METROVATION

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By Alameda County Environmental Health at 10:57 am, Sep 19, 2014

September 18, 2014

Mr. Jerry Wickham
Senior Hazardous Materials Specialist
Alameda County Health Care Services Agency
Environmental Health Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

Re: Terradev Jefferson LLC Property
645 Fourth Street, Oakland, CA 94607
Fuel Leak Case No. RO0003001
Blue Rock Project No. ASE-1

Dear Mr. Wickham,

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

Sincerely,

Sara May
Director of Operations
Metrovation, LLC, managing agent for
Terradev Jefferson, LLC

Attachment:

Blue Rock Environmental, Inc.'s *Report for Geophysical Survey and Additional Site Characterization Workplan* dated September 18, 2014.

Mr. Jerry Wickham
Senior Hazardous Materials Specialist
Alameda County Health Care Services Agency
Environmental Health Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

September 18, 2014

Re: Report for Geophysical Survey and Additional Site Characterization Workplan
Terradev Jefferson LLC Property
645 4th Street, Oakland, CA 94607
Fuel Leak Case No. RO0003001
Blue Rock Project No. ASE-1

Dear Mr. Wickham,

This document, prepared by Blue Rock Environmental, Inc. (Blue Rock) on behalf of Terradev Jefferson, LLC, presents the results of the geophysical survey along the sidewalk in front of the subject site (previously approved by the Alameda County Environmental Health Services [ACEHS] in their letter dated July 22, 2013) to rule out the presence of other potentially unknown underground storage tanks, review of historical site use documents (i.e. aerials photographs), and review of agency files for other nearby sources of fuel impact to the subsurface. The results of that work were used, along with previous site characterization information, to develop a workplan for additional site investigation as requested in the ACEHS in their letter dated July 7, 2014.

Background

Site Description and UST Discovery / Removal
The site is located southeast of the intersection of 4th Street and Martin Luther King Jr. Way in Oakland, California (Figures 1 and 2a). The site consists of a single story commercial building, bounded closely on the sides and back by other commercial buildings. One single-walled steel underground storage tank (UST) was discovered beneath the sidewalk immediately adjacent to the front of the building during renovation in 2006 (Figure 2b).

Phase I Environmental Site Assessments completed in support of the purchase (1999) and for refinancing in 2006 indicated that no sign of an underground tank was observed during associated site inspections. The Phase I author also interviewed persons knowledgeable with the property from the 1950s until the time of the Phase I; the interviewees could recollect no underground tank being used during the period of their familiarity.

A review of Sanborn Fire Insurance Maps revealed no evidence of subject site use that would potentially require an underground tank, and as such it is difficult to discern precisely when the tank was installed or operated. Based on the Phase I interviews, it is assumed the tank was installed and last used prior to the 1950s. State and local regulations require the proper abandonment of tanks that are no longer used to store or dispense fuels, thus the abandonment work after tank discovery in 2006.

According to Golden Gate Tank Removal, Inc. (Golden Gate), after consultation with the City of Oakland, it was determined that building structural considerations prohibited physical tank removal and that in-place abandonment was the appropriate means to close the subject UST. Therefore, Golden Gate abandoned the UST in-place by triple washing followed by filling it to capacity with concrete slurry on September 5, 2006. Abandonment was performed with the permission and under the oversight of the City of Oakland Fire Prevention Bureau. Details of this event are presented in Golden Gate's *Tank Closure Report* dated September 21, 2006.

Golden Gate reported that the UST contained gasoline with an approximate holding capacity of 1,000-gallons, measuring approximately 10 feet in length and 4 feet in diameter. The bottom of the UST was estimated to be located 7.5 to 8 feet below ground surface (ft bgs). The fill port was reported to be located at the west end of the tank.

At the direction of the Oakland Fire Department, two holes were cored in the bottom of the cleaned tank prior to its abandonment to enable the collection of samples of underlying material. Golden Gate reported that the soil beneath the tank was wet, but that groundwater was not encountered. Soil samples were collected at a depth of 9 ft bgs. The samples were analyzed for concentrations of total petroleum hydrocarbons as diesel (TPHd), gasoline (TPHg), benzene, toluene, ethylbenzene, and xylenes (BTEX), and the five fuel oxygenates (MTBE, TBA, ETBE, DIPE, and TAME). Results of analysis of the sampled sediments indicated the presence of residual fuel hydrocarbons in both samples, with concentrations higher in the sample collected from the western end of the tank. This sample contained TPHg at a 10,000 mg/kg and benzene at 130 mg/kg.

<u>Summary of Investigation Activities</u>

Subsurface investigation began in 2009. A total of eight soil borings have been drilled (B-1 through B-6, CB-1, and CB-2), and three extraction wells (DPE-1 through DPE-3) and three sub-slab soil vapor points (VP-1 through VP-3) have been installed at the site. A summary of well construction details is included in Table 1, and summaries of soil, groundwater, and sub-slab soil vapor sample analytical data are included in Tables 2, 3, and 4, respectively.

Site Conceptual Model

The subject site is located in a commercial/industrial neighborhood along the San Francisco Bay-Margin. The site is underlain predominantly by sand. The upper six feet generally consists of a brown sand (SP-SM), which has been interpreted as fill material. Native soil underlying the fill consists of a gray and yellow-brown sandy clay (CL) unit from ~6 – 7 ft bgs and a mottled red-brown and gray clayey sand (SC) from ~7 – 14 ft bgs, a brown sand (SP) from ~14 – 16 ft bgs, and gray clayey sand (SC) from ~ 16 – 20 ft bgs, the maximum depth explored. Groundwater is present in unconfined conditions at a depth of approximately 9 ft bgs. Groundwater flows generally to the south and southwest, towards the Oakland Inner Harbor, based on information from nearby sites (Allen Property, Markus Hardware).

Gasoline range hydrocarbons are present in soil and groundwater proximal to the abandoned UST. Interestingly, the contaminant signature also includes the gasoline additive methyl tert-butyl ether (MTBE). The addition of MTBE to gasoline began as early as 1979, and its use became ubiquitous in California by March 1996 to meet Clean Air Act standards at that time. However, its use in California was banned as of January 1, 2004. Although it is uncertain when the subject UST was removed from service, it is not expected to have been in service during MTBE's lifespan as a gasoline additive in California.

Blue Rock obtained historical Sanborn Fire Insurance maps, historical aerial photographs, city directories, a database records review summary, and individual regulatory case files for two nearby LUST sites to better understand potential nearby sources and past site use.

Blue Rock understands that an upgradient property at the southeast corner of 5th Street and Martin Luther King Jr. Way was formerly used as a gas station, the case name for which is "Grove Auto Repair" (Global ID T06000101350). Sanborn maps indicate that property was used as a gasoline station from at least the early 1950s. ACEHS file documents indicate that five USTs (two 4,000-galllon, two 6,000-gallon, and one 550-gallon capacities) were removed in 1983. In 1988, approximately 1,000 cubic yards were excavated from the former UST area and disposed off-site. The Grove Auto Repair case received regulatory closure in 1993. The former fuel system layout and investigation points for that site are shown on Figure 2a. It is notable the area of the former southern dispenser island appears not to have been investigated, nor was the southerly extent of dissolved-phase fuel hydrocarbons detected in former well MW-3 ever delineated in the direction of the subject site.

The "Allen Property" case (Global ID T0600108713) is located at the southwest corner of 4th Street and Martin Luther King Jr. Way. The Allen Property UST (10,000-gallon capacity) was abandoned in-place in 1993. The site received regulatory case closure in 2014. The former fuel system layout and investigation points for that site are shown on Figure 2a. The lateral extent of the Allen Property dissolved-phase fuel plume was delineated in the direction of the subject site by Allen well MW-2.

The database records search map also shows an "Oil/Gas" pipeline running down the west side of Martin Luther King Jr. Way; however, the specific product conveyed in the pipeline is unknown. The relationship, if any, between the historic service station and oil/gas pipeline and residual hydrocarbons found at the subject site is currently unknown.

The abandoned subject UST is located beneath the sidewalk along 4th Street, at the upgradient edge of a city block. The location of densely packed, low ceiling (occupied) buildings has limited implementation of a traditional environmental investigation (i.e. an array of downgradient borings and wells). The nearest location for the construction of downgradient monitoring wells is the street or sidewalk along 3rd Street, on the other side of the city block. Review of the previous UST studies at nearby sites (Allen Property at 325 Martin Luther King Jr. Way and Markus Hardware at 632-638 Second Street) suggest that a 3rd Street location for downgradient monitoring wells might be far from the expected downgradient edge of the plume to serve any practical purpose.

The lateral extent of groundwater impact has been defined to the southwest of the subject UST by grab groundwater samples from borings B-3, B-4, and B-5, which were drilled inside interior service hallways with concrete floors. Fuel hydrocarbons were detected in the sample from B-6, located approximately 110 feet south of the subject UST.

Groundwater beneath this area of Oakland is not presently used for beneficial purposes (consumption or irrigation). Additionally, it is reasonable to assume that the shallowest water-bearing zone in the vicinity of the subject site will plausibly not be used for beneficial consumption for the indeterminate future, if ever (in terms of City habitation). The residual hydrocarbons in groundwater do not, therefore, pose a threat to human health via consumption.

Secondary Source Removal

Amicus evaluated investigative and remedial options available at the site in their September 13, 2009 correspondence. It was noted that corrective actions would be necessarily constrained by the location of the abandoned UST relative to existing development - i.e. assessment proximally downgradient is prohibited, inadequate space to build a traditional fixed in-situ remediation system, and remedial excavation would undermine the existing building. Yet the persistence of elevated concentrations of gasoline range hydrocarbons in the subsurface merited remedial action. As a result, the use of mobile high-vacuum extraction (HVDPE) equipment was recommended as an aggressive approach to reduce the remaining gasoline mass in the vicinity of the UST for which details were proposed in the *Removal Action Workplan* dated February 3, 2010, which was conditionally approved by the ACEHS in a letter dated February 19, 2010.

First High-Vacuum Dual-Phase Extraction Event (September-October 2010)

An initial mobile HVDPE remedial event was performed at the site from September 28 to October 3, 2010 (5 days). The event was completed using a truck-mounted unit consisting of a 25-horsepower oil sealed liquid-ring pump capable of producing 29 "Hg vacuum, and a thermal oxidizer capable of treating an air flow of approximately 450 ACFM. Wells DPE-1, DPE-2, and DPE-3 were used as extraction wells. A stinger hose was lowered into each well through a vacuum tight cap and placed approximately one foot off the bottom of each well. Depth to water at the beginning of the event was approximately 9.5 ft bgs in all three wells. At the beginning of the event, influent TPHg levels at individual wells ranged from 1,700 ppmv to 3,530 ppmv; however, they dropped to less 1,000 ppmv by the end of the event. The total average hydrocarbon mass recovered was **174 lbs** (based on 122 lbs calculated from field PID data and 225 lbs calculated from lab data), which equates to an average extraction rate of nearly 35 lbs/day.

Second High-Vacuum Dual-Phase Extraction Event (July 2012)

A second mobile HVDPE remedial event was performed at the site from July 9 to 24, 2012 (15days). The event was completed using a truck-mounted unit consisting of a 25-horsepower oil sealed liquid-ring pump capable of producing 29 "Hg vacuum, and a thermal oxidizer capable of treating an air flow of approximately 450 ACFM. Wells DPE-1 and DPE-2 were used as primary extraction wells, as they proved to be the most productive. A stinger hose was lowered into each well through a vacuum tight cap and placed approximately one foot off the bottom of each well. Depth to water at the beginning of the event was approximately 8.5 to 9 ft bgs, and the no LNAPL was observed in any of the wells. The total influent TPHg level was 1,200 ppmv at the start of the event and declined to 430 ppmv by the end of the event. The ending mass recovery rate was estimated to be approximately 11 lbs/day.

Blue Rock estimated the total average hydrocarbon mass recovered was approximately **249 lbs** (based on 199 lbs calculated from field PID data and 298 lbs calculated from lab data). The HVDPE unit provider (CalClean) estimated the total average hydrocarbon mass recovered was approximately **166 lbs** (based on 130 lbs calculated from field PID data and 191 lbs calculated from lab data). The difference between the mass removal estimates appears to be due to the fact that Blue Rock used flowrates from the manufacturer's blower curve based on the measured vacuum and Calclean used flowrates measured in the field with an inline flowmeter.

Cumulative Secondary Source Removal Efforts

The total hydrocarbon mass of approximately **340 to 423 lbs** has been removed by both the 2010 and 2012 events. At the beginning of the 2010 event, total inlet concentrations were 1,660 ppmv resulting in an extraction rate of approximately 90 lbs/day. By the end of the 2012 event, total inlet concentrations had declined to 430 ppmv and the extraction was approximately 10 lbs/day. Based on these data, it appears the use mobile HVDPE may have reached its effective limit and the mass appears to have been removed to the extent practicable. Additional use of mobile HVDPE would likely not be cost effective.

Free-Product Occurrence and Removal

Free-product was measured once in DPE-3 at a thickness of 0.13-feet in January 2011. However, following the second HVDPE event, no measurable thicknesses of free product has been observed in any of the wells.

Evaluation of Secondary Source Removal / Reduction

As presented in Blue Rock's March 11, 2013 report, a comparison of pre- and post-remedial soil quality proximal to the abandoned UST was intended to serve as a proxy for removal / reduction of the secondary source mass. The results of confirmation soil sampling are shown below.

West Side of UST			
Sample ID	Pre-remedial TPHg (mg/kg)	Post-Remedial TPHg (mg/kg)	CB-1 Sample ID
DPE-1-7.5'	6,500	<1.0	CB-1-7.5'
EX-W-9'	10,000	1,200	CB-1-9'
DPE-1-12'	2,300	14,000	CB-1-12'
DPE-1-15'	770	1,000	CB-1-15'

East Side of UST			
Sample ID	Pre-remedial TPHg (mg/kg)	Post-Remedial TPHg (mg/kg)	CB-2 Sample ID
DPE-2-6'	1.2	No sample	
EX-E-9'	920	840	CB-2-9'
DPE-2-11'	160,000	2,700	CB-2-11'
DPE-2-15'	430	380	CB-2-15'

TPHg concentrations in the upper 11 feet of soil were lower compared to pre-remedial levels, while concentrations at a depth of 12 feet and below were similar to, or higher, than pre-remedial levels. The reduction in concentrations in the upper 11 feet is expected based on historical depth to water and temporary local dewatering during the HVDPE events. Static depth to water is approximately 9 ft bgs and the intake hoses were placed at a depth of approximately 14 ft bgs in DPE-3 and 14 ft bgs in DPE-1 / DPE-2 during HVDPE extraction (i.e. one foot off the bottom of the well casing). The combined effect of the naturally occurring vadose zone and depressed water levels in each extraction well likely facilitated better vapor flow, and therefore mass removal, in the upper 11 feet of the soil column relative to soil deeper in the saturated zone. These results are indicative of secondary source reduction primarily in the upper 11 feet of the soil column.

Previous Vapor Intrusion Evaluation

In August 2012 and January 2014, Blue Rock sampled three sub-slab soil vapor points (VP-1 through VP-3) inside the building adjacent to the closed UST (Figure 2b). The points are located between approximately 6 and 38 feet south to southeast of the UST. Tracer gas (helium) leakage was minimal (i.e. equal to or less than 1%) during these events. Results from both events did not indicate a vapor intrusion risk based on comparison to Shallow Soil Gas ESLs from Table E of *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Interim 2007 (Revised 2008)* and CHHSLs published in *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties (CALEPA 2005)* for commercial / industrial land use scenarios. Details of this work were presented in Blue Rock's *Second Sub-Slab Soil Vapor Sampling Report* dated October 18, 2012 and *Additional Site Characterization Report* dated May 29, 2014. Sub-slab vapor data is summarized in Table 4.

Geophysical Survey for Other Potential Tanks

On August 6, 2014, Blue Rock supervised Norcal Geophysical Consultants, Inc. (Norcal) in performance of the geophysical survey to evaluate the sidewalk area around the subject UST to evaluate the presence of other potential UST(s) in the area (Figure 2b). The area investigated was approximately 90 feet long by 17 feet wide. Techniques employed consisted of electromagnetic survey and ground penetrating radar. The survey revealed the presence of numerous shallow utility lines, mostly in the eastern half of the survey area. Norcal did not report any areas of anomalous survey results that would be suggestive of additional USTs in the search area. Norcal's report is attached.

Workplan for Additional Site Characterization

Upgradient Subsurface Characterization

Blue Rock proposes to drill two borings in 4th Street, in the upgradient direction of the subject UST, to evaluate the extent of subsurface impact in that direction and possible relationship to the historical Grove Auto Repair release. This will be accomplished by collection of soil and grab groundwater samples from two temporary borings located in the eastbound lane of 4th Street, located approximately 30 feet north of the subject UST (Figure 2a).

Prior to drilling, Blue Rock will obtain soil boring permits from the ACPWA, and the drilling locations will be marked in white paint and Underground Service Alert was notified to identify utilities proximal to the proposed drilling locations. Blue Rock will also prepare a site specific Health and Safety Plan.

Drilling and sampling will be completed using direct-push drilling methods. At each drilling location, drill-rod, approximately 2.5-inches in diameter, will be used to advance a boring several feet into the water table (i.e. approximately 12 to 13 ft bgs). During drilling, soil types will be logged in accordance with the USCS, and field observations of potential petroleum presence will be noted. Blue Rock proposes to collect one soil sample from the capillary fringe for laboratory analysis (i.e. approximately 8 ft bgs). If petroleum impact is observed or suspected at other depths, soil samples from those intervals will also be collected. The sample tube will then be covered with Teflon lined plastic end caps, labeled, documented on a chain-of-custody form, and placed on ice in an insulated cooler for transport to the laboratory.

Following advancement of the each boring to the desired depth, a new SCH40 PVC well screen will be placed in each boring to help facilitate collection of a water sample. A new disposable polyethylene bailer will be used to collect a groundwater samples from each boring. Water samples will be transferred to laboratory supplied containers, labeled, documented on a chain-of-custody form, and placed on ice in an insulated cooler for transport to the project laboratory.

A California DHS-certified will analyze the soil and groundwater samples for concentrations of:

- TPHd by EPA Method 8015M with silica-gel clean-up
- TPHg by EPA Method 8260B
- BTEX by EPA Method 8260B
- MTBE and TBA by EPA Method 8260B
- 1,2-DCA and EDB by EPA Method 8260B
- Naphthalene by EPA Method 8260B

Upon completion of sampling, all boreholes will backfilled to the surface with cement and finished at the surface with concrete. Drill-rod, hand-augers, and sampling devices will be decontaminated in an Alconox® wash followed by double rinse in clean tap water to prevent cross-contamination. Soil cutting and rinseate will be stored in labeled 55-gallon drums on-site pending removal and disposal.

<u>Passive Sampling Survey of Downgradient Area between UST and B-6</u>

Blue Rock proposes to employ the minimally invasive passive technology of Applied Geochemical Imaging, LLC (AGI) (formerly Gores-Sorber) to evaluate the area between the subject UST and B-6. This approach will use approximately 12 passive sampling devices arrayed into a grid measuring approximately 110 feet by 90 feet. This investigation approach is aimed at gathering the maximum amount of information regarding the general distribution of remaining petroleum hydrocarbons in the subsurface while minimizing disruption to the building occupants/operations. This technology uses narrow diameter sample modules, consisting of an engineered sorbent material encased in a vapor permeable membrane sleeve, to passively adsorb volatile organic compounds that are then analyzed in a laboratory. It generates a distribution map of target compounds in mass (i.e. the mass accumulated on the sorbent) that provides the user with information regarding the general distribution of the remaining plume in both soil and/or groundwater.

At each location, a hole, approximately 1-inch or less in diameter will be created using hand-held tools. The hole will be approximately three to four feet deep. A the passive sampler will be inserted into the hole with an appropriate sized cork plug at the top to secure it. The unique sampler number will be recorded for each location. The passive samplers will be left for seven days following which they will be retrieved, placed in the supplied containers, documented on chain-of-custody form, and shipped in an appropriate condition to AGI for analysis.

Upon completion of sampling, all sampling holes will backfilled to the surface with cement and finished at the surface with concrete.

AGI will analyze the samples by GC/MS methods for mass per sampler of:

- Total Petroleum Hydrocarbons (TPH), Gasoline Range PH, and Diesel Range PH
- BTEX
- MTBE
- 1,2-DCA
- Naphthalene

AGI will provide compound distribution maps as part of their service, which will be attached to Blue Rock's technical report. These maps will aid in the understanding of the magnitude and distribution of target compounds through the survey area.

Reporting

Following completion of the proposed site activities, Blue Rock will prepare a technical report. The report will include tabulated data and figures depicting site conditions. The report will present an evaluation of site conditions and provide for case closure, if appropriate. The report will be reviewed and signed by a California Professional Geologist at Blue Rock.

References

AEI Consultant, 2013, *Site Status Update and Case Closure Request*, Allen Property, 325 Martin Luther King Jr. Way, Oakland, November 5

Amicus Strategic Environmental Consulting, 2009, letter regarding Terradev Jefferson, LLC Property, 645 Fourth Street, Oakland, March 4.

Amicus Strategic Environmental Consulting, 2009, letter regarding Terradev Jefferson, LLC Property, 645 Fourth Street, Oakland, September 13.

Blue Rock, 2010, *Removal Action Workplan*, 645 Fourth Street, Oakland, California, February 3.

Blue Rock, 2010, *Well Installation and Removal Action Report*, 645 Fourth Street, Oakland, California, October 29.

Blue Rock, 2011, *Groundwater Monitoring Report – First Quarter 2011*, 645 Fourth Street, Oakland, California, February 1.

Blue Rock, 2012, *Sub-Slab Soil Vapor Sampling Workplan and Project Schedule*, 645 Fourth Street, Oakland, California, April 23.

Blue Rock, 2012, *Sub-Slab Soil Vapor Sampling Report*, 645 Fourth Street, Oakland, California, July 7.

Blue Rock, 2012, *Second Removal Action and Groundwater Monitoring Report*, 645 Fourth Street, Oakland, California, August 16.

Blue Rock, 2012, *Second Sub-Slab Soil Vapor Sampling Report*, 645 Fourth Street, Oakland, California, October 18.

Blue Rock, 2013, *Confirmation Soil and Groundwater Sampling Report & Low Threat UST Case Closure Policy Evaluation*, 645 Fourth Street, Oakland, California, March 11.

Blue Rock, 2014, *Additional Site Characterization Report*, 645 Fourth Street, Oakland, California, May 29.

California EPA - DTSC. 2004. *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air.* December 15 (Revised February 7, 2005).

California EPA. 2005. *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties.* January.

California EPA - DTSC. 2010. *Advisory – Active Soil Gas Investigation.* March.

Clayton Environmental Consultants, 1993, *UST Closure Report*, 424 Martin Luther King Jr. Way, Oakland, California, April 30.

Ninyo & Moore, 2009, *Limited Phase II Environmental Site Assessment*, 645 Fourth Street, Oakland, California, July 24.

Golden Gate Tank Removal, Inc. 2006, *Tank Closure Report*, 645 Fourth Street, Oakland, California, September 21.

San Francisco Bay RWQCB. 2008. *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater - Interim Final November 2007 (Revised May 2008)*. May.

Certification

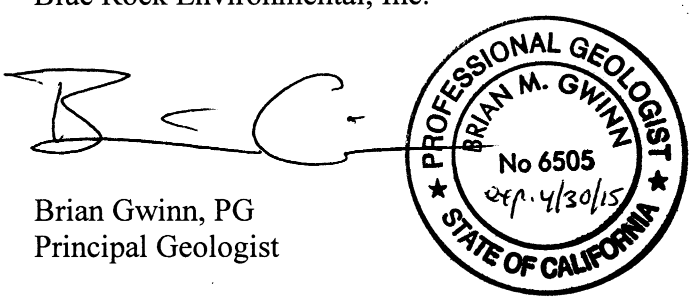
This workplan was prepared under the supervision of a California Professional Geologist at Blue Rock. All statements, conclusions, and recommendations are based upon published results from past consultants, field observations by Blue Rock, and analyses performed by a state-certified laboratory as they relate to the time, location, and depth of points sampled by Blue Rock. Interpretation of data, including spatial distribution and temporal trends, are based on commonly used geologic and scientific principles. It is possible that interpretations, conclusions, and recommendations presented in this report may change, as additional data become available and/or regulations change.

Information and interpretation presented herein are for the sole use of the client and regulating agency. The information and interpretation contained in this document should not be relied upon by a third party.

The service performed by Blue Rock has been conducted in a manner consistent with the level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions in the area of the site. No other warranty, expressed or implied, is made.

If you have any questions regarding this project, please contact us at (650) 522-9292.

Sincerely,
Blue Rock Environmental, Inc.



Brian Gwinn, PG
Principal Geologist

Attachments:

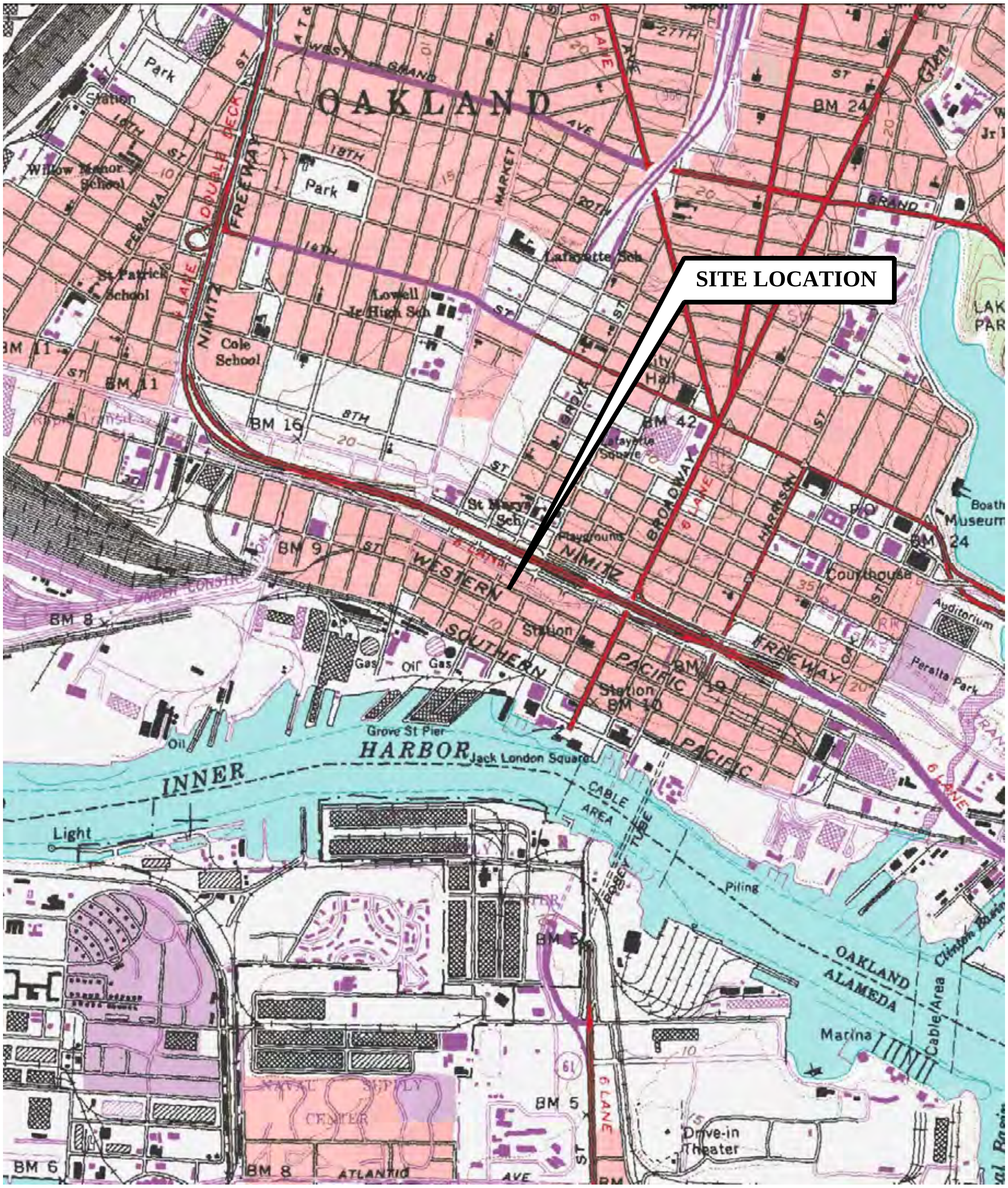
Figure 1: Site Location Map
Figure 2a: Site Plan
Figure 2b: Detailed Site Plan

Table 1: Well Construction Data
Table 2: Soil Sample Analytical Data
Table 3: Groundwater Analytical Data
Table 4: Sub-Slab Vapor Sample Analytical Data

Norcal's Geophysical Survey Report dated September 3, 2014

Distribution:

Ms. Sara May, Metrovation, 580 Second St. Suite 260, Oakland, CA 94607



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APPROX. SCALE IN FEET

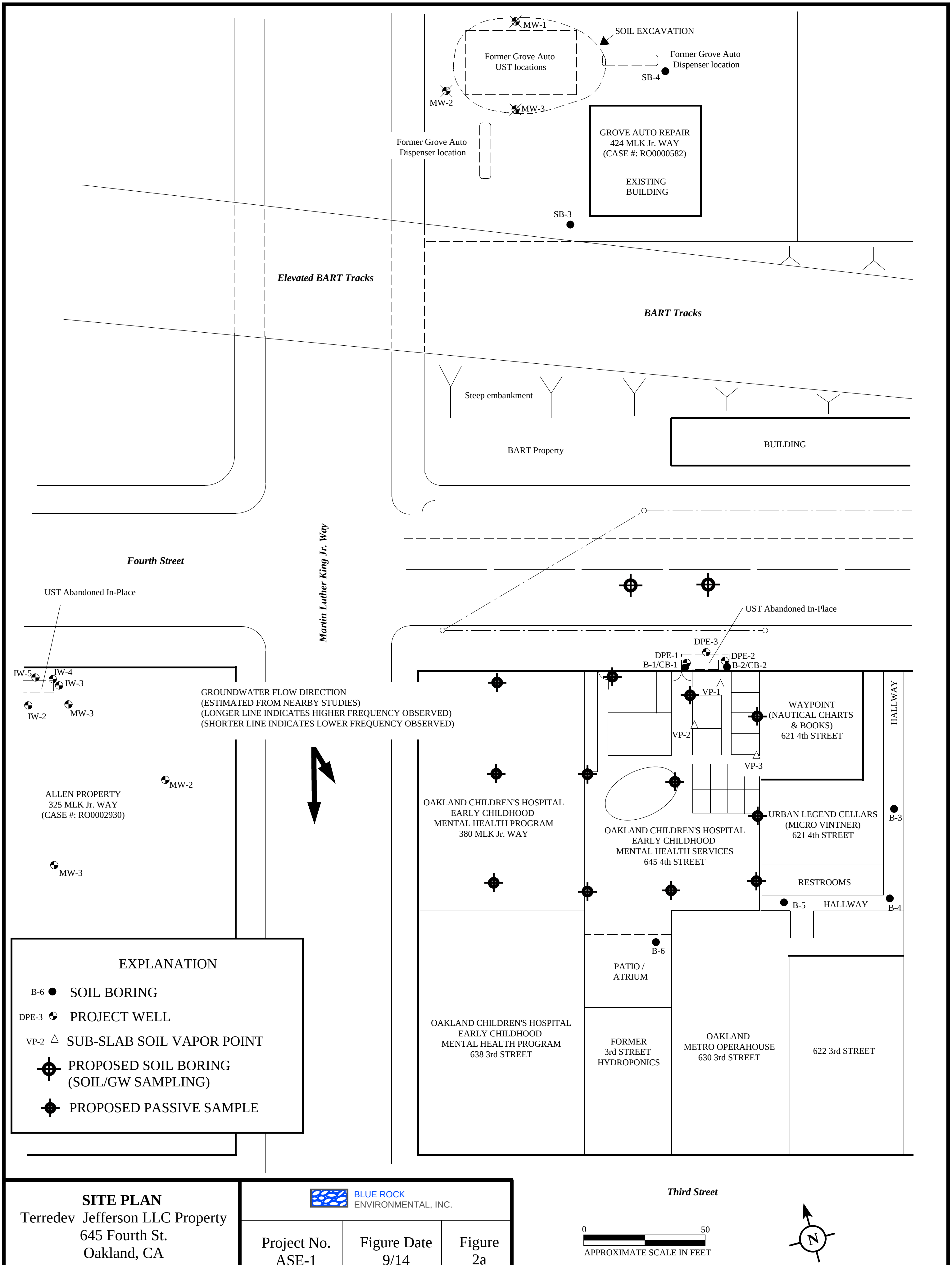
N

SOURCE: MyTopo.com

SITE LOCATION MAP
Terradev Jefferson LLC Property
645 Fourth St.
Oakland, CA

BLUE ROCK
ENVIRONMENTAL, INC.

Project No.	Figure Date	Figure
ASE-1	10/10	1



SITE PLAN
Terredev Jefferson LLC Property
645 Fourth St.
Oakland, CA

BLUE ROCK
ENVIRONMENTAL, INC.

Project No.	Figure Date	Figure
ASE-1	9/14	2a

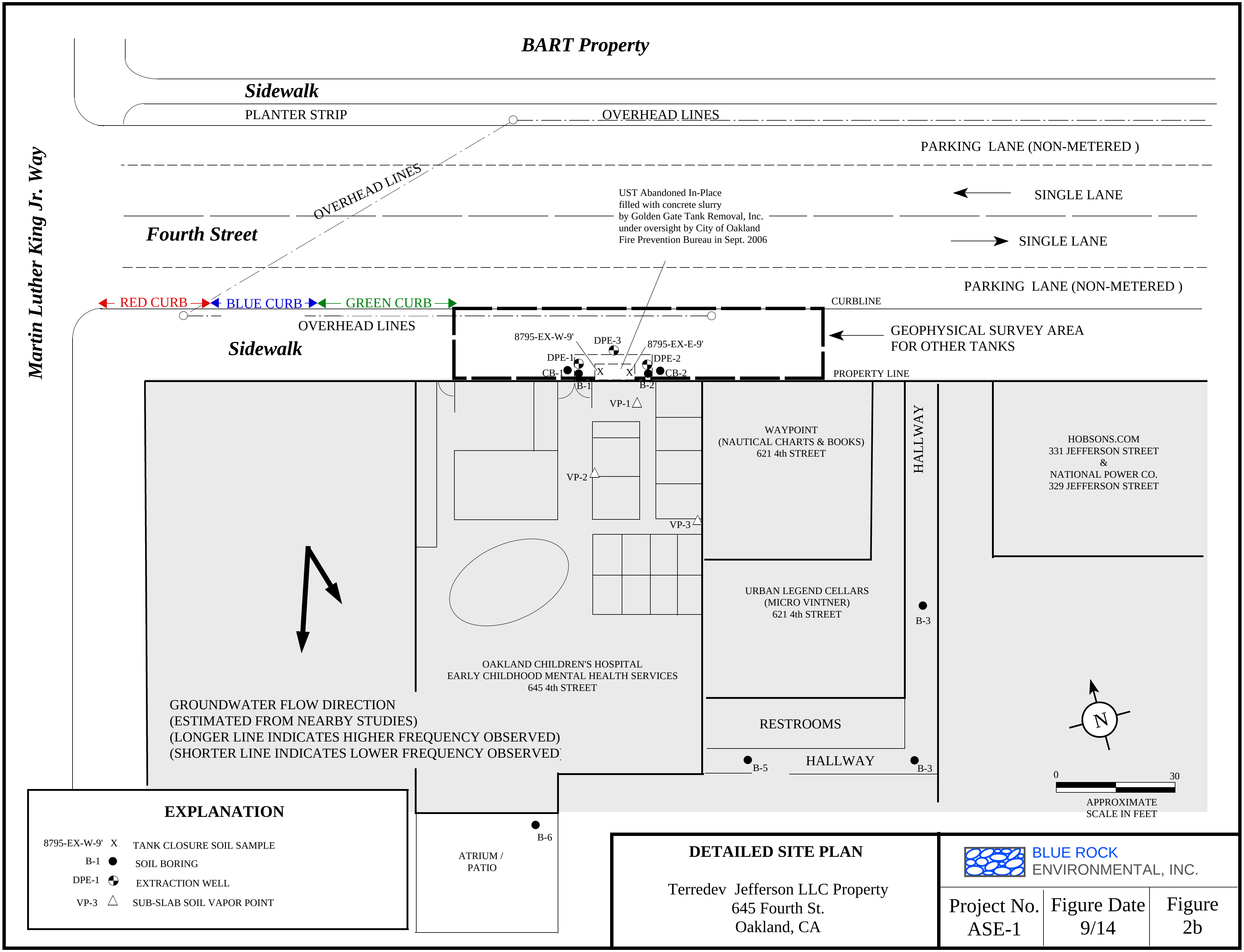

BART Property
Sidewalk
PLANTER STRIP
OVERHEAD LINES
PARKING LANE (NON-METERED)
OVERHEAD LINES
UST Abandoned In-Place
filled with concrete slurry
by Golden Gate Tank Removal, Inc.
under oversight by City of Oakland
Fire Prevention Bureau in Sept. 2006
SINGLE LANE
Fourth Street
SINGLE LANE
Martin Luther King Jr. Way
PARKING LANE (NON-METERED)
RED CURB
BLUE CURB
GREEN CURB
CURBLINE
OVERHEAD LINES
Sidewalk
GEOPHYSICAL SURVEY AREA
FOR OTHER TANKS
8795-EX-W-9'
DPE-3
8795-EX-E-9'
DPE-1
DPE-2
CB-1
CB-2
B-1
B-2
X
X
PROPERTY LINE
VP-1
VP-2
VP-3
WAYPOINT
(NAUTICAL CHARTS & BOOKS)
621 4th STREET
HALLWAY
HOBSONS.COM
331 JEFFERSON STREET
&
NATIONAL POWER CO.
329 JEFFERSON STREET
URBAN LEGEND CELLARS
(MICRO VINTNER)
621 4th STREET
B-3
OAKLAND CHILDREN'S HOSPITAL
EARLY CHILDHOOD MENTAL HEALTH SERVICES
645 4th STREET
GROUNDWATER FLOW DIRECTION
(ESTIMATED FROM NEARBY STUDIES)
(LONGER LINE INDICATES HIGHER FREQUENCY OBSERVED)
(SHORTER LINE INDICATES LOWER FREQUENCY OBSERVED)
RESTROOMS
N
B-5
HALLWAY
B-3
0
30
APPROXIMATE
SCALE IN FEET
B-6
ATRIUM /
PATIO
EXPLANATION
8795-EX-W-9' X TANK CLOSURE SOIL SAMPLE
B-1 SOIL BORING
DPE-1 EXTRACTION WELL
VP-3 SUB-SLAB SOIL VAPOR POINT
DETAILED SITE PLAN
Terredev Jefferson LLC Property
645 Fourth St.
Oakland, CA
BLUE ROCK
ENVIRONMENTAL, INC.
Project No.
ASE-1
Figure Date
9/14
Figure
2b

TABLE 1
Well Construction Data
Terradev Jefferson, LLC Property
645 Fourth Street
Oakland, CA

Extraction Wells

Well ID	Date Installed	Total Boring Depth (ft bgs)	Casing Diameter (inches)	Screen Depth (ft bgs)	Sandpack Depth (ft bgs)	Bentonite Depth (ft bgs)	Cement Grout Depth (ft bgs)
DPE-1	9/20/10	15	2	8 - 15	7 - 15	5 - 7	0 - 5
DPE-2	9/20/10	15	2	8 - 15	7 - 15	5 - 7	0 - 5
DPE-3	9/20/10	10	2	6 - 10	5 - 10	3 - 5	0 - 3

Vapor Probes

Well ID	Date Installed	Total Probe Depth (in bgs)	Tubing Diameter (inches)	Slab Thickness (in bgs)	Screen Depth (in bgs)	Rubber Plug (in bgs)	Cement Depth (in bgs)
VP-1	6/16/12	9	0.25	6.0	~ 6 - 9	~5.0 - 6.0	0 - 5
VP-2	6/16/12	9	0.25	4.5	~ 6 - 9	~3.5 - 4.5	0 - 3.5
VP-3	6/16/12	9	0.25	4.0	~ 6 - 9	~3.0 - 4.0	0 - 3

Notes:
ft bgs	Feet below ground surface.
in bgs	Inches below ground surface.

TABLE 2
Soil Sample Analytical Data
Terradev Jefferson, LLC Property
645 Fourth Street
Oakland, CA

Sample ID	Depth (ft bgs)	Sample Date	TPHd (mg/kg)	TPHd w/SGCU (mg/kg)	TPHg (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)	MTBE (mg/kg)	TBA (mg/kg)	DIPE, ETBE, TAME (mg/kg)	1,2-DCA (mg/kg)	EDB (mg/kg)
UST Removal Samples														
8795-EX-W-9'	9	8/23/06	<120	---	**10,000**	**130**	**1,000**	**230**	**1,200**	<12	<100	all<12	---	---
8795-EX-E-9'	9	8/23/06	<25	---	**920**	**6.8**	**55**	**18**	**110**	<1.2	<10	all<1.2	---	---
Investigation Samples														
DPE-1-7.5	7.5	9/20/10	**810^**	---	**6,500**	**14**	**320**	**180**	**980**	<0.50	<2.5	---	<0.50	**0.50**
DPE-1-12	12	9/20/10	**260^**	---	**2,300**	**26**	**160**	**45**	**240**	**0.71**	<1.5	---	<0.30	<0.30
DPE-1-15	15	9/20/10	**92^**	---	**770**	**10**	**53**	**15**	**80**	**0.39**	<0.50	---	**0.11**	<0.090
DPE-2-6	6	9/20/10	**15**	---	**1.2**	<0.0050	**0.0054**	<0.0050	**0.021**	<0.0050	<0.0050	---	<0.0050	<0.0050
DPE-2-11	11	9/20/10	**1,200^**	---	**160,000**	**1,400**	**10,000**	**3,300**	**19,000**	<0.25	<1.5	---	<0.25	**1.8**
DPE-2-15	15	9/20/10	**66^**	---	**430**	**3.8**	**25**	**8.3**	**47**	<0.50	<2.5	---	<0.050	<0.50
DPE-3-7	7	9/20/10	**260^**	---	**860**	**2.1**	**37**	**19**	**100**	<0.10	<0.50	---	<0.10	<0.10
DPE-3-10	10	9/20/10	**800^**	---	**8,900**	**78**	**580**	**180**	**980**	<0.25	<1.5	---	<0.25	**0.82**
CB-1-7.5	7.5	2/18/13	**1.2***	---	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	<0.0050	<0.0050
CB-1-9	9	2/18/13	**110^**	---	**1,200**	**2.8**	**55**	**27**	**150**	<0.25	---	---	<0.25	<0.25
CB-1-12	12	2/18/13	**880^**	---	**14,000**	**100**	**850**	**180**	**1,400**	**0.53**	---	---	<0.25	**0.86**
CB-1-15	15	2/18/13	**89^**	---	**1,000**	**8.4**	**62**	**15**	**100**	<0.050	---	---	<0.050	<0.050
CB-2-9	9	2/18/13	**120^**	---	**840**	**0.44**	**17**	**20**	**110**	<0.15	---	---	<0.15	<0.15
CB-2-11	11	2/18/13	**110^**	---	**2,700**	**23**	**160**	**48**	**260**	<0.40	---	---	<0.40	<0.40
CB-2-15	15	2/18/13	**45^**	---	**380**	**3.9**	**18**	**6.6**	**34**	<0.050	---	---	<0.050	<0.050
B-6-6'	6.5	1/11/14	**340^**	**350^**	**1,700**	**0.13**	**8.0**	**12**	**91**	<0.050	<0.25	---	<0.050	<0.050
B-6-10.5'	10.5	1/11/14	**280^**	**280^**	**1,500**	**4.1**	**48**	**26**	**130**	<0.25	<1.5	---	<0.25	<0.25

Notes:

ft bgs	feet below ground surface
mg/kg	milligrams per kilogram
TPHd	total petroleum hydrocarbons as diesel by EPA Method 8015M or 8015B, w/SCGCU = analysis performed after silica-gel clean-up.
TPHg	total petroleum hydrocarbons as gasoline by EPA Method 8260B
BTEX	benzene, toluene, ethylbenzene, and xylenes by EPA Method 8260B
MTBE, TBA, ETBE, DIPE, TAME	methyl tert-butyl ether, tert-butanol, ethyl tert-butyl ether, di-isopropyl ether, tert-amyl methyl ether by EPA Method 8260B,
1,2-DCA, EDB	1,2-dichloroethane, 1,2-dibromoethane by EPA Method 8260B.
µg/L	Micrograms per liter.
<###	Not detected at or above the indicated reporting limit.
^	Laboratory Flag: Hydrocarbons are lower-boiling than typical Diesel Fuel
*	Laboratory Flag: Hydrocarbons are higher-boiling than typical Diesel Fuel
---	Data not available, not monitored, or not sampled

TABLE 3
Groundwater Analytical Data
Terradev Jefferson, LLC Property
645 Fourth Street
Oakland, CA

Sample ID	Sample Date	TOC (ft MSL)	DTW (ft)	LNAPL (ft)	GWE (ft MSL)	TPHd (µg/L)	TPHd w/SGCU (µg/L)	TPHg (µg/L)	B (µg/L)	T (µg/L)	E (µg/L)	X (µg/L)	MTBE (µg/L)	TBA (µg/L)	1,2-DCA (µg/L)	EDB (µg/L)
Grab Groundwater Samples																
B-1-GW*	7/10/09	--	~10 - 20	--	--	**5,300**	--	**78,000**	**15,000**	**13,000**	**1,700**	**10,500**	**570**	--	--	--
B-2-GW*	7/10/09	--	~10 - 20	--	--	**2,300**	--	**60,000**	**13,000**	**13,000**	**890**	**4,800**	**120**	--	--	--
B-3	1/10/14	--	~12 - 13	--	--	**58#**	<50	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<0.50	<0.50
B-4	1/10/14	--	~12 - 13	--	--	**67#**	<50	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<0.50	<0.50
B-5	1/10/14	--	~12 - 13	--	--	**110#**	<50	**110**	**1.2**	**1.4**	**0.65**	**4.5**	**2.7**	**200**	**43**	<0.50
B-6 (2)	1/11/14	--	~11 - 12	--	--	**5,200^**	**360^**	**84,000**	**1,800**	**7,600**	**2,400**	**12,000**	**5,100**	**180J**	**110**	<20
Monitoring Well Data																
DPE-1	9/22/10	15.81	9.21	0.00	6.60	<4,000 (1)	--	**120,000**	**25,000**	**18,000**	**3,300**	**17,000**	**320**	**320**	**620**	<40
Screen	9/28-10/3/10	15.81	--	--	--	5-day HVDPE Remedial Event										
~8' - 15'	10/18/10	15.81	9.26	sheen	6.55	<4,000 (1)	--	**97,000**	**15,000**	**20,000**	**1,600**	**11,000**	**490**	**270**	**390**	<40
	1/20/11	15.81	8.56	sheen	7.25	<3,000 (1)	--	**83,000**	**12,000**	**16,000**	**2,000**	**11,000**	**270**	<200	**220**	<40
	7/6/12	15.81	8.85	0.00	--	--	--	--	--	--	--	--	--	--	--	--
	7/9-7/24/12	15.81	--	--	--	15-day HVDPE Remedial Event										
	8/12/12	15.81	9.03	0.00	6.78	<2,000 (1)	--	**71,000**	**7,500**	**9,800**	**1,000**	**6,500**	**280**	**89**	**190**	<15
	2/11/13	15.81	8.74	0.00	7.07	<3,000 (1)	--	**81,000**	**9,400**	**14,000**	**1,800**	**10,000**	**240**	**110**	**210**	<15
	1/10/14	15.81	9.84	0.00	5.97	**1,600^**	**56^**	**98,000**	**14,000**	**13,000**	**2,100**	**12,000**	**270**	**200**	**270**	<25
DPE-2	9/22/10	16.01	9.44	0.00	6.57	<4,000 (1)	--	**110,000**	**21,000**	**18,000**	**3,100**	**14,000**	**200**	**260**	**540**	**110**
Screen	9/28-10/3/10	16.01	--	--	--	5-day HVDPE Remedial Event										
~8' - 15'	10/18/10	16.01	9.48	sheen	6.53	<5,000 (1)	--	**84,000**	**11,000**	**16,000**	**1,600**	**9,200**	**77**	<200	**220**	**77**
	1/20/11	16.01	8.77	sheen	7.24	<5,000 (1)	--	**94,000**	**12,000**	**19,000**	**2,500**	**13,000**	**64**	<200	**220**	**88**
	7/6/12	16.01	9.06	0.00	--	--	--	--	--	--	--	--	--	--	--	--
	7/9-7/24/12	16.01	--	--	--	15-day HVDPE Remedial Event										
	8/12/12	16.01	9.27	0.00	6.74	<2,000 (1)	--	**70,000**	**9,900**	**16,000**	**1,700**	**9,600**	**54**	<200	**160**	**56**
	2/11/13	16.01	8.95	0.00	7.06	<4,000 (1)	--	**60,000**	**7,300**	**9,500**	**1,400**	**7,000**	**34**	<90	**120**	<20
	1/10/14	16.01	10.08	0.00	5.93	**2,800^**	<50	**100,000**	**17,000**	**15,000**	**2,400**	**11,000**	**120**	**100**	**220**	**27**
DPE-3	9/22/10	15.87	9.43	0.00	6.44	insufficient water column for sampling (i.e. <0.5-ft)										
Screen	9/28-10/3/10	15.87	--	--	--	5-day HVDPE Remedial Event										
~6' - 10'	10/18/10	15.87	9.35	0.00	6.52	insufficient water column for sampling (i.e. <0.5-ft)										
	1/20/11	15.87	8.51	**0.13**	7.36	no groundwater sample collected, LNAPL present.										
	7/6/12	15.87	8.65	0.00	--											
	7/9-7/24/12	15.87	--	--	--	15-day HVDPE Remedial Event										
	8/12/12	15.87	9.02	sheen	6.85	<200,000 (1)	--	**190,000**	**1,400**	**7,800**	**3,700**	**29,000**	**27**	**120**	**40**	**130**
	2/11/13	15.87	8.34	sheen	7.53	<40,000 (1)	--	**130,000**	**4,700**	**9,000**	**1,900**	**25,000**	<40	<200	**54**	**80**
	1/10/14	15.87	Dry	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

Screen	Well screen depth interval.
TOC	Top of casing relative to feet above mean sea level (ft MSL) (ref NAVD88).
DTW	Depth to water (for borings DTW shows "depth to water" and "depth to bottom of boring")
LNAPL	Light non-aqueous phase liquid petroleum, "sheen" is an immeasurable thickness (i.e. <0.01-ft)
GWE	Groundwater Elevation (TOC-DTW) in ft MSL. (This does not account for LNAPL thickness, if present).
TPHd	Total petroleum hydrocarbons as diesel by EPA Method 8015M, *8015B. SGCU = Silica-gel cleanup prior to analysis.
TPHg	Total petroleum hydrocarbons as gasoline by EPA Method 8260B, *8015B.
BTEX	Benzene, toluene, ethylbenzene, and xylenes by EPA Method 8260B, *8021B.
	Note: total xylenes equal the sum of sepearate isomers reported for the 7/09 samples.
MTBE	Methyl tert-butyl ether by EPA Method 8260B, * 8021B.
TBA	Tert-butanol by EPA Method 8260B.
1,2-DCA, EDB	1,2-dichloroethane, 1,2-dibromoethane by EPA Method 8260B.
µg/L	Micrograms per liter.
<###	Not detected at or above the indicated reporting limit.
---	Data not available, not monitored, or not sampled
^	Laboratory Flag: Hydrocarbons are lower-boiling than typical Diesel Fuel
#	Laboratory Flag: Discrete peaks in Diesel range, atypical for Diesel Fuel
J	Laboratory Flag: TBA concentration may be biased slightly high due to conversion of a small fraction of MTBE to TBA during water sample analysis.
(1)	Method detection limit increased due to ineterference from gasoline range hydrocarbons
(2)	Repeat analysis by Method 8260B yielded inconsistent results. The concentrations appear to vary between bottles. The highest valid result is reported.

Table 4
SUB-SLAB VAPOR SAMPLE ANALYTICAL DATA
Terradev Jefferson LLC Property
645 Fourth St.
Oakland, CA

			Consituent Concentrations									Soil Gas Concentrations			Tracer Gas In Shroud	Tracer Gas In Sample	Tracer Gas Leak Percent^	Sample Can Vacuum End of	Sample Can Vacuum Arrival
Sample I.D.	Sample Date	sample container	TPHg (µg/m³)	B (µg/m³)	T (µg/m³)	E (µg/m³)	X (µg/m³)	MTBE (µg/m³)	Naphthalene (µg/m³)	1,2-DCA (µg/m³)	EDB (µg/m³)	O_2 (%)	CO_2 (%)	CH_4 (%)	He - Avg (%)	He (%)	Leak (%)	Sampling ("Hg)	at Lab ("Hg)
VP-1	6/16/12	1-L	1,300	38	120	21	138	7.3	<0.09	<0.14	<0.050	15	0.096	<0.008	22.2	2.4	10.8%	~8	~6
VP-1	9/22/12	1-L	<330	<8.0	<9.4	<11	<22	<9.0	<13	<10	<3.8	19	0.78	<0.008	20.0	0.19	1.0%	~5	~6
VP-1	1/25/14	1-L	<330	<8.0	<9.4	<11	<22	<9.0	<13	<10	<3.8	14	4.7	<0.008	5.7	0.023	0.40%	~5	~5
VP-2	6/16/12	1-L	1,200	66	25	2.6	8.2	<6.3	<0.090	<0.14	<0.050	11	1.3	<0.009	13.8	<0.003	<0.02%	~8	~7
VP-2	9/22/12	1-L	<330	<8.0	<9.4	<11	<22	<9.0	<13	<10	<3.8	14	4.0	<0.008	19.0	<0.003	<0.02%	~7	~6
VP-2	1/25/14	1-L	<330	<8.0	<9.4	<11	<22	<9.0	<13	<10	<3.8	12	7.4	<0.008	6.6	<0.003	<0.05%	~5	~5
VP-3	6/16/12	1-L	960	16	19	2.9	20	<5.8	<0.08	<0.13	<0.050	16	0.029	<0.008	23.6	2.6	11%	~5	~5
VP-3	9/22/12	1-L	<330	<8.0	<9.4	<11	<22	<9.0	<13	<10	<3.8	20	0.46	<0.008	15.7	0.036	0.23%	~5	~6
VP-3	1/25/14	1-L	<330	<8.0	<9.4	<11	<22	<9.0	<13	<10	<3.8	19	1.5	<0.008	6.6	0.012	0.18%	~5	~5

ESLs Comm/Indus Soil Gas	*3,100,000*	*420*	*1,300,000*	*4,900*	*440,000*	*47,000*	*360*	*580*	*170*
CHHSLs Comm /Indus Soil Gas	*NA*	*122*	*378,000*	*NA*	*879,000*	*13,400*	*106*	*167*	*NA*

Notes:

TPHg	Total Petroluem Hydrocarbons as gasoline by EPA Method TO-15
BTEX, MTBE	Benzene, Toluene, Ethylbenzene, and Total Xylenes, Methyl tert-Butyl Ether by EPA Method TO-15(M) GC/MS (note: Xylene number shown in table is the sum of xylene isomers reported by lab)
Naphthalene	Naphthalene by EPA Method TO-15
1,2-DCA, EDB	1,2-dichloroethane, 1,2-dibromoethane by EPA Method TO-15
O_2, CO_2, CH_4, He	Oxygen, Carbon Dioxide, Methane, and Helium by modified ASTM D-1946
µg/m³	Micrograms per cubic meter
<#.##	Compound not detected at or above the reported laboratory detection limit
ESLs	Environmental Screening Levels for Soil Vapor in Commercial/Industrial or Residential setting (SFBRWQCB 2013)
CHHSLs	California Human Health Screening Levels for Soil Vapor in Commercial/Industrial or Residential setting (CalEPA/OEHHA2005)
Tracer Gas in Shroud	Concentration range of tracer gas in shroud recorded during sample collection. Average = (Max - Min) / 2
Tracer Gas in Sample	Concentration of tracer gas in sample as detected by lab analysis.
Tracer Gas Leak into Sample	If helium was detected in the sample, the concentration measured in the sample was divided by the average concentration in the shroud (and multiplied by 100 to convert to percent).
	^ a leak of less than 5% is considered acceptable for data evaluation.
	Shaded samples indicate a tracer gas leak of more than 5%.

September 3, 2014

Mr. Brian Gwinn
Blue Rock Environmental, Inc.
1169 Chess Drive, Suite C
Foster City, California 94404

Subject: Geophysical Survey
645 4th Street
Oakland, California

NORCAL Job No: 14-857.04

Dear Mr. Gwinn:

This report presents the findings of a geophysical survey performed by NORCAL Geophysical Consultants, Inc. at the subject address. The field survey was conducted on August 6th, 2014 by NORCAL California Professional Geophysicist David Hagin PGp 1033. Logistical support, site and safety information were provided on site by Mr. Brian Gwinn of Blue Rock Environmental, Inc. (Blue Rock).

1.0 SITE DESCRIPTION and SCOPE OF WORK

The area of investigation is a portion of the concrete sidewalk on the south side of 4th Street adjacent to the subject address. The dimensions of the area are 90 X 17 feet, as indicated by the dashed green line on Plate 1. A concrete patch measuring 21 X 7 feet is near the center of the area. Based on information supplied by Blue Rock, the patch covers an abandoned-in-place UST. Three monitoring wells are located adjacent to and/or on the patch; two water valve boxes and a utility pole are found approximately 30 feet north of the concrete patch, near the street. At the time of the survey the ground surface was dry.

The scope of work, as outlined by Blue Rock, is to search for evidence of any additional USTs within the area of investigation; the scope also includes locating detectable subsurface utilities or other subsurface features.

2.0 FIELD INVESTIGATIONS

2.1 EQUIPMENT

We investigated the designated survey area using the electromagnetic line locating/metal detection (EMLL) and ground penetrating radar (GPR) methods. The EMLL method was used in the electromagnetic conduction, ambient and metal detection (MD) modes. The conduction mode was used to locate metal utilities that are accessible from the surface in at least one location. This is typically done by applying a current to a line by directly connecting the transmitter to the exposed utility through a vault or a hose bib and operating a receiver to trace respective lines. The ambient procedure was used to locate utilities that exhibit currents already flowing on the line (passive signals). The most common passive signals are generated by live electric lines, water lines acting as electrical grounds and metal pipes re-radiating radio signals.

The MD mode is used to locate metal utilities that are not accessible at the surface and isolated buried objects such as USTs, utility vaults, and other metallic features or debris. This is done by holding the transmitter-receiver unit above the ground and continuously scanning over the surface. Metallic utilities and isolated objects will produce a response indicating when the unit is directly over the metal object.

The GPR method was used to confirm the location of the utilities detected with the EMLL, and to locate possible non-metallic utilities. Since GPR depth of detection is based on site specific soil conditions, not all subsurface features are detectable. Descriptions of the MD, EMLL, and GPR methods are provided in Appendix A.

2.2 SITE SURVEY

We investigated the designated survey area for detectable underground utilities and other potential subsurface features. The locations of all detected utilities were identified on the ground surface with marking paint. A brief description of our field procedures is presented below:

- Site Reconnaissance: We visually inspected the immediate area to locate visible utility vaults, valves, clean-outs, meters, hose bibs, etc.

- EMLL Direct Connect and Induction Survey: We traced accessible utilities using the EMLL direct connect and induction methods, as described above.

- EMLL Ambient Survey: We used the EMLL ambient procedure to investigate the survey area for non-accessible utilities emitting a passive signal, as described above.

- EMLL Metal Detection (MD) Survey: We scanned the survey area with the MD to investigate for metal utilities that were not accessible at the surface. Since the specific type of utility (i.e. water, gas, etc.) cannot be determined by this method, they are referred to as undifferentiated utilities. We also used the MD method to investigate the survey area for possible buried metal objects.

- GPR Survey: We obtained GPR data throughout the survey area. We examined the GPR records for reflection patterns characteristic of underground utilities and other potential subsurface objects, as well as changes in fill material that may be associated with utility corridors or USTs.

- Field Survey Map: Upon completion of the area survey, we drafted a scaled site diagram showing the limits of the geophysical survey, structures or above ground cultural features that are in close proximity to the site, and the locations of detected subsurface objects and utility alignments. The physical locations of detected features were obtained by measuring distances from specific features on site.

3.0 LIMITATIONS

All of the geophysical methods used for this investigation have limitations that may not allow for the detection of certain subsurface features due to size, depth, subsurface conditions or the proximity of above ground objects. The specific limitations for each method are described in Appendix A.

Any above-ground metallic items create instrumental interference and limit the detection abilities of the EMLL and MD. Also, highly conductive soils tend to limit the depth of investigation for the GPR.

4.0 RESULTS

The results of the geophysical investigation are summarized on the Geophysical Survey Map presented as Plate 1. This map depicts the locations of pertinent above-ground site features, the survey limits, the concrete patch, monitoring wells, water valves, a utility pole and the locations of detected underground utility lines.

We detected two water lines as well as several undifferentiated (unknown) utility lines. The locations and positions of these lines are presented on Plate 1. We note that the majority of the detected utilities are in the eastern half of the survey area.

We did not detect any areas with anomalous MD or GPR characteristics suggestive of the presence of any additional USTs at this location.

5.0 STANDARD CARE AND WARRANTY

The scope of NORCAL's services for this project consisted of using geophysical methods to explore the area of investigation for underground utilities. The accuracy of our findings is subject to specific site conditions and limitations inherent to the techniques used. We performed our services in a manner consistent with the level of skill ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

We appreciate having the opportunity to provide our geophysical services to Blue Rock Environmental, Inc. If you have any questions, or require additional geophysical services, please do not hesitate to call.

Respectfully,

NORCAL Geophysical Consultants, Inc.

David T. Hagin
Professional Geophysicist, PGp 1033

DTH/KGB/tt

Enclosure:	Plate 1:	GEOPHYSICAL SURVEY MAP
	Appendix A:	GEOPHYSICAL METHODOLOGY

Appendix A

GEOPHYSICAL METHODOLOGY, INSTRUMENTATION, DATA ANALYSIS, AND LIMITATIONS

Appendix A

GROUND PENETRATING RADAR (GPR)

Methodology

Ground penetrating radar is a method that provides a continuous, high resolution cross-section depicting variations in the electrical properties of the shallow subsurface. The method is particularly sensitive to variations in electrical conductivity and electrical permittivity (the ability of a material to hold a charge when an electrical field is applied).

The GPR system operates by radiating electromagnetic pulses into the ground from a transducer (antenna) as it is moved along a traverse. Since most earth materials are transparent to electromagnetic energy, the signal spreads downward into the subsurface. However, when the signal encounters a variation in electrical permittivity, a portion of the electromagnetic energy is reflected back to the surface. When the signal encounters a metal object, all of the incident energy is reflected. The reflected signals are received by the same transducer and are printed in cross-section form on a graphical recorder. Changes in subsurface reflection character on the GPR records can provide information regarding the location of USTs, sumps, buried debris, underground utilities, and variations in the shallow stratigraphy.

Instrumentation

The GPR system typically used is a Geophysical Survey Systems, Inc. SIR-2000 Subsurface Interface Radar Systems equipped with a 500 megahertz (MHz) transducer. This transducer is near the center of the available frequency range and is used to provide high resolution at shallow depths.

Data Analysis

GPR records are examined to identify reflection patterns characteristic of USTs, utilities, and other buried debris. Typically, USTs are manifested by broad localized hyperbolic (upside-down "U" shape) reflection patterns that vary in intensity. The intensity of a reflection pattern is usually dependent upon the condition of the respective UST, its burial depth, and the type of fill over the UST. Utilities and other buried debris are typically manifested by narrow localized hyperbolic reflections that also vary in intensity.

Limitations

The ability to detect subsurface targets is dependent on site specific conditions. These conditions include depth of burial, the size or diameter of the target, the condition of the specific target in question, the type of backfill material associated with the target, and the surface conditions over the target. Under ideal conditions, the GPR can generally detect objects buried to approximately six feet. However, as the clay content in the subsurface increases, the GPR depth of detection decreases. Therefore, it is possible that on-site soil conditions and target features may limit the depth of detection to the upper one to two feet below ground surface.

ELECTROMAGNETIC LINE LOCATION and METAL DETECTION (EMLL/MD)

Methodology

Electromagnetic line location techniques are used to locate the magnetic field resulting from an electric current flowing on a line. These magnetic fields can arise from currents already on the line (passive) or currents applied to a line with a transmitter (active). The most common passive signals are generated by live electric lines and re-radiated radio signals. Active signals can be introduced by connecting the transmitter to the line at accessible locations or by induction.

The detection of underground utilities is affected by the composition and construction of the line in question. Utilities detectable with standard line location techniques include any continuously connected metal pipes, cables/wires or utilities with tracer wires. Unless the utilities carry a passive current, they must be exposed at the surface or in accessible utility vaults. These generally include water, electric, natural gas, telephone, and other conduits related to facility operations. Utilities that are not detectable using standard electromagnetic line location techniques include those made of non-electrically conductive materials such as PVC, fiberglass, vitrified clay, and pipes with insulated connections.

Buried objects can also be detected, without direct contact, by using the induction mode. This is used to detect buried near surface metal objects such as rebar, manhole covers, USTs, and various metallic debris. The induction mode is used by holding the transmitter-receiver unit above the ground and continuously scanning the surface. The unit utilizes two orthogonal coils that are separated by a specified distance. One of the coils transmits an electromagnetic signal (primary magnetic field) which in turn produces a secondary magnetic field about the subsurface metal object. Since the receiver coil is orthogonal to the transmitter coil, it is unaffected by the primary field. Therefore, the secondary magnetic fields produced by buried metal object will generate an audible response from the unit. The peak of this response indicates when the unit is directly over the metal object.

Instrumentation

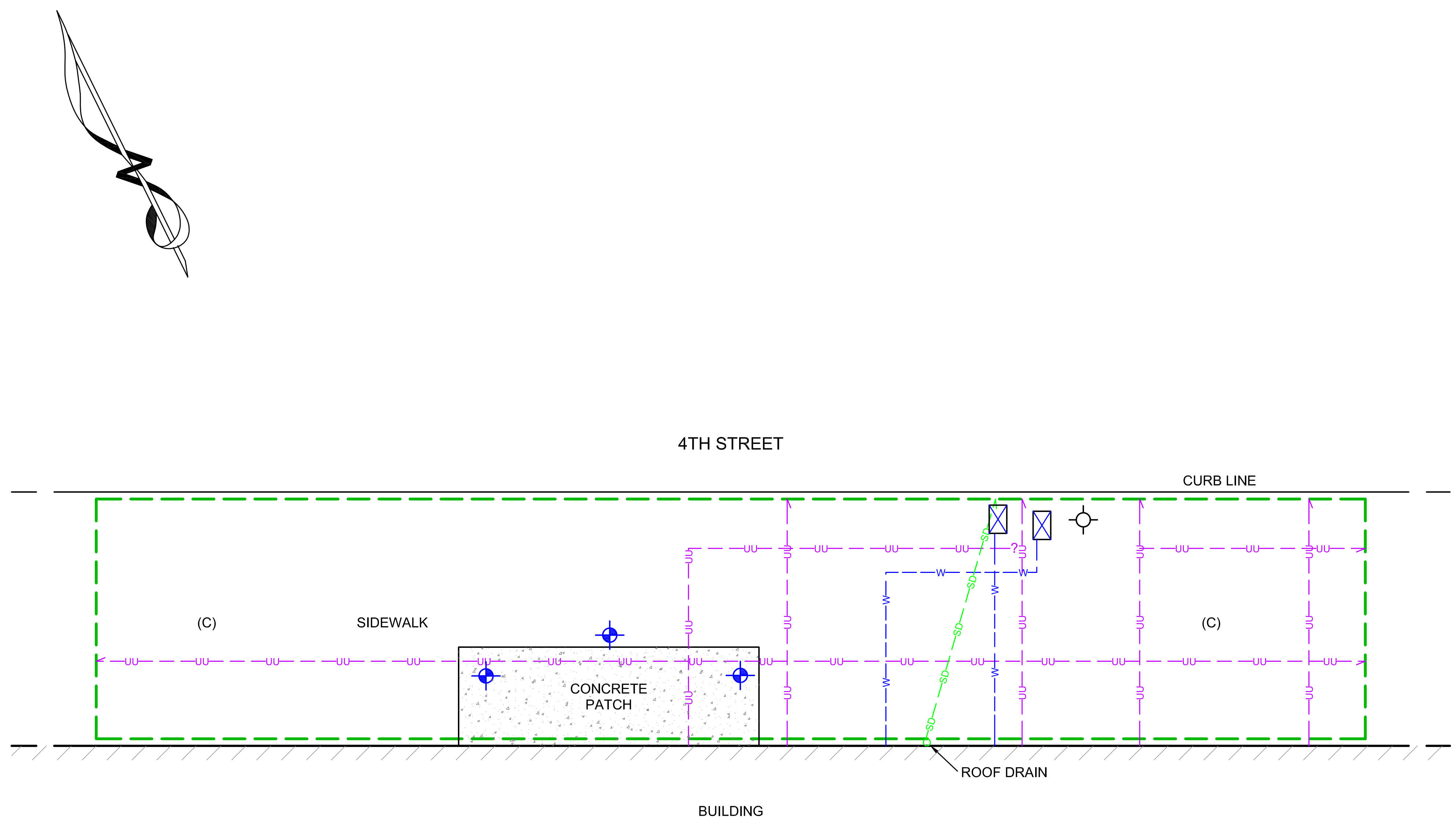
The instrumentation typically used for the EMLL survey consists of a Radio Detection RD-4000 and a Fisher TW-6 inductive pipe and cable locator.

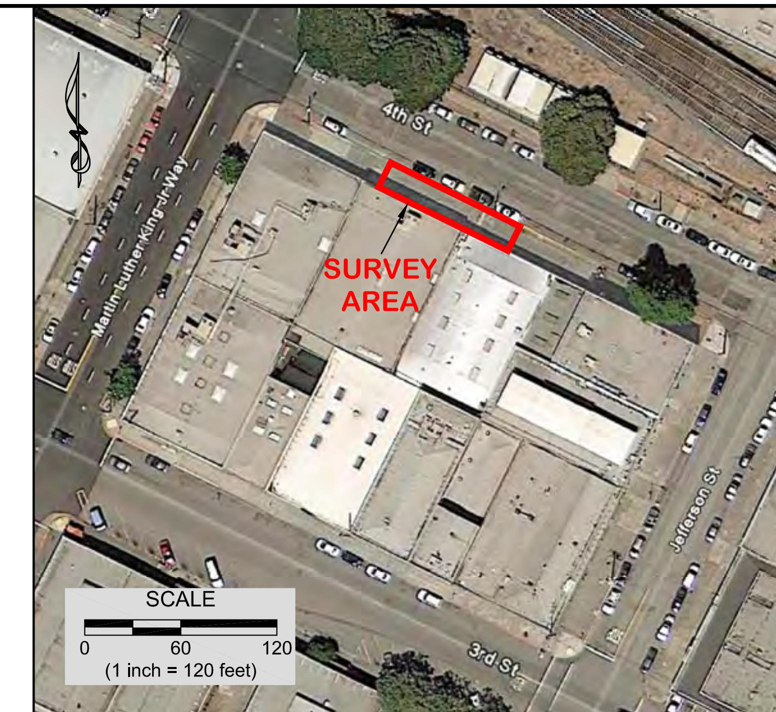
Data Analysis

The EMLL instrumentation indicates the presence of buried metal by emitting an audible tone; there are no recorded data to analyze. Therefore, the locations of buried objects detected with the EMLL method are marked on the ground surface during the survey.

Limitations

The detection of underground utilities is dependent upon the composition and construction of the line of interest, as well as depth. Utilities detectable with standard line location techniques include any continuously connected metal pipes, cables/wires or utilities with tracer wires. Unless carrying a passive current these utilities must be exposed at the surface or accessible in utility vaults. These generally include water, electric, natural gas, telephone, and other conduits related to facility operations. Utilities that may not be detectable using standard electromagnetic line location techniques include certain abandoned utilities, utilities not exposed at the ground surface, or those made of non-electrically conductive materials such as PVC, fiberglass, vitrified clay, and metal pipes with insulating joints. Pipes generally deeper than about five to seven feet may not be detected.





VICINITY MAP

SCALE

0 5 10 20

(1 inch = 10 feet)

LEGEND

— — —	LIMITS OF GEOPHYSICAL SURVEY
—SD—	STORM DRAIN LINE
—UU—	UNDIFFERENTIATED UTILITY LINE
—W—	WATER LINE
——→	UTILITY LINE CONTINUATION (LINE IS SUSPECTED TO CONTINUE BEYOND DETECTED LOCATION)
——?	UTILITY LINE NOT DETECTED BEYOND LOCATION (LINE MAY TERMINATE OR CONTINUE)
☒	WATER VALVE
⌖	WELL
⌖	UTILITY POLE
(C)	CONCRETE

LIMITATIONS:

The detected utilities, as shown, may not represent all of the existing underground utilities as there are limitations unique to each geophysical method. These limitations may include: 1) subsurface targets too small or at depths beyond the detection limits of specific instruments, 2) subsurface targets not having a significant contrast in physical properties with the surrounding soils and 3) other cultural features above or below ground that cause instrumental interference and do not allow the detection of certain subsurface targets.

Some utilities may not be detectable using standard line location techniques, such as certain abandoned utilities, utilities not exposed at the ground surface, or those made of non-electrically conductive materials such as PVC, fiberglass, vitrified clay, metal pipes with insulating joints, communication lines, and non-energized electrical lines. In addition, utilities with tracer wires may be unavailable to private utility locating companies due to security reasons.

NORCAL

GEOPHYSICAL SURVEY MAP
645 4TH STREET

LOCATION: OAKLAND, CALIFORNIA

CLIENT: BLUE ROCK ENVIRONMENTAL, INC.

JOB #: 14-857.04

NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: SEP. 2014

DRAWN BY: G.RANDALL

APPROVED BY: DTH

PLATE 1