0.0	

WELL #	DEPTH	DIAM	USE	ADDRESS	CITY	OWNER	OTHER DESI
3S/2E 3A 1	54.0	2.5	mon	BLUEBELL DR	LIVERMORE	Z7-MON	
3S/2E 3G 6	20.0	4.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO REFINING	MW-7
3S/2E 3G 7	20.0	4.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO REFINING	MW-8
3S/2E 3G 8	33.0	6.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO	EW-1
3S/2E 3G 9	12.0	2.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO	VE-1
3S/2E 3G10	18.0	1.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO	SP-1
3S/2E 3H 2	208.0	11.0	dom	5153 SOUTH FRONT RD	LIVERMORE	ERNST FAGUNDES	
3S/2E 3H 3	20.0	2.0	mon	5237 SOUTH FRONT ROAD	LIVERMORE	ERNEST JONES	MW-1
3S/2E 3K 3	60.0	2.5	mon	S. FRONT NR FIRST ST.	LIVERMORE	Z7-MON	
3S/2E 3K24	28.0	2.0	mon	4700 FIRST ST, LIVERMORE	LIVERMORE	UNOCAL	
3S/2E 3K25	26.0	2.0	mon	4700 FIRST ST, LIVERMORE	LIVERMORE	UNOCAL	
3S/2E 3K26	26.0	2.0	mon	4700 FIRST ST, LIVERMORE	LIVERMORE	UNOCAL	
3S/2E 3K27	26.0	2.0	mon	4700 FIRST ST, LIVERMORE	LIVERMORE	UNOCAL	
3S/2E 3K28	30.0	2.0	mon	4700 FIRST STREET LIVERMORE	LIVERMORE	UNOCAL	
3S/2E 3K32	25.0	2.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-20
3S/2E 3K33	25.0	2.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-21
3S/2E 3G 4	25.0	2.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO USA	MW-6
3S/2E 3B 1	25.0	3.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO	MW-4
3S/2E 3G 1	20.0	4.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO USA	MW-1
3S/2E 3G 2	20.0	4.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO USA	MW-2
3S/2E 3G 3	20.0	4.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO USA	MW-3
3S/2E 3G 5	30.0	2.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO	MW-5
3S/2E 3K 4	35.0	0.0	mon	FIRST ST & FRONT RD	LIVERMORE	MOBIL	C-10
3S/2E 3K 5	30.0	0.0	mon	FIRST ST & FRONT RD	LIVERMORE	MOBIL	C-11
3S/2E 3K 6	0.0	0.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-4
3S/2E 3K 7	32.0	12.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	RW-1
3S/2E 3K 8	29.0	8.0	mon	FIRST ST & FRONT RD	LIVERMORE	CHEVRON	C-18
3S/2E 3K 9	25.0	8.0	mon	FIRST ST & FRONT RD	LIVERMORE	CHEVRON	C-19
3S/2E 3K10	0.0	0.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-1
3S/2E 3K11	26.5	3.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-2
3S/2E 3K12	21.5	3.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-3
3S/2E 3K13	21.0	3.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-5
3S/2E 3K14	22.0	3.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-6
3S/2E 3K15	22.0	3.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-7
3S/2E 3K16	23.0	3.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-8
3S/2E 3K17	0.0	0.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-9
3S/2E 3K18	23.0	3.0	mon	FIRST ST & FRONT RD	LIVERMORE	MOBIL	C-12
3S/2E 3K19	22.0	3.0	unk	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-14
3S/2E 3K20	20.0	3.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C15
3S/2E 3K21	21.5	3.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C16
3S/2E 3K22	21.0	3.0	mon	FIRST ST & FRONT RD	LIVERMORE	MOBIL	C17
3S/2E 3K23	0.0	0.0	mon	4904 SOUTHFRONT RD	LIVERMORE	CHEVRON	C-13
3S/2E 3K29	24.0	2.0	mon	4700 FIRST ST	LIVERMORE	UNOCAL	MW-5
3S/2E 3K30	24.0	2.0	mon	4700 FIRST ST	LIVERMORE	UNOCAL	MW-6
3S/2E 3K31	24.0	2.0	mon	4700 FIRST ST	LIVERMORE	UNOCAL	MW-7
3S/2E 3G11	20.0	2.0	mon	909 BLUEBELL DR.	LIVERMORE	JAMES & ANGIE MCATEE	MW-1
3S/2E 3G12	20.0	2.0	mon	909 BLUEBELL DR.	LIVERMORE	JAMES & ANGIE MCATEE	MW-2
3S/2E 3G13	20.0	2.0	mon	909 BLUEBELL DR.	LIVERMORE	JAMES & ANGIE MCATEE	MW-3
3S/2E 3G14	20.0	2.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO	
3S/2E 3G15	25.0	2.0	mon	930 SPRINGTOWN BLVD	LIVERMORE	TEXACO	
3S/2E 3H 4	160.4	6.0	sup	461 MCGRAW AVE	LIVERMORE	CRANDAL MACKEY	

Appendix E

SFBRWQCB Data

Table F-1a. Groundwater Screening Levels
(groundwater is a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-1	Drinking Water (Toxicity) Table F-3	Vapor Intrusion Into Buildings Table E-1a	Aquatic Habitat Goal (Chronic) Table F-4a
Acenaphthene	2.0E+01	Ceiling Value	2.0E+01	4.2E+02	4.2E+03	2.3E+01
Acenaphthylene	3.0E+01	Aquatic Habitat Goal	2.0E+03	2.1E+02	(Use soil gas)	3.0E+01
Acetone	1.5E+03	Aquatic Habitat Goal	2.0E+04	6.3E+03	5.3E+07	1.5E+03
Aldrin	2.0E-03	Drinking Water Toxicity	8.5E+00	2.0E-03		1.3E-01
Anthracene	7.3E-01	Aquatic Habitat Goal	2.2E+01	2.1E+03	4.3E+01	7.3E-01
Antimony	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00		3.0E+01
Arsenic	3.6E+01	Aquatic Habitat Goal	5.0E+04	5.0E+01		3.6E+01
Barium	1.0E+03	Drinking Water Toxicity	5.0E+04	1.0E+03		1.0E+03
Benzene	1.0E+00	Drinking Water Toxicity	1.7E+02	1.0E+00	5.4E+02	4.6E+01
Benzo(a)anthracene	2.7E-02	Aquatic Habitat Goal	5.0E+00	2.9E-02		2.7E-02
Benzo(b)fluoranthene	2.9E-02	Aquatic Habitat Goal	7.0E+00	2.9E-02		2.9E-02
Benzo(k)fluoranthene	2.9E-02	Drinking Water Toxicity	4.0E-01	2.9E-02		3.7E+00
Benzo(g,h,i)perylene	1.0E-01	Aquatic Habitat Goal	1.3E-01	2.1E+02		1.0E-01
Benzo(a)pyrene	1.4E-02	Aquatic Habitat Goal	1.9E+00	2.0E-01		1.4E-02
Beryllium	5.3E-01	Aquatic Habitat Goal	5.0E+04	4.0E+00		5.3E-01
1,1-Biphenyl	5.0E-01	Ceiling Value	5.0E-01	3.5E+02	(Use soil gas)	1.4E+01
Bis(2-chloroethyl) ether	3.2E-02	Drinking Water Toxicity	3.6E+02	3.2E-02	6.5E+01	1.2E+01
Bis(2-chloroisopropyl) ether	1.4E-02	Drinking Water Toxicity	3.2E+02	1.4E-02	(Use soil gas)	1.2E+01
Bis(2-ethylhexyl) phthalate	4.0E+00	Drinking Water Toxicity	6.5E+02	4.0E+00		3.2E+01
Boron	1.6E+00	Aquatic Habitat Goal	5.0E+04	1.0E+03		1.6E+00
Bromodichloromethane	1.0E+02	Drinking Water Toxicity	5.0E+04	1.0E+02	1.7E+02	1.1E+03
Bromoform (Tribromomethane)	1.0E+02	Drinking Water Toxicity	5.1E+02	1.0E+02		1.1E+03
Bromomethane	9.8E+00	Drinking Water Toxicity	5.0E+04	9.8E+00	5.8E+02	1.6E+02
Cadmium	2.5E-01	Aquatic Habitat Goal	5.0E+04	5.0E+00		2.5E-01
Carbon tetrachloride	5.0E-01	Drinking Water Toxicity	5.2E+02	5.0E-01	9.3E+00	9.8E+00
Chlordane	4.0E-03	Aquatic Habitat Goal	2.5E+00	1.0E-01		4.0E-03
p-Chloroaniline	5.0E+00	Aquatic Habitat Goal	5.0E+04	2.8E+01		5.0E+00
Chlorobenzene	2.5E+01	Aquatic Habitat Goal	5.0E+01	7.0E+01	1.3E+04	2.5E+01
Chloroethane	1.2E+01	Aquatic Habitat Goal	1.6E+01	1.2E+01	8.2E+02	1.2E+01
Chloroform	7.0E+01	Drinking Water Toxicity	2.4E+03	7.0E+01	3.3E+02	6.2E+02
Chloromethane	4.1E+01	Indoor Air Impacts	5.0E+04	1.8E+02	4.1E+01	1.1E+03
2-Chlorophenol	1.8E-01	Ceiling Value	1.8E-01	3.5E+01	5.3E+03	4.4E+02
Chromium (total)	5.0E+01	Drinking Water Toxicity	5.0E+04	5.0E+01		1.8E+02
Chromium III	1.8E+02	Aquatic Habitat Goal	5.0E+04	2.0E+05		1.8E+02
Chromium VI	1.1E+01	Aquatic Habitat Goal	5.0E+04	2.1E+01		1.1E+01
Chrysene	3.5E-01	Aquatic Habitat Goal	8.0E-01	4.8E+00	(Use soil gas)	3.5E-01

Table F-1a. Groundwater Screening Levels
(groundwater is a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-1	Drinking Water (Toxicity) Table F-3	Vapor Intrusion Into Buildings Table E-1a	Aquatic Habitat Goal (Chronic) Table F-4a
Cobalt	3.0E+00	Aquatic Habitat Goal	5.0E+04	1.4E+02		3.0E+00
Copper	3.1E+00	Aquatic Habitat Goal	1.0E+03	1.3E+03		3.1E+00
Cyanide	1.0E+00	Aquatic Habitat Goal	1.7E+02	1.5E+02	(Use soil gas)	1.0E+00
Dibenz(a,h)anthracene	4.8E-03	Drinking Water Toxicity	2.5E-01	4.8E-03		7.5E+00
Dibromochloromethane	1.0E+02	Drinking Water Toxicity	5.0E+04	1.0E+02	1.7E+02	1.1E+03
1,2-dibromo-3-chloropropane	2.0E-01	Aquatic Habitat Goal	1.0E+01	2.0E-01	(Use soil gas)	2.0E-01
1,2-Dibromoethane	5.0E-02	Drinking Water Toxicity	5.0E+04	5.0E-02	1.5E+02	1.4E+03
1,2-Dichlorobenzene	1.0E+01	Ceiling Value	1.0E+01	6.0E+02	7.7E+04	1.4E+01
1,3-Dichlorobenzene	6.5E+01	Aquatic Habitat Goal	5.0E+04	2.1E+02	(Use soil gas)	6.5E+01
1,4-Dichlorobenzene	5.0E+00	Ceiling Value	5.0E+00	5.0E+00	3.4E+02	1.5E+01
3,3-Dichlorobenzidine	2.9E-02	Drinking Water Toxicity	1.6E+03	2.9E-02		2.5E+02
Dichlorodiphenyldichloroethane (DDD)	1.0E-03	Aquatic Habitat Goal	8.0E+01	1.5E-01		1.0E-03
Dichlorodiphenyldichloroethene (DDE)	1.0E-03	Aquatic Habitat Goal	2.0E+01	1.0E-01		1.0E-03
Dichlorodiphenyltrichloroethane (DDT)	1.0E-03	Aquatic Habitat Goal	1.5E+00	1.0E-01		1.0E-03
1,1-Dichloroethane	5.0E+00	Drinking Water Toxicity	5.0E+04	5.0E+00	1.0E+03	4.7E+01
1,2-Dichloroethane	5.0E-01	Drinking Water Toxicity	7.0E+03	5.0E-01	2.0E+02	2.0E+03
1,1-Dichloroethene	6.0E+00	Drinking Water Toxicity	1.5E+03	6.0E+00	6.3E+03	2.5E+01
cis-1,2-Dichloroethene	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00	6.2E+03	5.9E+02
trans-1,2-Dichloroethene	1.0E+01	Drinking Water Toxicity	2.6E+02	1.0E+01	6.7E+03	5.9E+02
2,4-Dichlorophenol	3.0E-01	Ceiling Value	3.0E-01	2.1E+01		3.7E+01
1,2-Dichloropropane	5.0E+00	Drinking Water Toxicity	1.0E+01	5.0E+00	2.8E+02	1.5E+03
1,3-Dichloropropene	5.0E-01	Drinking Water Toxicity	5.0E+04	5.0E-01	5.3E+01	2.4E+01
Dieldrin	1.9E-03	Aquatic Habitat Goal	4.1E+01	2.2E-03		1.9E-03
Diethyl phthalate	1.5E+00	Aquatic Habitat Goal	5.0E+04	5.6E+03		1.5E+00
Dimethyl phthalate	1.5E+00	Aquatic Habitat Goal	5.0E+04	7.0E+04		1.5E+00
2,4-Dimethylphenol	1.0E+02	Drinking Water Toxicity	4.0E+02	1.0E+02	2.5E+06	1.1E+02
2,4-Dinitrophenol	1.5E+01	Aquatic Habitat Goal	5.0E+04	1.4E+02		1.5E+01
2,4-Dinitrotoluene	5.1E-02	Drinking Water Toxicity	5.0E+04	5.1E-02		1.2E+02
1,4-Dioxane	3.0E+00	Drinking Water Toxicity	5.0E+04	3.0E+00		3.4E+05
Dioxin (2,3,7,8-TCDD)	1.0E-06	Aquatic Habitat Goal	7.0E+03	3.0E-05		1.0E-06
Endosulfan	8.7E-03	Aquatic Habitat Goal	7.5E+01	4.2E+01		8.7E-03
Endrin	2.3E-03	Aquatic Habitat Goal	4.1E+01	2.0E+00		2.3E-03
Ethylbenzene	3.0E+01	Ceiling Value	3.0E+01	3.0E+02	1.7E+05	4.3E+01
Fluoranthene	8.0E+00	Aquatic Habitat Goal	1.3E+02	2.8E+02		8.0E+00
Fluorene	3.9E+00	Aquatic Habitat Goal	9.5E+02	2.8E+02	1.9E+03	3.9E+00
Heptachlor	3.6E-03	Aquatic Habitat Goal	2.0E+01	1.0E-02		3.6E-03

Table F-1a. Groundwater Screening Levels
(groundwater is a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-1	Drinking Water (Toxicity) Table F-3	Vapor Intrusion Into Buildings Table E-1a	Aquatic Habitat Goal (Chronic) Table F-4a
Heptachlor epoxide	3.6E-03	Aquatic Habitat Goal	1.8E+02	1.0E-02		3.6E-03
Hexachlorobenzene	1.0E+00	Drinking Water Toxicity	5.5E+01	1.0E+00		3.7E+00
Hexachlorobutadiene	4.5E-01	Drinking Water Toxicity	6.0E+00	4.5E-01		9.3E-01
γ-Hexachlorocyclohexane (Lindane)	1.6E-02	Aquatic Habitat Goal	3.5E+03	2.0E-01		1.6E-02
Hexachloroethane	9.0E-01	Drinking Water Toxicity	1.0E+01	9.0E-01		1.2E+01
Indeno(1,2,3-c,d)pyrene	4.8E-02	Aquatic Habitat Goal	2.7E-01	4.8E-02		4.8E-02
Lead	2.5E+00	Aquatic Habitat Goal	5.0E+04	1.5E+01		2.5E+00
Mercury (elemental)	2.5E-02	Aquatic Habitat Goal	5.0E+04	2.0E+00	(Use soil gas)	2.5E-02
Methoxychlor	3.0E-03	Aquatic Habitat Goal	2.0E+01	4.0E+01		3.0E-03
Methylene chloride	5.0E+00	Drinking Water Toxicity	9.1E+03	5.0E+00	2.4E+03	2.2E+03
Methyl ethyl ketone	4.2E+03	Drinking Water Toxicity	8.4E+03	4.2E+03	2.4E+07	1.4E+04
Methyl isobutyl ketone	1.2E+02	Drinking Water Toxicity	1.3E+03	1.2E+02	3.0E+06	1.7E+02
Methyl mercury	3.0E-03	Aquatic Habitat Goal	5.0E+04	7.0E-01		3.0E-03
2-Methylnaphthalene	2.1E+00	Aquatic Habitat Goal	1.0E+01	2.8E+01	2.6E+04	2.1E+00
tert-Butyl methyl ether	5.0E+00	Ceiling Value	5.0E+00	1.3E+01	2.4E+04	8.0E+03
Molybdenum	3.5E+01	Drinking Water Toxicity	5.0E+04	3.5E+01		2.4E+02
Naphthalene	1.7E+01	Drinking Water Toxicity	2.1E+01	1.7E+01	3.2E+03	2.4E+01
Nickel	8.2E+00	Aquatic Habitat Goal	5.0E+04	1.0E+02		8.2E+00
Pentachlorophenol	1.0E+00	Drinking Water Toxicity	3.0E+01	1.0E+00		7.9E+00
Perchlorate	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00		6.0E+02
Phenanthrene	4.6E+00	Aquatic Habitat Goal	4.1E+02	2.1E+02	(Use soil gas)	4.6E+00
Phenol	5.0E+00	Ceiling Value	5.0E+00	4.2E+03		2.6E+02
Polychlorinated biphenyls (PCBs)	1.4E-02	Aquatic Habitat Goal	1.6E+01	5.0E-01		1.4E-02
Pyrene	2.0E+00	Aquatic Habitat Goal	6.8E+01	4.2E+02	1.4E+02	2.0E+00
Selenium	5.0E+00	Aquatic Habitat Goal	5.0E+04	5.0E+01		5.0E+00
Silver	1.9E-01	Aquatic Habitat Goal	1.0E+02	3.5E+01		1.9E-01
Styrene	1.0E+01	Ceiling Value	1.0E+01	1.0E+02	3.1E+05	1.0E+02
tert-Butyl alcohol	1.2E+01	Drinking Water Toxicity	5.0E+04	1.2E+01	(Use soil gas)	1.8E+04
1,1,1,2-Tetrachloroethane	1.3E+00	Drinking Water Toxicity	5.0E+04	1.3E+00	(Use soil gas)	9.3E+02
1,1,2,2-Tetrachloroethane	1.0E+00	Drinking Water Toxicity	5.0E+02	1.0E+00	1.9E+02	2.4E+02
Tetrachloroethene	5.0E+00	Drinking Water Toxicity	1.7E+02	5.0E+00	1.2E+02	1.2E+02
Thallium	2.0E+00	Drinking Water Toxicity	5.0E+04	2.0E+00		4.0E+00
Toluene	4.0E+01	Ceiling Value	4.0E+01	1.5E+02	3.8E+05	1.3E+02
Toxaphene	2.0E-04	Aquatic Habitat Goal	1.4E+02	3.0E+00		2.0E-04
TPH (gasolines)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02	(Use soil gas)	2.1E+02
TPH (middle distillates)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02	(Use soil gas)	2.1E+02

Table F-1a. Groundwater Screening Levels
(groundwater is a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-1	Drinking Water (Toxicity) Table F-3	Vapor Intrusion Into Buildings Table E-1a	Aquatic Habitat Goal (Chronic) Table F-4a
TPH (residual fuels)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02		2.1E+02
1,2,4-Trichlorobenzene	5.0E+00	Drinking Water Toxicity	3.0E+03	5.0E+00	2.5E+03	2.5E+01
1,1,1-Trichloroethane	6.2E+01	Aquatic Habitat Goal	9.7E+02	2.0E+02	1.3E+05	6.2E+01
1,1,2-Trichloroethane	5.0E+00	Drinking Water Toxicity	5.0E+04	5.0E+00	3.5E+02	9.4E+02
Trichloroethene	5.0E+00	Drinking Water Toxicity	3.1E+02	5.0E+00	5.3E+02	3.6E+02
2,4,5-Trichlorophenol	1.1E+01	Aquatic Habitat Goal	2.0E+02	7.0E+02	8.3E+05	1.1E+01
2,4,6-Trichlorophenol	7.0E-01	Drinking Water Toxicity	1.0E+02	7.0E-01		9.7E+01
Vanadium	1.5E+01	Drinking Water Toxicity	5.0E+04	1.5E+01		1.9E+01
Vinyl chloride	5.0E-01	Drinking Water Toxicity	3.4E+03	5.0E-01	3.8E+00	7.8E+02
Xylenes	2.0E+01	Ceiling Value	2.0E+01	1.8E+03	1.6E+05	1.0E+02
Zinc	8.1E+01	Aquatic Habitat Goal	5.0E+03	5.0E+03		8.1E+01

Notes:

1. Lowest of Ceiling Value, Drinking Water (toxicity) goal, Indoor-Air Impact goal and Aquatic Habitat Goal>Used to develop soil leaching levels for protection of groundwater quality.

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

sol - solubility threshold

Ceiling Level: Odor threshold, 1/2 solubility or 50000 µg/L maximum, whichever is lower. Intended to limit nuisances and general resource degradation.

Odor-thresholds assume no dilution.

Human Toxicity: Based on primary maximum concentration levels (MCLs), or equivalent. Considered protective of human health.

Indoor Air Impact: Addresses potential emission of volatile chemicals from groundwater and subsequent impact on indoor air. Value for permeable (e.g., sandy vadose-zone soils).

Aquatic Habitat Goal: Addresses potential discharge of groundwater to surface waterbody and subsequent impact on aquatic life;

Potential dilution upon discharge to surface water not considered.

Method detection limits and background concentrations replace final screening level as appropriate.