



OFFICE OF ENVIRONMENT, HEALTH AND SAFETY
UNIVERSITY HALL, 3rd FLOOR

BERKELEY, CALIFORNIA 94720-1150

August 22, 2011

Lynn Nakashima
Project Manager
Department of Toxic Substances Control
700 Heinz Avenue
Berkeley, CA 94710

**Subject: University of California, Berkeley, Richmond Field Station
Response to DTSC Comments on the Phase I Groundwater Sampling Results Technical
Memorandum, DTSC Site Investigation and Remediation Order I/SE-RAO 07/07-004 Section
5.16**

Dear Ms Nakashima:

Please find enclosed the August 22, 2011 Final, Revision 1 Phase I Groundwater Sampling Results Technical Memorandum (two copies on paper and disc). This version updates the version submitted May 11, 2011 and incorporates all the edits requested by your July 21, 2011 letter. This submission (via email) includes the revised text, tables, and a response to comments. Two hard copies and electronic copies on CD will be sent to your office and will include all figures and attachments.

If you have any questions or need further information regarding this submittal, please contact me (gjhaet@berkeley.edu, 510-642-4848) or Karl Hans (khans@berkeley.edu, 510-643-9574).

Sincerely,

Greg Heat
EH&S Associate Director
Environmental Protection

Enclosure

cc:
Bill Marsh, Edgcomb Law Group
Anthony Garvin, UC Office of the General Counsel
Doug Mosteller, CSV

FINAL, Revision 1

Phase I Groundwater Sampling Results Technical Memorandum

University of California, Berkeley
Richmond Field Station, Richmond, California

Prepared for
Office of Environment, Health and Safety
University of California, Berkeley
317 University Hall, No. 1150
Berkeley, California 94720

August 22, 2011

Prepared by



TETRA TECH EM INC.
1999 Harrison Street, Suite 500
Oakland, California 94612

A handwritten signature in black ink, appearing to read 'Jason Brodersen', with a long horizontal line extending to the right.

Jason Brodersen, P.G., No 6262

CONTENTS

1.0	INTRODUCTION	1
1.1	PHYSICAL SETTING.....	1
1.2	INVESTIGATION PURPOSE	1
2.0	FIELD ACTIVITIES	3
2.1	UTILITY CLEARANCE	3
2.2	DRILLING AND COMPLETION.....	3
2.3	PIEZOMETER DEVELOPMENT	4
2.3	GROUNDWATER SAMPLING	5
2.4	WATER LEVEL MEASUREMENTS AND SURVEYING	6
2.5	WASTE CHARACTERIZATION AND DISPOSAL	6
3.0	GEOLOGY	8
4.0	HYDROLOGY	9
5.0	DATA QUALITY ASSESSMENT	10
5.1	DATA QUALITY OBJECTIVES	10
5.2	LABORATORY DATA REVIEW	10
5.3	DATA QUALITY REVIEW FINDINGS	11
5.4	DEVIATIONS	12
6.0	DATA EVALUATION	14
6.1	VOLATILE ORGANIC COMPOUNDS	14
6.2	SEMI-VOLATILE ORGANIC COMPOUNDS	14
6.3	METALS.....	15
6.4	TOTAL PETROLEUM HYDROCARBONS	16
6.5	EXPLOSIVES AND PERCHLORATES.....	16
7.0	REFERENCES	17

Attachment

1	GEOLOGIC BORING LOGS
2	WELL COMPLETION LOGS
3	WELL DEVELOPMENT LOGS
4	WELL PERMITS
5	WELL SAMPLING FORMS
6	COMPLETE ANALYTICAL RESULTS

CONTENTS (continued)

Appendix

A RESPONSE TO COMMENTS

Figure

- 1 SITE LOCATION MAP
- 2 SITE MAP
- 3 GROUNDWATER SAMPLING LOCATIONS
- 4 SHALLOW GROUNDWATER ELEVATION CONTOURS, NOVEMBER 1, 2010
- 5 SHALLOW GROUNDWATER ELEVATION CONTOURS, FEBRUARY 10, 2010
- 6 GEOLOGIC CROSS SECTION A-A'
- 7 GEOLOGIC CROSS SECTION B-B'
- 8 TDS RESULTS AND CONTOURS

Table

- 1 GROUNDWATER SAMPLE RATIONALE
- 2 GROUNDWATER SAMPLING REGISTRY
- 3 PIEZOMETER COMPLETION SUMMARY
- 4 PARAMETERS SUMMARY
- 5 STATE AND FEDERAL WATER QUALITY CRITERIA
- 6 VOC DETECTED RESULTS SUMMARY
- 7 SVOC DETECTED RESULTS SUMMARY
- 8 METALS DETECTED RESULTS SUMMARY
- 9 TPH SUMMARY
- 10 EXPLOSIVE RESIDUE AND PERCHLORATE DETECTED RESULTS SUMMARY

ACRONYMS AND ABBREVIATIONS

DPT	Direct push technology
QDO	Data quality objective
DTSC	Department of Toxic Substances Control
EMF	Electromagnetic field
EPA	Environmental Protection Agency
FSW	Field Sampling Workplan
ft bgs	Feet below ground surface
GPS	Global positioning system
HSA	Hollow stem auger
IDW	Investigation derived waste
J	Estimated value
LCS	Laboratory control sample
MCL	Maximum contaminant level
MDL	Method detection level
MFA	Mercury Fulminate Area
MS	Matrix spike
MSD	Matrix spike suppicate
Order	DTSC Site Investigation and Remediation Order No. IS/E-RAO 06/07-004
PAH	Polyaromatic hydrocarbons
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethylene
PID	Photo ionization detector
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
QL	Quantination limit
R	Invalid data
RDL	Required detection limit
RFS	Richmond Field Station
RSI	RSI Drilling Inc.
SVOC	Semi volatile organic compounds
TCE	Trichloroethylene
TDS	Total dissolved solids

ACRONYMS AND ABBREVIATIONS (continued)

Tetra Tech	Tetra Tech EM Inc.
TPH-E	Total extractable petroleum hydrocarbons
TPH-P	Total purgeable petroleum hydrocarbons
U	Not detected
UC Berkeley	University of California, Berkeley
ug/L	Micrograms per liter
UJ	Not detected at an estimated value
VOC	Volatile organic compound

1.0 INTRODUCTION

This technical memorandum has been prepared on behalf of The Regents of the University of California (UC) in accordance with California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), Site Investigation and Remediation Order No. IS/E-RAO 06/07-004 (Order), dated September 15, 2006. This memorandum describes the results of the Field Sampling Workplan (FSW) Phase I Groundwater Sampling Plan, dated June 2, 2010 (Tetra Tech EM Inc [Tetra Tech] 2010). The objective of the FSW is to address data gaps identified in the Current Conditions Report (Tetra Tech 2008) and identify immediate or potential risks to public health and the environment. The first phase of the FSW consisted of a site-wide groundwater sampling investigation to determine overall groundwater characteristics and confirm or deny the presence of any unknown groundwater contamination conditions.

This memorandum presents a summary of field activities, site geology, site hydrology, data quality assessment, and data evaluation. The report attachments provide field documentation forms as well as complete analytical results.

1.1 PHYSICAL SETTING

The Richmond Field Station (RFS) is located at 1301 South 46th Street, Richmond, California, along the southeastern shoreline of the City of Richmond on the San Francisco Bay and northwest of Point Isabel (see Figure 1). It consists of upland areas developed for academic teaching and research activities, an upland remnant coastal terrace prairie, a tidal salt marsh, and a transition zone between the upland areas and marsh. Between the late 1800s and 1948, several companies, including the California Cap Company, manufactured explosives at the RFS. In 1950, The UC Regents purchased the property from the California Cap Company. UC Berkeley initially used the RFS for research for the College of Engineering; later, it was also used by other campus departments.

Three habitat type areas have been identified at RFS: (1) the Upland Area, (2) the Transition Area, and (3) the Western Stege Marsh (see Figure 2). The Upland area consists of 96 acres of land bounded by Meade Street to the north, South 46th Street to the east, the Transition Area to the south, and Meeker Slough and Regatta Boulevard to the west. The Transition Area occupies approximately 5.5 acres and is bounded to the north by the Upland Area at the location of a buried, former seawall that is believed to have been the edge of the historic mudflats, and to the south by Western Stege Marsh at the 5-foot elevation upper extent of the marsh (National Geodetic Vertical Datum 29). The Transition Area is believed to consist entirely of artificial fill placed on historic mudflats. Western Stege Marsh occupies approximately 7.5 acres and is bounded by the Transition Area to the north, the RFS connector trail to the East Bay Regional Park District Trail and Eastern Stege Marsh to the east, the Bay Trail to the south, and Meeker Slough and Marina Bay housing development to the west (see Figure 2).

1.2 INVESTIGATION PURPOSE

The possible presence of contaminants in groundwater at RFS was identified as a data gap in the Current Conditions Report (Tetra Tech 2008). Potential sources include contamination from off-site sources as well as potential contamination from previous site activities that may have leached from soil or underground utilities to groundwater. The Phase I FSW field effort was conducted to

address these data gaps through the installation of piezometers throughout the RFS (see [Figure 3](#)), which were strategically sited at critical down gradient locations from previously identified data gaps (see [Figures 4 and 5](#)). Data collected from the installed and developed piezometers included groundwater samples, geology, and depth to water measurements, was used to develop a hydrogeologic model of the site, and improve the understanding of overall site-wide groundwater quality.

2.0 FIELD ACTIVITIES

The sampling strategy for Phase I consisted of drilling, constructing, developing, and sampling 51, 2-inch diameter completed piezometers throughout the RFS, as well as sampling three previously-installed piezometers. Groundwater samples were analyzed for dissolved metals, pesticides, polychlorinated biphenyls (PCB), semi-volatile organic compounds (SVOC), total extractable petroleum hydrocarbons (TPH-e), total purgeable petroleum hydrocarbons (TPH-p), polycyclic aromatic hydrocarbons (PAH), and volatile organic compounds (VOC). In addition, the depth to groundwater and water quality parameters such as total dissolved solids (TDS), dissolved oxygen, pH, oxidation-reduction potential, specific conductance, and temperature, were measured at each location. Certain locations included additional analytes based on site history. Rationales for groundwater sampling locations, depths, and analyses are presented in [Tables 1 and 2](#) of the FSW and this report.

2.1 UTILITY CLEARANCE

Prior to any subsurface disturbance, the piezometer locations were sited with a hand-held global positioning system (GPS) unit and marked with either a spray paint or stakes, depending upon the ground surface. Utility clearance included contacting Underground Service Alert to inform them that digging would occur and obtaining a dig ticket, as well as site-specific screening. Tetra Tech contracted Precision Locating to locate any underground utilities in the vicinity of the proposed piezometers using electromagnetic field (EMF) detectors. Tetra Tech accompanied the utility locator, helping to identify the piezometer locations, as well as providing existing utility maps to mark known utility locations. Once an underground utility was detected, its estimated location and bearing were marked with spray paint.

Several piezometer locations were adjusted to keep the drilling locations a safe distance from underground utilities. In areas near known or presumed utilities, boreholes were hand-augured to 5 feet below ground surface (ft bgs) for additional utility clearance.

2.2 DRILLING AND COMPLETION

Tetra Tech contracted with RSI Drilling, Inc. (RSI) to perform all piezometer drilling and completion work. Forty-seven of the newly installed piezometers targeted groundwater in the shallow horizon and four additional piezometers targeted a lower groundwater horizon. A summary of the newly installed piezometers is provided in [Table 3](#). Drilling and installation of 49 of the 51 piezometers took place between July 26 and August 12, 2010. The two remaining piezometers, located in the site feature referred to as the “Bulb area”, were drilled and installed on October 18, 2010. The installation of these two locations was delayed to prevent interference with the California Clapper Rail breeding season which ends annually on September 1st.

All boreholes were drilled with a track mounted, dual direct-push technology (DPT) and hollow-stem auger (HSA) drill rig. Boreholes were initially advanced using 2-inch diameter DPT rods that collected a continuous core sample in acetate sleeves for analysis by an on-site geologist. The continuous cores of each borehole were logged by soil type, color, and moisture. Small soil samples were collected from the cores at periodic depth intervals and were placed in marked ziplock bags. These bags were stabilized for a minimum of 10 minutes, then a photo ionization

detector (PID) was used to detect possible VOCs in the soil cuttings. The boring logs, including VOC readings from the PID, are included in [Attachment 1](#).

Based on the lithology and moisture content, the on-site geologist estimated a depth to groundwater which was used to position the piezometer screen and determine total depth of the HSA boring. Each borehole was then drilled using 8.25-inch outside diameter, 4-inch inside diameter hollow-stem augers. The soil cuttings from the drilling activities were drummed, labeled, and moved to the secured on-site drum storage location west of Building 110.

The piezometers were installed in the borehole through the hollow stem of the auger after the HSA drilling was completed. The final depth of the 47 shallow boreholes varied between 13 and 20 ft bgs while the 4 boreholes that penetrated to a deeper underlying groundwater zone were completed between 40 and 44 ft bgs. The piezometer screen intervals were determined in the field by the on-site geologist. For the shallow piezometers, each screened interval was 10 feet in length and was positioned so that the screen interval extended 2 feet above the estimated groundwater table. The screen interval on the deep piezometers extended from 30 ft to 40 ft bgs with the exception of piezometer B480Deep which extended from 35 to 40 ft bgs. All piezometers were constructed from 2-inch diameter schedule 40 polyvinyl chloride (PVC) blank casing with 2-inch diameter schedule 40 PVC screen with 0.01-inch slot size. The screen intervals of the piezometers were encased in a filter pack consisting of #2/12 kiln-fired sands that was tremied into place through the HSA. The filter pack extended from the bottom of the boring to 1 foot above the top of the PVC screen where a 2-foot-thick seal of hydrated bentonite chips was installed. The remainder of the boring surrounding the PVC casing was filled with an annular seal of Portland cement grout to within 1 foot of the ground surface.

Steel well christy boxes were used to complete the piezometers. Depending on the type of ground surface, the steel well casing was either installed flush with the existing surface or a few inches above grade. The above grade casings were then encased in a 2 foot by 2 foot concrete pad to protect the piezometers from accidental damage. A locking well cap, to prevent rain or irrigation water from entering the piezometers, was placed on each completed piezometer. At the request of DTSC, the well casing surrounding location B474 was raised several feet, and is surrounded by a steel stove-pipe stickup. All piezometer completion logs are included in [Attachment 2](#).

2.3 PIEZOMETER DEVELOPMENT

Following completion, the piezometers were allowed to stabilize for a minimum of 24 hours before development began to ensure that the bentonite and annular seals had set. Following the minimum stabilization period, the piezometers were opened, a depth to water measurement was recorded, and the development process initiated. The piezometers were initially surged for a minimum of 10 minutes using a surge block and pulley system that forces water into and out of the filter pack. After the surge process was complete, the piezometers were bailed for a minimum of 10 minutes to remove excessive sediments from the standing water in the piezometers. A pump connected to the development rig was then inserted into the piezometer and the final step in piezometer development began. The discharge water from the pump was run through a flow-cell that measured groundwater turbidity, dissolved oxygen content, pH, temperature, and electrical conductance among other parameters. The discharge water was then collected in a drum. Piezometer development logs showing the varying groundwater parameters are included in [Attachment 3](#).

The amount of groundwater that was pumped during the development phase varied for each piezometer and depended on the length of the water column in each piezometer. A minimum of 3 times the volume of water within the filter pack and piezometer casing was purged during development. Pumping would continue beyond 3 times the volume if the parameters measured by the flow cell had not stabilized. The total volume purged from each piezometer varied between 6 and 65 gallons but averaged just over 25 gallons per piezometer. Due to the tight lithologic formations where the shallow piezometers were screened, the piezometers often became dry during the development process. Some of the piezometers were successfully developed using a low-flow peristaltic pump while still others required time to recharge over one or several nights in order to supply the minimum required amount of purge water.

All pumped groundwater was captured in drums which were then labeled and moved to the secure on-site drum storage location west of Building 110.

2.3 GROUNDWATER SAMPLING

Sampling of the newly installed piezometers and three existing piezometers was conducted between September 3 and October 19, 2010. Groundwater sampling was protracted to accommodate the U.S. Environmental Protection Agency (EPA) Region 9 Laboratory's capacity to process the samples. Per the EPA request, 10 to 11 piezometers were sampled over 2 days each week. The groundwater from each sampled piezometer was collected through sterile Teflon and silicone tubing using a low-flow, peristaltic pump. The discharge from the pump ran through a flow cell which measured turbidity, dissolved oxygen content, pH, temperature, and electrical conductance. Groundwater samples were collected from each piezometer after the parameters stabilized to within the acceptable ranges as shown on the groundwater sample collection sheets included in [Attachment 5](#). Groundwater results are discussed in [Section 6](#).

Ample sample volume was collected from the shallow piezometers to submit samples for laboratory analysis of dissolved metals, pesticides, perchlorates, PCBs, PAHs, SVOCs, TPH-e, TPH-p, TDS, and VOCs. Samples were immediately placed in coolers containing ice. At the end of each day, the samples were delivered to the EPA Region 9 laboratory located at the RFS.

Additional sample volume was collected at the former dry house and test pit locations to allow for laboratory analysis of explosive residue. These samples were placed in coolers containing ice and were delivered the same day to Curtis and Tompkins Laboratory in Berkeley, CA.

At piezometer locations CTPS and EERC, the piezometers could not yield the required sample volume. The field sampling team returned to these locations in the next few days allowing the piezometers to recharge. The piezometers were purged until stabilization occurred, then the remaining sampling volume was collected. At location B450, no sample could be collected following development due to insufficient groundwater recharge into the piezometer. The field sampling team returned to this location on many occasions; however, the piezometer would not yield groundwater after less than 1 gallon was purged.

Chemical analysis was not conducted at the deep piezometer locations. Groundwater parameters were recorded and following stabilization, samples for TDS were collected, placed on ice and delivered to the EPA Region 9 laboratory, see [Table 4](#).

2.4 WATER LEVEL MEASUREMENTS AND SURVEYING

A comprehensive set of depth to water measurements for all piezometers were recorded on November 1, 2010 to coincide with a similar field event occurring on the adjacent Campus Bay property. A small notch was placed at due North location at the top of each PVC piezometer casing so that the measurement could be taken from the same reference location during future measuring events. The depth to water in all 51 of the newly installed piezometers was measured from the top of the PVC casing to 0.01 foot accuracy using a water level meter. If the piezometers were found to be pressurized, then the well cap was removed for a minimum of 10 minutes prior to the depth to water measurement to allow for the water level to adjust. A second round of groundwater measurements was collect on February 10, 2010 to assess seasonal variation in groundwater elevations and contours. The depths to water measurements were recorded in the field notebook and are included on [Figure 4](#) and [Figure 5](#).

On November 1 and November 16, all existing piezometers were surveyed by a licensed land surveyor. The elevation for the top of each piezometer casing was measured to sub 0.01 foot accuracy and recorded in the NAVD88 elevation datum. This elevation data was used with the measured depths to water to determine the water table elevations and estimated gradients across the RFS. Groundwater contour maps created from this data is shown on [Figure 4](#) and [Figure 5](#).

2.5 WASTE CHARACTERIZATION AND DISPOSAL

All investigation derived waste (IDW) created during the field effort was drummed, labeled, and moved to a fenced storage location west of Building 110. The drums containing soil cuttings were characterized by four composite samples. During the drilling process, once the DPT cores had been logged, the field samplers scraped the length of the core, obtaining equal volume from the entire depth interval. This sample was placed in an appropriate sample jar and labeled. Following the completion of drilling, five soil waste streams were identified.

- Sample WASTE1 is representative of soil collected from piezometers installed in the core of the former California Cap Company buildings and Mercury Fulminate Area (MFA), which have a higher potential for elevated metals concentrations based on previous site investigations. Piezometers installed in this area consist of B128, MFA, CCC3, and CCC2.
- Sample WASTE7 is representative of soil collected from piezometers installed in the “Bulb” area adjacent to the marsh, which consists of fill material from undocumented sources. Piezometers installed this area consist of Bulb1 and Bulb2.
- Sample WASTE3 is representative of any soil containing visually-identified cinders. These soils were segregated into a separate drum for analysis.
- Sample WASTE4 represents any soil with elevated PID readings. Elevated PID readings were only identified at piezometer B163. Encore samples were collected for VOC analysis from the drum containing soil from location B163.
- Sample WASTE2 represents soil generated from all remaining piezometer installations.

Representative soil from each waste stream was combined, homogenized, and sub-sampled. All of these samples were delivered to Curtis and Tompkins, located in Berkeley, CA for analysis. Additionally, at the two Bulb locations, soil was collected and submitted to Eberline Analytical for gross alpha, gross beta, and tritium analysis due to historic concerns for radiologic disposal in this area. A soil sample was also collected from the location CTP and used for comparison to the Bulb results as a background concentration. The results indicate that the Required Detection Limit (RDL) was achieved for each analyte requested. The activity measured in soil from the locations Bulb1 and Bulb2 was not statistically different from soil evaluated from location CTP. Not statistically different in this case was defined as activity less than the background levels or within the 2 sigma error (95% confidence level) associated with each measurement.

The drums containing auger rinse water (drummed water and sediment produced from the water used to steam clean the drilling equipment between locations) was characterized with one composite sample, WASTE6. A clean bailer was used to collect equal amount water from each of the drums, which was then combined in a decontaminated 5-gallon bucket and the sample volume was collected from this composited water. The drums containing water purged from piezometers during the development and sampling processes were characterized through the samples collected and analyzed as part of the field sampling effort.

3.0 GEOLOGY

As presented in the Current Conditions Report ([Tetra Tech 2008](#)), four major geologic units were defined for the RFS as follows:

- Artificial Fill
- Quaternary Alluvium
- Bay Sediments
- Yerba Buena Mud (Older Bay Mud)

The borings for this investigation were limited to the upper 40 feet; therefore, only the artificial fill, alluvium, and to a lesser extent bay sediments were encountered. Artificial fill was difficult to differentiate from the underlying alluvium because it was of a similar lithology and texture. The lithology of the fill and alluvium can be grouped into four basic soil types: silt/clay, clayey gravel, clayey/silty sand, and sand. In most cases, the gravels contained clay and sand and the clays layers had an estimated 5 to 40 percent sand or gravel. The relationship between the lithologies was typical of a coastal alluvial plain: thin interbedded layers of clays, silts, sands, and gravels that were laterally discontinuous. The fine-grained sediments (clays and silts) could have been deposited as over-bank flood-plain deposits and the coarse grained sediments could be from former stream or river beds meandering across a flood plain. The meandering of former surface water channels likely causes the lateral variation in the lithologies observed in the borings.

Two geologic cross-sections were developed to aid in the description of the site stratigraphy. Section A-A' provides an east-west transect, as shown on [Figure 6](#). Section B-B' provides a north-south transect, as shown on [Figure 7](#). Generally, the horizontal extent of individual layers of clay, sand, and gravel is limited in the upper 20 ft bgs, as would be expected in a coastal alluvial depositional environment. Between 20 and 44 ft bgs, less variation in lateral extent is observed, although this could be an artificial result of fewer borings to define the deeper horizons.

4.0 HYDROLOGY

As presented in the previous section, the geologic materials encountered at the site included clays, silts, sands, and gravels. Generally, the coarser-grained materials are expected to transmit or yield more groundwater; however, most of the gravels and sands contained a silt/clay fraction which may severely inhibit groundwater flow or yield. A few exceptions were encountered where cleaner sand lenses occurred, which were classified in the field as well-graded and poorly-graded sands. In the upper 20 ft bgs, these sand lenses only occurred over short lateral distances. Based on the limited number of deeper borings, a more continuous thin layer of sand may be present between depths of 35 and 40 ft bgs.

As presented in Section 2.0, 51 piezometers were installed throughout the site. Because of the somewhat uniform spacing and broad coverage of the piezometer locations, comprehensive groundwater flow directions were determined. Figure 4 and Figure 5 show the groundwater elevations measured on November 1, 2010 and February 10, 2011, respectively, and the resulting contours from the shallow piezometers. The November groundwater elevations are likely representative of the dry season since no major rainfall had occurred 6 months prior to their measurement. The February measurements represent the mid-point of the wet season. Groundwater generally flows onto the site from the northeast and across the site to the southwest. Groundwater elevations will continue to be collected quarterly and a more thorough assessment of seasonal variation in groundwater flow will be presented in a future monitoring report.

The horizontal groundwater gradient or slope is estimated from the November groundwater contours. The gradient within the northeast portion of the site is approximately 0.008 ft/ft. The gradient within the central portion of the site is slightly flatter at 0.002 ft/ft. The gradient in the southern portion of the site is approximately 0.004 ft/ft. The variation in gradients is likely influenced by local areas of recharge due to varying surface cover and features and the variation in hydraulic conductivity of the soil. A localized variation in the groundwater gradient was encountered near location B175W, where the groundwater elevations were higher than nearby piezometers. This variation is likely due to discharge from a broken freshwater pipe that was recently identified and repaired. Although this variation is still present in the February contours, the water levels for the center of the mounding area only rose 0.2 feet while the nearby wells rose approximately 1.5 to 2 feet. Based on this observation, the water levels in this area are dissipating. As discussed in Section 3.0, the RFS is predominately made of clayey soil with inherently low permeability; therefore the dissipation of this area could take several months to over a year.

Vertical groundwater gradients were also determined from the November contours at the shallow/deep well pairs. Two of the well pairs had a calculated an upward gradient (480 at 0.25 ft/ft and B38 at 0.015 ft/ft) and two of the well pairs had a calculated downward gradient (CTP at 0.038 ft/ft and B128 at 0.031 ft/ft). The upward gradient at piezometer 480 was significantly higher than the other three calculated vertical gradients. Further assessment of seasonal variation of vertical groundwater gradients will be presented in a future monitoring report.

5.0 DATA QUALITY ASSESSMENT

5.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQO) were developed during the FSW planning process to help ensure the collection of data appropriate for support of defensible decisions. The DQOs stated the need for additional groundwater data collection at the RFS to develop a hydrogeologic model of the site and to improve overall understanding of groundwater quality. The implementation of this objective was achieved through the strategic placement of the 51 groundwater monitoring piezometers that spanned the RFS from fenceline to fenceline and also targeted specific locations defined as data gaps in the Current Conditions Report. The data collected was adequate to create a hydraulic gradient map and help gain a better understanding of the general hydrology at the RFS. Additionally, the chemical data collected improved site knowledge of areas identified as data gaps as well as areas previously uncharacterized. With the exception of piezometer B450, the 50 piezometers located in the shallow groundwater zone were sampled according to the sampling plan and quality assurance project plan in the FSW (Tetra Tech 2010). The analytical data achieved appropriate method detection levels (MDL) to be compared to relevant State and Federal groundwater criteria.

5.2 LABORATORY DATA REVIEW

Assignment of data qualification flags for analytical data from both the EPA Region 9 laboratory and Curtis and Tompkins conformed to EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA 2008) and Inorganic Data Review (EPA 2010). Data review specifications require that various data qualifiers be assigned when a deficiency is detected or when a result is less than its detection limit. If no qualifier is assigned to a result that has been reviewed, the data user is assured that no technical deficiencies were identified during validation. The qualification flags used are defined as follows:

- U – Indicates that the chemical was not detected at the numerical detection limit (sample-specific detection limit) noted. Non-detected results from the laboratory are reported in this manner.
- UJ – Indicates that the chemical was not detected; however, the detection limit (sample-specific detection limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.
- J – Indicates that the chemical was detected; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is considered to be an estimate of the true concentration.

- R – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (for example, a holding time missed by a factor of two times the specified time limit, severe calibration non-compliance, or extremely low analyte recovery in quality control [QC] spike samples).

The preceding data qualifiers may be categorized as indicating major or minor problems. Major problems are defined as issues that result in the rejection of data and qualification with R qualifiers. These data are considered invalid and are not used for decision-making unless they are used in a qualitative way and the use is justified and documented. Minor problems are defined as issues resulting in the estimation of data and qualification with U, J, and UJ qualifiers. Estimated analytical results are considered suitable for decision-making unless the data use requirements are stringent and the qualifier indicates a deficiency that is incompatible with the intended data use. A U qualifier does not indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

5.3 DATA QUALITY REVIEW FINDINGS

A review of the inorganic data quality determined that quality assurance (QA)/QC objectives for bias and precision were met for most analytical results with the following exceptions:

- Matrix spike (MS) recoveries resulted in qualification of results as “estimated” (“J”) for aluminum and copper in one sample.
- MS/matrix spike duplicate (MSD) recoveries and relative percent difference percentages between the MS and MSD resulted in qualification of results as estimated (“J”) for one mercury result in one sample.
- Several inorganic sample results were estimated because they were reported at concentrations between the MDL and the laboratory quantitation limit (QL). The analytical instrument can make reliable qualitative identification of analytes’ MDL but below the QL, however, detected results below the QL are considered quantitatively uncertain. Approximately 12 percent of the inorganic groundwater data was affected; however, these results are considered usable as qualified.

A review of the organic data quality determined that QA/QC objectives for bias and precision were met for most analytical results with the following exceptions:

- MS/MSD and Laboratory Control Sample (LCS) spike recoveries resulted in qualification of results as estimated (“J”) for several organic compounds in multiple samples. Less than 2 percent of the organic groundwater data was affected.
- Relative percent difference percentages between the MS and MSD resulted in qualification of results as estimated (“J”) for several organic compounds in a few samples. Less than 1 percent of the organic groundwater data was affected.

- Polychlorinated biphenyl results were “J” qualified as estimated due to surrogate QC violations in nine samples. Less than 1 percent of all the organic groundwater data was qualified due to these criteria violations.
- A few organic results were “J” qualified as estimated due to calibration QC violations in multiple samples. Approximately 3 percent of all the organic groundwater data was qualified due to these criteria violations.
- Due to laboratory blank contamination, bis(2-ethylhexyl)phthalate results in three samples, pyrene result in one sample, and acetone results in five samples are considered nondetect and “UJ” qualified. Less than 1 percent of the organic groundwater data was qualified due to laboratory blank contamination problems.
- The results for several organic compounds in a few samples were estimated because they were reported at a concentration between the MDL and the QL. The analytical instrument can make reliable qualitative identification of analytes’ MDL but below the QL; however, detected results are considered quantitatively uncertain. Less than 1 percent of the organic groundwater data was affected.

Although some qualifiers were added to the data, a final review of the data set against the EPA data quality parameters indicated that the data are of high overall quality. The data meet all the requirements of the precision, accuracy, representativeness, completeness, and comparability described in EPA guidance for quality assurance project plans and the Richmond Field Station quality assurance plan (EPA 2002, Tetra Tech 2010) and are usable for meeting the project data quality objectives and future risk assessments. The overall assessment of the sampling program, quality assurance and quality control data, and data review, indicate the data from this investigation are of acceptable precision, accuracy, representativeness, completeness, and comparability.

5.4 DEVIATIONS

During the FSW planning process, piezometer locations were proposed prior to site-specific site reconnaissance or utility clearance. During the siting and utility clearance processes, five locations were relocated to avoid underground or overhead utilities. Location B38 was moved 50 feet east and CCC3 was moved 50 feet northwest due to overhead utilities. Location B158 was moved approximately 60 feet west due to an underground utility. The database coordinates for existing piezometer PZ-8 were incorrect and after the actual piezometer location was surveyed, its location on site figures was adjusted to be approximately 75 feet southeast of its originally displayed location. Location WTA was incorrectly sited in the field and was placed 100 feet northeast of its intended location.

Due to the tight lithologic formations where the shallow piezometers were screened, the piezometers often became dry during the development and sampling processes. Some of the piezometers were successfully developed using a low-flow peristaltic pump while still others required additional time to recharge over several days in order to supply the minimum required amount of purge water.

At locations CTPS and EERC, the piezometers could not yield the required sample volume during sampling. The field sampling team returned to these locations in the next few days allowing the piezometers time to recharge. The piezometers were once again purged until stabilization occurred and the remaining sampling volume was collected. Although CTPS was sampled on three different occasions, there was not enough sample volume to analyze for TPH-E; therefore, no data is available for TPH-E for this location. As previously described, piezometer B450 yielded insufficient groundwater following development and no sample could be collected from this location. The field sampling team returned to this location on numerous occasions; however, the piezometer would not yield groundwater after less than 1 gallon was purged.

The deviations identified do not impact the DQOs or usability of the data consistent with the purpose of the FSW.

6.0 DATA EVALUATION

This section provides an overview of the compounds detected during the groundwater sampling conducted between September 3 and October 18, 2010. State and Federal water quality criteria consistent with the groundwater data evaluation at the adjacent Campus Bay site were identified to help evaluate the groundwater data, as presented in [Table 5](#). The comparisons are solely intended to provide a baseline and are not intended to represent remedial or cleanup criteria or triggers for further sampling. [Tables 5 through 10](#) provide summaries of the detected data. No pesticides or PCBs were detected; therefore, no discussion of these compounds or summary tables is provided. Complete analytical results are included in [Attachment 6](#). [Figure 8](#) presents TDS results and contours.

6.1 VOLATILE ORGANIC COMPOUNDS

Groundwater samples were submitted to the EPA Region 9 laboratory for analysis of VOCs by EPA Method 8260. While VOCs were detected at many sampling locations, only 17 of the 62 target analytes analyzed by this method were detected at the RFS. These results are presented in [Table 6](#). Of the VOCs detected, four compounds, 1,2-dichloroethane, carbon tetrachloride, tetrachloroethylene (PCE), and trichloroethylene (TCE), exceeded the maximum contaminant level (MCL). 1,2-Dichloroethane was detected at six of the 50 sampling locations, and one location, B163, exceeded the MCL of 5 micrograms per liter ($\mu\text{g/L}$) at a concentration of 8.5 $\mu\text{g/L}$. Carbon tetrachloride was also detected at six locations across the RFS. At one location, CTP, carbon tetrachloride was detected at concentrations of 19 and 20 $\mu\text{g/L}$ (there are two values because a duplicate sample was collected at this location), which exceed the MCL of 5 $\mu\text{g/L}$. PCE was detected at 13 locations. At two of these locations, B163 and PZ-11, PCE was detected at concentrations of 8.4 and 67 $\mu\text{g/L}$, respectively, which exceeds the MCL (5 $\mu\text{g/L}$). TCE was detected at 27 locations, 22 of which exceeding the MCL of 5 $\mu\text{g/L}$. Reported concentrations ranged from 6.0 to 690 $\mu\text{g/L}$. The concentrations of TCE that exceeded the MCL were predominantly found along the eastern RFS property boundary, with the two highest concentrations of 360 and 690 $\mu\text{g/L}$ reported in samples collected from B178 and PZ-11, respectively.

6.2 SEMI-VOLATILE ORGANIC COMPOUNDS

Groundwater samples were submitted to the EPA Region 9 laboratory for analysis of SVOCs and PAHs by EPA Method 8270. SVOCs were detected infrequently across the RFS with only 3 of the 62 target analytes analyzed by this method were detected. These results are presented in [Table 7](#). Only one SVOC, bis(2-ethylhexyl) phthalate, exceeded its MCL (6.0 $\mu\text{g/L}$) at two locations. The sample collected from location B128 had a reported bis(2-ethylhexyl) phthalate concentration of 6.2 $\mu\text{g/L}$, while the duplicate for this sample was undetected at an MDL of 1.0 $\mu\text{g/L}$. The sample collected from location MFA had a reported concentration of 27 $\mu\text{g/L}$. Other samples near the MFA had lower reported concentrations of bis(2-ethylhexyl) phthalate, but did not exceed its MCL. The compound 1,4-dioxane was detected at concentrations less than its MCL at 11 locations. 3,4-Methylphenol was reported at a concentration of 13 $\mu\text{g/L}$ in the primary sample and at a concentration of 9 $\mu\text{g/L}$ in the duplicate sample collected from location CTP; there is no MCL for this analyte.

PAHs are a subset of SVOCs, analyzed by EPA Method 8270-SIM (selective ion monitoring) to obtain a lower QL and MDL. PAHs were detected in groundwater samples collected from 6 of the 50 sampling locations across the RFS. The detected PAH results are presented in [Table 7](#). None of the six detected analytes, 1-Methylnaphthalene, acenaphthene, fluoranthene, fluorene, naphthalene, and pyrene has an MCL. The other ten analytes were not detected in any samples.

6.3 METALS

With the exception of antimony, silver, and thallium, metals were detected in all samples submitted for analysis. A summary of all detected metals are presented in [Table 8](#).

Aluminum. Aluminum was detected at 44 of the 50 sampling locations, ranging in concentrations from 12 to 770 µg/L. There were two outlier detections at 1,600 and 30,000 µg/L in samples collected at locations ETA and FG respectively. There is no MCL for aluminum.

Arsenic. Arsenic was detected in all samples with concentrations ranging from 0.89 to 9.8 µg/L. Additionally, at three locations (ETA, EERC, and Bulb1) the concentrations ranged from 11 to 22 µg/L and exceeding the MCL of 10 µg/L.

Barium. Barium was detected in all samples with concentrations ranging from 6.3 to 540 µg/L. No detection exceeded the MCL of 2,000 µg/L.

Beryllium. Beryllium was detected at one location, FG, at a concentration of 2.6 µg/L which was less than the MCL of 4.0 µg/L. Beryllium was not detected at any other location.

Boron. Boron was detected in all samples at concentrations ranging from 62 to 1700 µg/L. There is no MCL for boron.

Cadmium. Cadmium was detected at four locations at concentrations ranging from 0.75 to 2.7 µg/L. At one location, B163, cadmium was detected at a concentration of 5.2 µg/L, which exceeds the MCL of 5.0 µg/L.

Chromium. Chromium was detected at 37 locations at concentrations ranging from 0.52 to 50 µg/L. No concentrations exceeded the Federal MCL of 100 µg/L; however at one location, FG, chromium was detected at 50 µg/L, which is the California Department of Public Health MCL.

Cobalt. Cobalt was detected at 36 locations with concentrations ranging from 0.28 to 11 µg/L, with one outlier at 49 µg/L for location FG. There is no MCL for cobalt.

Copper. Copper was detected at 41 locations at concentrations ranging from 1.1 to 56 µg/L. No concentrations exceeded the MCL of 1,300 µg/L.

Lead. Lead was detected at two locations, ETA and Bulb2, at concentrations of 9.8 and 3.2 µg/L (duplicate sample) and 3.9 µg/L, respectively. Lead was also detected at a third location, FG, at a

concentration of 33 µg/L, exceeding the MCL of 15 µg/L. Lead was not detected at any other sampling location.

Manganese. Manganese was detected at all sampling locations ranging in concentrations from 7.2 to 17,000 µg/L. There is no MCL for manganese.

Mercury. Mercury was detected at 15 locations at concentrations ranging from 0.015 to 0.33 µg/L. Mercury was also detected at three locations (B195 at 10.0 µg/L; ETA at 2.3 µg/L and 1.3 µg/L [duplicate sample]; and RFS-GW-Bulb2 at 2.5 µg/L) which exceeded the MCL of 2.0 µg/L.

Nickel. Nickel was detected in almost every sample collected with concentrations ranging from 0.62 to 46 µg/L. At three locations, B163, FG, and PZ-11, nickel concentrations ranged from 130 to 170 µg/L, exceeding the California Department of Public Health MCL of 100 µg/L.

Selenium. Selenium was detected at five locations, with concentrations ranging from 1.1 to 8.6 µg/L. No reported concentrations exceeded the MCL of 50 µg/L.

Vanadium. Vanadium was detected at 27 locations at concentrations ranging from 2.0 to 90 µg/L. There is no MCL for vanadium.

Zinc. Zinc was detected at almost every location with concentrations ranging from 2.5 to 430 µg/L. There is no MCL for zinc.

6.4 TOTAL PETROLEUM HYDROCARBONS

All shallow samples were submitted for TPH analysis. A summary of detected TPH results are provided in [Table 9](#). There were no detections of motor oil-range organics in any of the samples. There were eight detections of diesel-range organics, with concentrations ranging from 120 to 370 µg/L. TPH as gasoline was detected in 12 samples, with concentrations ranging from 36 to 310 µg/L. There are no established MCLs for TPH.

6.5 EXPLOSIVES AND PERCHLORATES

Based on previous site use, the groundwater samples collected from three sampling locations near the former dry house and test pit areas (DH, TP1, and TP2) were submitted for laboratory analysis of explosive residue and perchlorates. The detected results for these samples are provided in [Table 10](#). For all three locations, perchlorates were not detected. The explosive RDX, was detected at the former dry house location at an estimated concentration of 1.0 µg/L. There are no MCLs identified for RDX.

7.0 REFERENCES

- Tetra Tech EM Inc. (Tetra Tech). 2008. Current Conditions Report, University of California, Berkeley, Richmond Field Station, Richmond, California. November 21.
- Tetra Tech. 2010. Phase I Groundwater Sampling, Field Sampling Workplan, University of California, Berkeley, Richmond Field Station, Richmond, California. June 2.
- U.S. Environmental Protection Agency (EPA). 2002. Guidance for Quality Assurance Project Plans. Document Number EPA QA/G-5. December.
- EPA. 2008. USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.” Document Number EPA-540-R-08-01. June.
- EPA. 2010. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review.” Document Number EPA-540-R-10-011. January.

TABLES

Table 1: Sample Rationale

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
 University of California, Berkeley, Richmond Field Station, Richmond, California

Location ID	Data Gap Addressed	Sampling Strategy
FG	The alleged pesticide spill by front gate needs further investigation.	This sample will be collected near the front gate and run for a full suite of analytes, potentially with low DL for pesticides. This sample will characterize groundwater conditions in the northeast corner of the property, along the property boundary, north of Building 478.
B490	Sewer line from B 490 to former digester ponds	This sample will be collected near the beginning of the former line, which will help to determine potential impacts to the line, as well as providing flow direction in the northern area of the property.
NRLF	Sanitary sewer lines and off-site impacts	This sample will provide information about flow direction in the northern end of the property, as well as for potential impacts from off-site sources (PG&E) or the northern lateral sewer line.
B280B	PCB-containing transformers were historically stockpiled at B280B	This sample will be collected near the area where PBC-containing materials were formerly stored.
CTP		This sample will provide information about the flow and direction in this area of the property, and potentially for impacts from off-site contamination.
CTPdeep	Investigation of the intermediate groundwater zone for gradient	This piezometer will be sampled for flow and direction of lower aquifer; however, chemical data will not be collected during the first round of sampling.
B450	Former transportation studies machine shop	Sampling will occur south of the building to test for potential impacts from previous site activity.
B460	UC Berkeley chemical storage, CCC stored vehicles here	Sampling will occur south of the building to test for potential impacts from previous site activity.
B480	Building 482, Asphalt testing building needs to be investigated for SVOCs and metals	This sample will be collected southeast of asphalt testing building and materials storage area to test for potential impacts from previous site activity.
B480deep	Investigation of the intermediate groundwater zone for gradient	This piezometer will be sampled for flow and direction of lower aquifer; however, chemical data will not be collected during the first round of sampling.
PZ-9	Characterize area west of B478 for evidence of contamination	This is a piezometer previously installed by Zeneca on the RFS site. This location will be sampled for GW data including flow direction and chemical analysis to test for potential impacts from previous site activity, as well as for potential impacts from off-site sources.
B474	B474 formerly and currently used for chemical storage	This sample will be collected from the drainage area to the southwest of the building to test for potential impacts from previous site activity.
B473	Former PBC-containing transformer location	This sample will be collected beneath the area where these transformers were formerly located.

Table 1: Sample Rationale

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
 University of California, Berkeley, Richmond Field Station, Richmond, California

TP1	Former Test Pit area	This sample will be collected from the northern area of the former test pit. For this sample, perchlorates, PAHs, and explosives residue will be added to the list of COCs.
TP2	Former Test Pit area, and CCC tram line	This sample will be collected from the southern area of the former test pit. For this sample, perchlorates, PAHs, and explosives residue will be added to the list of COCs. This sample also represents an area where the CCC tram line ran; therefore, creosote will be added to the list of COCs.
EERC	The earthquake engineering building has been used to store hydraulic oil	This sample will be collected from the courtyard of the earthquake engineering building to test for the presence of hydraulic oil as well as for potential impacts from the two current ASTs.
GEO	Geosciences well field	This sample will be collected to investigate any potential impacts from the well field or experiments performed in the well field.
B300	Geosciences well field and former chemical storage area	This sample will be collected to test for potential impacts from the well field as well as chemical storage in Building 300.
RWF	Research well field	This sample will be collected to investigate any potential impacts from the former research well field.
PZ-11	Property boundary	This piezometer, installed by Zeneca on the RFS site, will be sampled for flow direction and chemical data to investigate conditions along the property boundary.
B280A	B280A formerly used for chemical storage	This sample will be collected south of Building 280A to test for any impacts from former chemical storage, as well as potential impacts from the current AST.
B277	Former PBC containing transformer location	This area will be sampled for potential impacts from the formerly PCB-containing transformers located here. Also, this sample is located along a major sewer line and will test for impacts to groundwater from the sewer line.
B38	This sample lies in the former California Cap Company Blasting Cap Area.	Not much is known about the California Cap Company operations. This sample will be collected to help identify potential impacts from previous site activities.
B38deep	Investigation of the intermediate groundwater zone for gradient	This piezometer will be sampled for flow and direction of lower aquifer; however, chemical data will not be collected during the first round of sampling.
B194	Property boundary	This sample will be collected to obtain information about the flow and direction in this area, potential impacts from the current AST, and other potential impacts to groundwater.
B180	GW information in the core of the field station	Not much is known about the California Cap Company operations. This sample will be collected to help identify potential impacts from previous activities.

Table 1: Sample Rationale

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
University of California, Berkeley, Richmond Field Station, Richmond, California

PZ-8	Ground water flow and direction across the field station	This sample will be collected for information about the flow and direction in this area, potential impacts from previous site activity, and other potential impacts to groundwater.
B195	This shed has been used for chemical storage, this location is also along the property boundary	This sample will be collected for information about groundwater flow direction along the property boundary and to assess for potential impacts to groundwater.
B177	This location is in the core of the field station – there is also an unused well southwest of the building	Sampling will occur south of the building to test for potential impacts from previous site activity.
B158	Buildings 151 and 158 have both been identified as data gaps	Sampling will occur south of these buildings to test for potential impacts from these buildings.
CTPsouth	Ground water flow and direction across the field station	This sample will be collected to provide information about the flow and direction of groundwater near the west property boundary. Chemical data will also be collected.
B278	B 278 was previously used for chemical storage	This building is no longer on site, but a sample will be collected near where the building was formerly located to test for potential impacts.
CCC1	The locations of California Cap Company operations are not certain, therefore, these three samples are placed in the core areas of activities.	Not much is known about the California Cap Company operations. This sample will be collected to help identify potential impacts from previous activities.
B150	B150 was previously used for chemical storage	Sampling will occur in the courtyard area of the building to test for potential impacts from previous site activity, including the former California Cap Company tram line and hydraulic line, which appear to run through this location.
B175W	Location of a previously PCB-containing transformer	A sample will be collected from beneath the area where this formerly PCB-containing transformer was located.
B175S	There are two wells south of B175, also the B175 parking lot area has been identified as a data gap	Sampling will occur south of the building in the parking lot area to test for potential impacts from previous site activity.
B197	Building 197 and fuel pump island were previously used for chemical and waste oil storage	This sample will be collected from the west of the building in the parking lot area to test for potential impacts from previous site activity (including potential corp yard impacts, potential impacts from the current AST or former UST) as well as other potential impacts to groundwater.
B120	The courtyard of B120 has been identified as a data gap	This sample will be collected to test for potential impacts from previous site activities, which includes chemical storage and light vehicle maintenance. This sample will also provide information about property boundary flow direction and other potential impacts to groundwater.
CCCT	This is the location of a California Cap Company transformer house (as identified from a Sanborn map)	It is unknown if the transformer contained PCBs (although unlikely), however, a sample will be collected from this location to test for potential impacts.

Table 1: Sample Rationale

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
University of California, Berkeley, Richmond Field Station, Richmond, California

B121	B121 and B118 have both been identified as data gaps	A sample will be collected from the courtyard between these buildings to test for potential impacts from these buildings.
CCC2	The locations of California Cap Company operations are not certain, therefore, these three samples are placed in the core areas of activities.	Not much is known about the California Cap Company operations. This sample will be collected to help identify potential impacts from previous activities.
DH	Former California Cap Company dry house explosion area	This sample will be collected to test for impacts from the former dry house explosion. Perchlorates, PAHs, and explosives residue will be added to the list of standard COCs for this sample location.
EPA	The soil pile west of the EPA lab has been identified as a data gap	This sample will be collected to provide information about the soil pile area as well as groundwater conditions along the western property boundary.
B128	This sample has been placed over previous California Cap Company activity.	Not much is known about the California Cap Company operations. This sample will help to identify potential impacts from previous activities.
B128deep	Investigation of the intermediate groundwater zone for gradient	This piezometer will be sampled for flow and direction of lower aquifer; however, chemical data will not be collected during the first round of sampling.
CCC3	The locations of California Cap Company operations are not certain, therefore, these three samples are placed in the core areas of activities.	Not much is known about the California Cap Company operations. This sample will be collected to help identify potential impacts from previous activities.
B178	The corp yard storage area has been identified as a data gap	This sample will be collected for information about groundwater flow direction along the property boundary, potential impacts from previous site activity, and other potential impacts to groundwater.
B185	The corp yard storage area has been identified as a data gap	This sample will be collected for information about groundwater flow direction along the property boundary, potential impacts from previous site activity, and other potential impacts to groundwater.
B163	The former US Briquette Co has been identified as a data gap	This sample will be collected from the parking lot of B163 (the location of the former US Briquette Co) to test for potential impacts from previous site activity.
WTA	The transition area has been identified as a data gap	This sample will be collected from the area south of the core of California Cap Company activity, as well as along the sewer line lateral (part of which was previously removed) to test for potential impacts from previous site activity.
MFA	The former mercury fulminate plant has been identified as a data gap	This sample will be collected to test for potential impacts to groundwater from the MFA.
ETA	The transition area has been identified as a data gap	This sample will be collected south of the core of California Cap Company activity, as well as along the sewer line lateral (part of which was previously removed). This sample will also provide information about groundwater flow and direction south of the former seawall (fill area).

Table 1: Sample Rationale

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
University of California, Berkeley, Richmond Field Station, Richmond, California

Bulb1	During the WTA TCRA excavation, incidental debris was discovered in this area	This sample will be collected to test for potential impacts from previous site activity.
Bulb2	The magnetic anomaly detected in the bulb has been identified as a data gap	This sample will be collected to test for potential impacts from previous site activity.

Notes:

AST Above ground storage tank
B Building
CCC California Cap Company
COC Chemical of concern
CTP Costal terrace prairie
EERC Earthquake engineering research center
EPA Environmental Protection Agency
ETA Eastern transition area
GW Groundwater
ID Identification
MFA Mercury fulminate area
NRLF Northern research library facility
PAH Polycyclic aromatic hydrocarbons
PCB Polychlorinated biphenyls
PG&E Pacific Gas and Electric
RFS Richmond Field Station
SVOC Semivolatile organic compounds
TCRA Time critical removal action
UC University of California
UST Underground storage tank
WTA Western transition area

Table 2: Groundwater Sampling Registry

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
 University of California, Berkeley, Richmond Field Station, Richmond, California

Groundwater Samples															
Sample ID	Point Location ID	Sampling Date	Depth (feet bgs)	Analysis	TPH-P (EPA Method 8015B modified)	VOCs (EPA Method 8260B)	TPH-E (EPA Method 8015B modified)	SVOCs (EPA Method 8270C)	Metals (EPA Method 6020A/7400 series)	PAH (EPA Method 8270-SIM)	PCB (EPA Method 8082)	Pesticides (EPA Method 8081A)	Perchlorates (EPA Method 314)	Explosive residue (EPA Method 8330)	TDS (EPA Method 160.1)
				Sample Container	2 40mL Amber VOA vials with HCl	2 40mL Amber VOA vials with HCl	1 Liter Amber	1 Liter Amber	500mL Poly with HNO3	1 Liter Amber	1 Liter Amber	1 Liter Amber	250mL poly	1 Liter Amber	250mL poly
				Holding Time	14 Days	14 Days	14 Days	7/40 days	Metals – 6 Months (except Mercury – 28 Days)	7/40 days	7/40 days	7/40 days	28 days	7/40 days	7 days
RFGWB12001	B120	9/9/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWB12101	B121	9/8/2010	8-18	X	X	X	X	X	X	X	X	X	X		X
RFGWB12801	B128	9/23/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWB12801-D	B128	9/23/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWB128D01	B128deep	10/15/2010	30-40												X
RFGWB15001	B150	9/8/2010	5.5-15.5	X	X	X	X	X	X	X	X	X	X		X
RFGWB15801	B158	9/8/2010	5-15	X	X	X	X	X	X	X	X	X	X		X
RFGWB16301	B163	9/2/2010	7-17	X	X	X	X	X	X	X	X	X	X		X
RFGWB175S01	B175S	9/3/2010	5-15	X	X	X	X	X	X	X	X	X	X		X
RFGWB175W01	B175W	9/8/2010	5-15	X	X	X	X	X	X	X	X	X	X		X
RFGWB17701	B177	9/23/2010	9-19	X	X	X	X	X	X	X	X	X	X		X
RFGWB17801	B178	9/2/2010	4.5-14.5	X	X	X	X	X	X	X	X	X	X		X
RFGWB18001	B180	9/15/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWB18501	B185	9/2/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWB19401	B194	9/9/2010	7-17	X	X	X	X	X	X	X	X	X	X		X
RFGWB19501	B195	9/9/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWB19701	B197	9/9/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWB19701-D	B197	9/9/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWB27701	B277	9/15/2010	7-17	X	X	X	X	X	X	X	X	X	X		X
RFGWB27801	B278	9/16/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWB280A01	B280A	9/16/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWB280B01	B280B	10/1/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWB30001	B300	9/9/2010	7-17	X	X	X	X	X	X	X	X	X	X		X
RFGWB3801	B38	9/15/2010	7-17	X	X	X	X	X	X	X	X	X	X		X
RFGWB38D01	B38deep	10/18/2010	31-41												X
RFGWB46001	B460	9/15/2010	8-18	X	X	X	X	X	X	X	X	X	X		X
RFGWB47301	B473	9/24/2010	7-17	X	X	X	X	X	X	X	X	X	X		X
RFGWB47401	B474	9/23/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWB48001	B480	9/24/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWB480D01	B480deep	10/15/2010	35-40												X
RFGWB49001	B490	9/16/2010	8-18	X	X	X	X	X	X	X	X	X	X		X
RFGWBULB101	Bulb1	10/19/2010	8-18	X	X	X	X	X	X	X	X	X	X		X
RFGWBULB201	Bulb2	10/19/2010	9-19	X	X	X	X	X	X	X	X	X	X		X
RFGWCCC101	CCC1	9/8/2010	3.5-13.5	X	X	X	X	X	X	X	X	X	X		X
RFGWCCC201	CCC2	9/8/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWCCC301	CCC3	9/3/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWCCC301-D	CCC3	9/3/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWCCCT01	CCCT	9/3/2010	5.5-15.5	X	X	X	X	X	X	X	X	X	X		X
RFGWCTP01	CTP	9/30/2010	7-17	X	X	X	X	X	X	X	X	X	X		X
RFGWCTP01-D	CTP	9/30/2010	7-17	X	X	X	X	X	X	X	X	X	X		X
RFGWCTPD01	CTPdeep	10/15/2010	30-40												X
RFGWCTPS01	CTPS	9/30/2010	4-14	X	X			X		X					
RFGWCTPS01A	CTPS	10/1/2010	4-14				X								
RFGWCTPS01B	CTPS	10/18/2010	4-14						X			X			
RFGWDH01	DH	9/30/2010	3.5-13.5	X	X	X	X	X	X	X	X	X	X	X	X
RFGWEERC01	EERC	10/1/2010	7-17	X	X	X	X	X		X					
RFGWEERC01A	EERC	10/15/2010	7-17						X		X				X
RFGWEPA01	EPA	9/16/2010	4-14	X	X	X	X	X	X	X	X	X	X		X
RFGWETA01	ETA	9/24/2010	3.5-13.5	X	X	X	X	X	X	X	X	X	X		X
RFGWETA01-D	ETA	9/24/2010	3.5-13.5	X	X	X	X	X	X	X	X	X	X		X
RFGWFG01	FG	9/23/2010	6-16	X	X	X	X	X	X	X	X	X	X		X
RFGWGEO01	GEO	9/3/2010	6.5-16.5	X	X	X	X	X	X	X	X	X	X		X
RFGWMFA01	MFA	9/24/2010	3.5-13.5	X	X	X	X	X	X	X	X	X	X		X
RFGWNRLF01	NRLF	9/16/2010	9-19	X	X	X	X	X	X	X	X	X	X		X
RFGWPZ1101	PZ-11	10/1/2010	9-19	X	X	X	X	X	X	X	X	X	X		X
RFGWPZ801	PZ-8	10/15/2010	8-21	X	X	X	X	X	X	X	X	X	X		X
RFGWPZ901	PZ-9	9/24/2010	9-20	X	X	X	X	X	X	X	X	X	X		X
RFGWRWF01	RWF	9/15/2010	8-18	X	X	X	X	X	X	X	X	X	X		X
RFGWTP101	TP1	9/29/2010	7-17	X	X	X	X	X	X	X	X	X	X	X	X
RFGWTP201	TP2	9/29/2010	6-16	X	X	X	X	X	X	X	X	X	X	X	X
RFGWWT01	WTA	9/30/2010	4-14	X	X	X	X	X	X	X	X	X	X		X

Notes:
 bgs below ground surface ml milliliters TPH-E Total extractable petroleum hydrocarbons
 EPA U.S. Environmental Protection Agency PAH Polyaromatic hydrocarbons TPH-P Total purgeable petroleum hydrocarbons
 HCl Hydrochloric acid PCB Polychlorinated biphenyl VOC Volatile organic compound
 HNO3 Nitric Acid SVOC Semivolatile organic compound
 ID Identification TDS Total dissolved solids

Table 3: Piezometer Completion Summary

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
 University of California, Berkeley, Richmond Field Station, Richmond, California

Piezometer Name	Well Installation Date	Total Depth (ft bgs)	Casing Diameter (inches)	Screen Interval (ft bgs)	Development Date	Development Gallons Purged	Sampling Date	TOC (a)	Approximate Ground Surface Elevation (a)
B120	8/2/10	14	2.0 PVC	4-14	8/19/10	26	9/9/10	11.72	12.12
B121	8/3/10	18	2.0 PVC	8-18	8/16/10	53	9/8/10	14.77	15.55
B128	8/12/10	16	2.0 PVC	6-16	8/31/10	33	9/23/10	11.62	12.21
B128deep	8/12/10	40	2.0 PVC	30-40	9/1/10	65	10/15/10	12.15	12.26
B150	8/3/10	15.5	2.0 PVC	5.5-15.5	8/17/10	28	9/8/10	17.24	17.51
B158	8/11/10	15	2.0 PVC	5-15	8/18/10	19	9/8/10	15.88	16.33
B163	7/26/10	17.5	2.0 PVC	7-17	8/16/10	53	9/2/10	10.37	10.60
B175S	8/3/10	15	2.0 PVC	5-15	8/17/10	22	9/3/10	15.16	15.45
B175W	8/3/10	15	2.0 PVC	5-15	8/17/10	32	9/8/10	16.57	17.21
B177	8/11/10	19	2.0 PVC	9-19	8/31/10	32	9/23/10	17.57	17.81
B178	8/2/10	14.5	2.0 PVC	4.5-14.5	8/19/10	32	9/2/10	10.67	11.33
B180	8/11/10	16	2.0 PVC	6-16	8/24/10	24	9/15/10	15.02	15.30
B185	8/2/10	14	2.0 PVC	4-14	8/20/10	31	9/2/10	10.01	10.08
B194	7/30/10	17	2.0 PVC	7-17	8/23/10	34	9/9/10	18.30	18.84
B195	7/30/10	16	2.0 PVC	6-16	8/20/10	29	9/9/10	14.28	14.91
B197	7/30/10	14	2.0 PVC	4-14	8/19/10	25	9/9/10	13.01	13.37
B277	7/29/10	17.5	2.0 PVC	7-17	8/19/10	25	9/15/10	14.82	15.69
B278	7/29/10	16.5	2.0 PVC	6-16	8/18/10	26	9/16/10	12.75	13.17
B280A	7/29/10	14.5	2.0 PVC	4-14	8/19/10	13	9/16/10	14.04	14.21
B280B	8/6/10	16	2.0 PVC	6-16	8/26/10	6	10/1/10	19.59	19.89
B300	7/29/10	17	2.0 PVC	7-17	8/24/10	21	9/9/10	18.16	18.72
B38	8/10/10	17	2.0 PVC	7-17	8/24/10	24	9/15/10	15.78	16.08
B38deep	8/10/10	41	2.0 PVC	31-41	8/24/10	47	10/18/10	15.84	16.09
B450	8/5/10	16	2.0 PVC	6-16	8/25/10	10	NS	21.34	21.76
B460	8/5/10	18	2.0 PVC	8-18	8/25/10	12	9/15/10	21.42	21.96
B473	8/9/10	17	2.0 PVC	7-17	8/31/10	12.5	9/24/10	22.29	22.50
B474	8/9/10	16	2.0 PVC	6-16	8/27/10	17.5	9/23/10	23.67	21.85
B480	8/5/10	16	2.0 PVC	6-16	8/27/10	10	9/24/10	20.84	21.04
B480deep	8/12/10	40	2.0 PVC	35-40	8/27/10	52	10/15/10	21.07	21.19
B490	8/6/10	18	2.0 PVC	8-18	8/30/10	27	9/16/10	24.41	24.95
Bulb1	9/29/10	18	2.0 PVC	8-18	10/19/10	30	10/19/10	7.19	7.83
Bulb2	9/29/10	19	2.0 PVC	9-19	10/19/10	35	10/19/10	7.46	7.91
CCC1	7/27/10	14	2.0 PVC	3.5-13.5	8/18/10	11.5	9/8/10	15.38	15.67
CCC2	7/27/10	14	2.0 PVC	4-14	8/16/10	19	9/8/10	14.60	14.75
CCC3	7/27/10	15	2.0 PVC	4-14	8/16/10	27	9/3/10	11.67	12.13
CCCT	8/2/10	15.5	2.0 PVC	5.5-15.5	8/20/10	31	9/3/10	12.13	13.19

Table 3: Piezometer Completion Summary

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
 University of California, Berkeley, Richmond Field Station, Richmond, California

Piezometer Name	Well Installation Date	Total Depth (ft bgs)	Casing Diameter (inches)	Screen Interval (ft bgs)	Development Date	Development Gallons Purged	Sampling Date	TOC (a)	Approximate Ground Surface Elevation (a)
CTP	7/30/10	17	2.0 PVC	7-17	8/26/10	20	9/30/10	17.27	18.26
CTPdeep	8/12/10	40	2.0 PVC	30-40	8/26/10	47	10/15/10	17.67	18.16
CTPS	7/28/10	14	2.0 PVC	4-14	8/19/10	7	9/30/2010, 10/1/10 and 10/18/10	15.25	15.43
DH	7/27/10	13.5	2.0 PVC	3.5-13.5	8/18/10	13	9/30/10	13.25	13.55
EERC	8/9/10	17	2.0 PVC	7-17	8/31/10	7.5	10/1/2010 and 10/15/10	21.84	22.01
EPA	7/28/10	14	2.0 PVC	4-14	8/19/10	13.5	9/16/10	10.59	11.20
ETA	7/28/10	14	2.0 PVC	3.5-13.5	9/2/10	32	9/24/10	7.54	7.72
FG	8/6/10	16	2.0 PVC	6-16	8/30/10	7	9/23/10	25.31	25.79
GEO	7/26/10	17.5	2.0 PVC	6.5-16.5	9/1/10	20	9/3/10	16.37	16.73
MFA	7/28/10	13.5	2.0 PVC	3.5-13.5	9/2/10	37	9/24/10	8.23	8.51
NRLF	7/26/10	19.5	2.0 PVC	9-19	8/26/10	10	9/16/10	22.62	22.99
PZ-11	10/6/09	19	2.0 PVC	9-19	unk	unk	10/15/10	21.48	21.73
PZ-8	4/12/07	21	2.0 PVC	8-21	unk	unk	10/1/10	14.12	14.52
PZ-9	4/12/07	20	2.0 PVC	9-20	unk	unk	9/24/10	23.29	23.72
RWF	8/4/10	18	2.0 PVC	8-18	8/23/10	30	9/15/10	16.46	16.78
TP1	8/5/10	17	2.0 PVC	7-17	8/23/10	13	9/29/10	19.33	19.91
TP2	8/4/10	16	2.0 PVC	6-16	8/23/10	20	9/29/10	18.91	19.24
WTA	7/27/10	14	2.0 PVC	4-14	8/18/10	28	9/30/10	8.61	8.93

Notes:

Total depth of boring assumed to be bottom of screen unless otherwise specified on boring log or well completion form.

(a) Ground surface elevation and TOC given in feet above mean sea level

ft bgs Feet below ground surface
 NS Not Sampled
 PVC Polyvinyl chloride
 TOC Top of casing
 unk Unknown

Table 4: Groundwater Sampling Parameters Summary

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
University of California, Berkeley, Richmond Field Station, Richmond, California

Sample ID	Total Dissolved Solids (mg/L)	pH	Temperature (C)	Specific Conductance (umhos/cm)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
RFGWB16301	2900	5.7	20.52	3402	NA	0.38	170
RFGWB17801	1800	6.62	19.62	2379	NA	0.55	156.6
RFGWB18501	1700	6.47	18.76	2162	NA	0.6	159.7
RFGWB175S01	590	7.19	19.27	0.978	14.3	0.42	206
RFGWCCC301	730	7.94	18.4	1.21	15.7	0.92	204
RFGWCCC301-D	710	NA	NA	NA	NA	NA	NA
RFGWCCCT01	1100	7.28	16.09	1.64	17.5	0.48	212
RFGWGEO01	510	7.63	17.49	0.9	13.8	2.7	204
RFGWB12101	520	7.34	17.32	0.856	21.1	0.42	210
RFGWB15001	290	6.76	18.98	0.432	15.5	0.43	200
RFGWB15801	200	7.04	17.06	0.256	30.5	3.23	192
RFGWB175W01	270	7.11	19.77	0.486	29.1	1.08	199
RFGWCCC101	440	7.81	18.13	0.714	17.4	0.77	201
RFGWCCC201	630	7.72	17.37	10.77	21.1	0.37	207
RFGWB12001	1900	7.25	17.77	2.48	21.7	0.79	220
RFGWB19401	670	7.41	19.19	0.003	46.8	1.54	206
RFGWB19501	1600	7.22	18.14	1.92	24.9	0.47	213
RFGWB19701	1500	7.26	19.15	2.02	18.6	0.48	215
RFGWB19701-D	1500	NA	NA	NA	NA	NA	NA
RFGWB30001	1100	7.22	16.96	2.34	17.5	0.68	211
RFGWB18001	360	7.59	19.4	0.496	40.3	6.28	203
RFGWB27701	400	7.86	17.96	0.725	31.3	0.59	209
RFGWB3801	310	6.91	17.65	0.587	43.1	0.86	207
RFGWB46001	290	7.6	16.84	0.771	10.1	1.67	211
RFGWRWF01	720	7.12	17.24	1.172	44	0.42	213
RFGWB27801	2300	7.27	18.19	3.75	16.2	1.38	218
RFGWB280A01	510	7.49	19.6	0.878	4.3	0.24	209
RFGWB49001	540	7.4	17.05	0.918	18.9	1.16	207
RFGWEPA01	710	7.75	18.03	1.467	11.8	2.7	215
RFGWNRLF01	400	7.46	17.82	0.731	4.7	0.5	201
RFGWB12801	800	7.33	18.77	1.319	24	3.09	226
RFGWB12801-D	970	NA	NA	NA	NA	NA	NA
RFGWB17701	190	6.19	19.3	0.277	80.8	0.97	200
RFGWB47401	430	7.66	17.51	1.06	22.6	1.36	220
RFGWFG01	1300	7.2	19.22	2.23	256	0.53	224
RFGWB47301	460	7.42	17.73	0.925	50.6	2.3	217
RFGWB48001	670	7.57	19.14	1.083	17.6	0.27	211
RFGWETA01	1300	7.19	18.74	1.92	50.2	0.27	219
RFGWETA01-D	1300	NA	NA	NA	NA	NA	NA
RFGWMFA01	900	7.64	17.87	1.45	109	0.18	215
RFGWPZ901	400	7.11	19.26	0.651	10.7	0.19	206
RFGWTP101	720	7.43	19.04	1.26	19.8	0.53	24
RFGWTP201	830	7.3	18.9	1.331	50.1	0.54	73
RFGWCTP01	490	7.72	16.74	0.88	19.1	2.79	-80
RFGWCTP01-D	500	NA	NA	NA	NA	NA	NA
RFGWDH01	5500	7.12	16.15	0.52	18.3	1.91	183
RFGWTA01	1000	7.92	16.6	1.93	12	0.56	22
RFGWB280B01	650	8.21	17.6	1.078	21.1	4.23	-108
RFGWPZ1101	2500	7.2	15.82	3.03	12.8	0.39	-36
RFGWB480D01	360	10.52	18.4	0.625	8	107	20
RFGWB128D01	440	8.62	18.28	0.795	74.2	1.02	-95
RFGWCTPD01	370	9.18	16.88	0.656	34.8	0.3	-170
RFGWEERC01	NA	7.11	17.07	6.99	12.4	0.64	-70
RFGWEERC01A	4800	7.05	17.12	6.92	33.1	0.73	-19
RFGWPZ801	510	7.22	18.37	0.814	46.6	0.63	123
RFGWB38D01	350	8.73	17.14	0.639	6.4	0.53	-141
RFGWBULB101	25000	7.82	18.11	38.6	21	6.32	67
RFGWBULB201	5900	7.81	18.37	10.42	35.9	5.88	-56
RFGWCTPS01B	NA	7.54	16.98	2.01	5.3	3.43	-51
RFGWCTPS01	NA	7.45	17.87	2.1	16.5	3.19	9
RFGWCTPS01A	NA	7.44	17.74	2.11	14	4.8	-34

Notes:

- C Celsius
- mg/L Milligrams per liter
- mV Millivolts
- NA Not available
- NTU Nephelometric Turbidity Units
- umhos/cm Micromhos per centimeter

Table 5: State and Federal Water Quality Criteria in ug/L

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
University of California, Berkeley, Richmond Field Station, Richmond, California

Chemical	Human Health Risk-Based SSGs (1)			Aquatic Criteria (2)			Drinking Water Standard (3)	MCL (4)			SWRCB			EPA 2004 PRG		EPA 2011 RSL	
	Upland			Near BAPB	Uplands	Lower horizon		California	EPA	Secondary	Drinking Water Criteria (5)	Non-Drinking Water Criteria (6)	Surface Water Screening Levels, Estuary Habitats (7)	Cancer (8)	Non-cancer (8)	Tapwater (Cancer) (9)	Tapwater (Non-cancer) (9)
	On-Site Residential	On-Site Commercial/Industrial Worker	On-Site Groundskeeper/Maintenance Worker	5x Aquatic Criteria	40x Aquatic Criteria	160x Aquatic Criteria											
VOCs																	
1,1-Dichloroethene	1,900	8900	630,000	160	1,300	5,100		6	7		6	25	3				340
1,2-Dichloroethane	120	360	2,900	5,000	40,000	160,000		0.5	5		0.5	200	99			0.15	
1,2-Dichloropropane	120	370	1,900	2,000	16,000	62,000		5	5		5	100	10			0.39	
2-Butanone (MEK)	2,800,000	13,000,000	140,000,000								4,200	14,000	8,400				
Acetone	7,900,000	37,000,000	220,000,000								1,500	1,500	1,500				22,000
Benzene	20	61	440	3,600	28,000	110,000		1	5		1	46	71			0.41	
Carbon tetrachloride	2.8	8.5	160	220	1,800	7,000		0.5	5		0.5	9.3	4			0.44	
Chlorobenzene	250,000	1,100,000	140,000	1,100,000	8,400,000	34,000,000			100		25	25	50				91
Chloroform	130	400	2,500	24,000	190,000	750,000					70	330	470			0.91	
cis-1,2-Dichloroethene	7,200	34,000	270,000					6	70		6	590	22,000				73
Dichloromethane								5	5								
Naphthalene	210	640	90								17	24	21			0.14	
Tetrachloroethene	38	110	22	440	3,500	14,000		5	5		5	120	9			0.11	
Toluene	3,500	160,000	570,000	10,000,000	80,000,000	320,000,000		150	1,000		40	130	40				2,300
trans-1,2-Dichloroethene	6,700	31,000	510,000	7,000,000	56,000,000	220,000,000		10	100		10	590	260				110
Trichloroethene	180	540	2,700	4,100	32,000	130,000		5	5		5	360	81			2	
Vinyl chloride	1.2	3.6	300	26,000	210,000	840,000		0.5	2		0.5	3.8	530			0.016	
SVOCs																	
1-Methylnaphthalene																	2.3
1,4-Dioxane											3	5000	5000			0.67	
Acenaphthene																	2,200
Bis(2-ethylhexyl) phthalate									6		4	32	5.9			4.8	
Fluoranthene											8	8	8				1,500
Fluorene											3.9	3.9	30				1,500
Naphthalene											17	24	21			0.14	
Pyrene											2	2	2			180	1,100
Metals																	
Aluminum								1,000		200							37,000
Antimony			150,000	220,000	1,700,000	6,900,000	6	6			6	30	500				15
Arsenic			110	180	1,400	5,800	10	10			36	36	0.14	0.071		0.045	
Barium			75,000,000				1,000	1,000	2,000		1,000	1,000	1,000				7,300
Beryllium								4	4		0.53	0.53	0.53				73
Boron											1.6	1.6	1.6				7,300
Cadmium			190,000	47	370	1,500	5	5	5		0.25	0.25	9.3				18
Calcium																	
Chromium			560,000,000				50	50	100		50	180	180				
Cobalt											3	3	3				11
Copper			15,000,000	16	120	500	1,300	1,300	1,300	1,000	3.1	3.1	3.1				1,500
Iron										300							26,000
Lead			41	320	1300	15	15	15			2.5	2.5	5.6				
Magnesium																	
Manganese										50							880
Mercury			110,000	11	84	340	2	2	2		0.025	0.025	0.025				.63
Molybdenum											35	240	240				180
Nickel			93,000,000	41	330	1,300	100	100			8.2	8.2	8.2				180
Potassium																	
Selenium			1,900,000	25	200	800	50	50			5	5	71				180
Silver			3,100,000	9.5	76	300	100			100	0.19	0.19	0.19				180
Sodium																	
Thallium			25,000	320	2,500	10,000	2	2	2		2	4	4				
Vanadium			370,000								15	19	19				180
Zinc			180,000,000	410	3,200	13,000	5,000			5,000	81	81	81				11,000
Hardness, as CaCO3 IN mg/L																	
TPH																	
TPH as Gasoline											100	210					
TPH - Diesel Range Organics																	
TPH - Oil Range Organics																	
Explosive Residue																	
RDX																	

- (1) Groundwater SSGs are developed in Appendix G of the Campus Bay Revised HHR (EKI 2008a). The formulas used to calculate the SSGs are presented in Appendix H of the Revised HHR
- (2) The aquatic criteria are the more stringent of the 10x Human Consumption of Aquatic organisms value and the Salt Water Aquatic Criteria Value, presented in the Quarterly Groundwater and Surface Water Monitoring Report (Arcadis 2/08)
- (3) The drinking water criteria are the more stringent of the federal (US EPA 2005) and California (CDHS) primary and secondary maximum contaminant levels (MCL): <http://www.cdph.ca.gov/certlic/drinkingwater/Documents/DWdocuments/EPAAandCDPH-11-28-2008.p>
- (4) <http://water.epa.gov/drink/contaminants/index.cfm>
Values taken from the California Regional Water Quality Control Board 2008 Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Table F-1
- (5) http://www.swrcb.ca.gov/sanfranciscobay/water_issues/available_documents/ESL_May_2008.pdf
Values taken from the California Regional Water Quality Control Board 2008 Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Table F-1
- (6) http://www.swrcb.ca.gov/sanfranciscobay/water_issues/available_documents/ESL_May_2008.pdf
Values taken from the California Regional Water Quality Control Board 2008 Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Table F-1
- (7) http://www.swrcb.ca.gov/sanfranciscobay/water_issues/available_documents/ESL_May_2008.pdf
- (8) EPA 2004 Regional Screening Levels (formerly Preliminary Remediation Goals) (<http://www.epa.gov/region9/superfund/pr>)
- (9) EPA 2011 Regional Screening Levels for tap water (<http://www.epa.gov/reg3hwmd/risk/humar>)

BAPB Biologically active permeable barrier
 EPA U.S. Environmental Protection Agency
 MCL Maximum contaminant level
 PRG Preliminary remediation goal
 RSL Regional screening level
 SSG Site specific goal
 SWRCB State Water Resources Control Board
 SVOC Semivolatile organic compound
 TPH Total petroleum hydrocarbon
 VOC Volatile organic compound

Table 7: SVOC Detected Results Summary in ug/L

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
 University of California, Berkeley, Richmond Field Station, Richmond, California

Sample ID	1-Methylpthalene	1,4-Dioxane	3&4-Methylphenol	Acenaphthene	Bis(2-ethylhexyl) phthalate	Fluoranthene	Fluorene	Naphthalene	Pyrene
Federal EPA MCL					6				
SWRCB GW (drinking water source)		3		20	4	8	3.9	17	2
SWRCB GW (not drinking water source)		5000		23	32	8	3.9	24	2
EPA 2011 RSL tapwater (cancer)	2.3	0.67			4.8			0.14	
EPA 2011 RSL tapwater (non-cancer)				2,200		1,500	1,500		1,100
EPA 2004 PRGs (non-cancer)				370					180
RFGWB16301	0.047 U	0.5 J	5.0 U	0.047 U	0.5	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB17801	0.050 U	1.0 U	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB18501	0.050 U	0.5	4.7 U	0.050 U	0.5 J	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB175S01	0.047 U	0.9 U	4.7 U	0.047 U	0.9 U	0.047 U	0.047 U	0.047 U	0.047 U
RFGWCCC301	0.047 U	0.9 U	4.7 U	0.047 U	0.9 U	0.047 U	0.047 U	0.047 U	0.047 U
RFGWCCC301-D	0.047 U	0.9 U	4.7 U	0.047 U	1.0 J	0.047 U	0.047 U	0.047 U	0.047 U
RFGWCCCT01	0.047 U	0.9 U	4.7 U	0.047 U	0.9 U	0.047 U	0.047 U	0.047 U	0.047 U
RFGWGEO01	0.047 U	0.9 U	4.7 U	0.047 U	0.9 U	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB12101	0.048 U	0.9 U	4.7 U	0.048 U	0.9 UJ	0.048 U	0.048 U	0.048 U	0.048 U
RFGWB15001	0.048 U	1.0 U	4.8 U	0.048 U	1.0 UJ	0.048 U	0.048 U	0.048 U	0.048 U
RFGWB15801	0.047 U	1.0 U	5.0 U	0.047 U	1.0 UJ	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB175W01	0.050 U	1.0 U	5.0 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.050 U	0.050 U
RFGWCCC101	0.047 U	0.9 U	4.7 U	0.047 U	0.9 UJ	0.047 U	0.047 U	0.047 U	0.047 U
RFGWCCC201	0.047 U	1.0 U	4.8 U	0.047 U	0.6 J	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB12001	0.047 U	0.9 U	4.7 U	0.047 U	0.9 UJ	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB19401	0.047 U	0.9 U	4.7 U	0.047 U	0.9 UJ	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB19501	0.047 U	0.9 U	4.7 U	0.047 U	0.9 UJ	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB19701	0.047 U	0.9 U	4.7 U	0.047 U	0.9 UJ	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB19701-D	0.047 U	1.0 U	4.8 U	0.047 U	1.0 UJ	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB30001	0.047 U	1.4	4.7 U	0.047 U	0.9 UJ	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB18001	0.050 U	1.0 U	4.8 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB27701	0.050 U	1.0 U	5.0 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB3801	0.050 UJ	1.0 U	5.0 U	0.050 UJ	1.0 UJ	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
RFGWB46001	0.050 U	1.0 U	5.0 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.050 U	0.050 U
RFGWRWF01	0.050 U	0.7 J	5.0 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB27801	0.050 U	1.4	5.0 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB280A01	0.050 U	1.0 U	5.0 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.035 J	0.050 U
RFGWB49001	0.050 U	1.0 U	5.0 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.050 U	0.050 U
RFGWEPA01	0.050 U	1.0 U	5.0 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.042 J	0.050 U
RFGWNRLF01	0.050 U	1.0 U	4.8 U	0.050 U	1.0 UJ	0.050 U	0.050 U	0.029 J	0.050 U
RFGWB12801	0.047 U	1.0 U	5.0 U	0.047 U	6.2	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB12801-D	0.050 U	1.0 U	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB17701	0.047 U	0.9 U	4.7 U	0.047 U	0.9 U	0.047 U	0.047 U	0.047 U	0.047 U
RFGWB47401	0.050 U	1.0 U	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWFG01	0.050 U	1.0 U	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB47301	0.050 U	0.5 J	5.0 U	0.050 U	0.5 J	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB48001	0.050 U	1.0 U	5.0 U	0.050 U	0.8 J	0.050 U	0.050 U	0.050 U	0.050 U
RFGWETA01	0.033 J	12	4.7 U	0.11	1.1	0.041 J	0.17	0.050 U	0.088
RFGWETA01-D	0.032 J	12	5.0 U	0.11	0.5 J	0.035 J	0.16	0.050 U	0.074
RFGWMFA01	0.050 U	2.3	5.0 U	0.050 U	27	0.050 U	0.050 U	0.050 U	0.050 U
RFGWPZ901	0.050 U	1.6	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWTP101	0.050 U	1.0 U	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.036 J
RFGWTP201	0.050 U	1.1	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWCTP01	0.050 U	1.0 U	13	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWCTP01-D	0.050 U	1.0 U	9.0	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWDH01	0.047 U	1.0 U	5.0 U	0.047 U	1.0 U	0.047 U	0.047 U	0.047 U	0.047 U
RFGWETA01	0.050 U	1.0 U	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWB280B01	0.050 U	1.0 U	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWCTPS01A	NS	1.2 U	6.0 U	NS	1.2 U	NS	NS	NS	NS
RFGWEERC01	NS	1.0 U	5.0 U	NS	1.0 U	NS	NS	NS	NS
RFGWPZ1101	0.050 U	0.7 J	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWEERC01A	50 U	NS	NS	0.050 U	NS	0.050 U	0.050 U	0.050 U	0.050 U
RFGWPZ801	0.050 U	1.0 U	5.0 U	0.050 U	1.0 U	0.050 U	0.050 U	0.050 U	0.050 U
RFGWCTPS01B	50 U	NS	NS	0.050 U	NS	0.050 U	0.050 U	0.050 U	0.050 U
RFGWBULB101	0.047 U	0.9 U	4.7 U	0.047 U	0.6 J	0.047 U	0.047 U	0.047 U	0.047 U
RFGWBULB201	0.033 J	1.3	5.0 U	0.062	1.0 U	0.050 U	0.050 U	0.19	0.050 U

EPA U.S. Environmental Protection Agency
 MCL Maximum contaminant level
 PRG Preliminary remediation goals
 RSL Regional screening levels
 SVOC Semivolatile organic compounds
 SWRCB State Water Resources Control Board
 ug/L Micrograms per liter

Table 9: TPH Detected Results Summary in ug/L

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
 University of California, Berkeley, Richmond Field Station, Richmond, California

Sample ID	TPH as Gasoline	TPH - Diesel Range Organics	TPH - Oil Range Organics
SWRCB GW (drinking water source)	100		
SWRCB GW (not drinking water source)	210		
RFGWB16301	46 J	200 J	1000 U
RFGWB17801	63 J	250 U	1000 U
RFGWB18501	36 J	240 J	950 U
RFGWB175S01	50 U	240 U	950 U
RFGWCCC301	50 U	240 U	950 U
RFGWCCC301-D	50 U	250 U	1000 U
RFGWCCCT01	38 J	240 U	940 U
RFGWGEO01	50 U	240 U	950 U
RFGWB12101	50 U	250 U	1000 U
RFGWB15001	50 U	240 U	950 U
RFGWB15801	50 U	240 U	950 U
RFGWB175W01	50 U	250 U	1000 U
RFGWCCC101	50 U	240 U	950 U
RFGWCCC201	50 U	250 U	1000 U
RFGWB12001	70 J	240 U	950 U
RFGWB19401	50 U	240 U	950 U
RFGWB19501	59 J	240 U	950 U
RFGWB19701	73 J	250 U	1000 U
RFGWB19701-D	74 J	240 U	950 U
RFGWB30001	50 U	240 U	950 U
RFGWB18001	50 U	250 U	1000 U
RFGWB27701	50 U	250 U	1000 U
RFGWB3801	50 U	250 U	1000 U
RFGWB46001	50 U	250 U	1000 U
RFGWRWF01	50 U	240 U	950 U
RFGWB27801	50 U	250 U	1000 U
RFGWB280A01	50 U	250 U	1000 U
RFGWB49001	50 U	250 U	1000 U
RFGWEP01	50 U	250 U	1000 U
RFGWNRLF01	41 J	120 J	1000 U
RFGWB12801	50 U	250 U	1000 U
RFGWB12801-D	50 U	250 U	1000 U
RFGWB17701	50 U	240 U	950 U
RFGWB47401	49 J	370 J	1000 U
RFGWFG01	50 U	250 U	1000 U
RFGWB47301	50 U	250 U	1000 U
RFGWB48001	50 U	250 U	1000 U
RFGWETA01	50 U	120 J	1000 U
RFGWETA01-D	50 U	120 J	1000 U
RFGWMFA01	50 U	250 U	1000 U
RFGWPZ901	50 U	250 U	1000 U
RFGWTP101	50 U	240 U	950 U
RFGWTP201	50 U	250 U	1000 U
RFGWCTP01	50 U	250 U	1000 U
RFGWCTP01-D	50 U	250 U	1000 U
RFGWCTPS01	NA	NA	1000 U
RFGWDH01	50 U	250 U	1000 U
RFGWETA01	50 U	250 U	1000 U
RFGWB280B01	50 U	250 U	1000 U
RFGWEERC01	50 U	160 J	1000 U
RFGWPZ1101	310 J	250 U	1000 U
RFGWPZ801	50 U	250 U	1000 U
RFGWBULB101	38 J	240 U	950 U
RFGWBULB201	77	170 J	1000 U

Notes:
 SWRCB State Water Resources Control Board
 ug/L Micrograms per liter

Table 10: Explosive Residue and Perchlorate Detected Results Summary ug/L

Technical Memorandum: Sampling Results for Phase I Groundwater Sampling, Field Sampling Workplan
 University of California, Berkeley, Richmond Field Station, Richmond, California

Sample ID	HMX	RDX	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	Nitrobenzene	Tetryl	2,4,6-Trinitrotoluene	2-Amino-4,6-dinitrotoluene	2-Amino-2,6-dinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Nitrotoluene	4-Nitrotoluene	3-Nitrotoluene	Perchlorates
RFSGWTP101	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	2.0 U
RFSGWTP201	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	2.0 U
RFSGWDH01	1.3 U	1.0 J	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	2.0 U

APPENDIX A

RESPONSE TO COMMENTS



Linda S. Adams
Acting Secretary for
Environmental Protection



Department of Toxic Substances Control

Deborah O. Raphael, Director
700 Heinz Avenue
Berkeley, California 94710-2721



Edmund G. Brown Jr.
Governor

July 21, 2011

Mr. Greg Haet
EH&S Associate Director, Environmental Protection
317 University Hall, No 1150
Berkeley, California 94720

Dear Mr. Haet:

The Department of Toxic Substances Control (DTSC) has reviewed the document entitled *Final Phase 1 Groundwater Sampling Results Technical Memorandum, University of California, Berkeley, Richmond Field Station, Richmond, California* (Tech Memo). The May 11, 2011 Tech Memo was prepared by Tetra Tech EM Inc. for the University of California (UC).

The Tech Memo summarizes the construction and sampling of 50 shallow water-bearing zone piezometers at the Richmond Field Station (Field Station). The piezometers were constructed at locations considered to be down gradient from areas where on-site or off-site activities may have resulted in releases of contaminants to the subsurface. The Tech Memo was amended in response to DTSC comments dated March 7, 2011.

Based on our review of the amended Tech Memo, we have the following comments:

1. The response to DTSC comment 2 states *"Suggested text regarding additional investigation will not be included in the summary memorandum, because the continued groundwater monitoring program was approved by DTSC on March 29, 2011."* The text in the DTSC comment was *"Therefore, the last sentence of this section should state that additional investigation is needed to address previously identified data gaps as well as new data gaps identified by this phase of investigation."* Data gaps remain regarding known and potential contamination of soil, soil gas, and ground water at the field station. Accordingly, additional investigation is needed to address previously identified data gaps as well as new data gaps identified by this or other phases of investigation regardless of the ongoing ground water monitoring program. No revision to the memorandum is necessary.

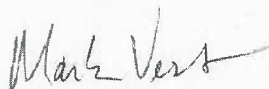
2. The response to DTSC comment 3 states "*Text has been updated to state that piezometers are located in critical downgradient locations from previously identified data gaps.*" We are unable to locate the statement in the amended Tech Memo. Please provide the specific location where this revision was made.
3. DTSC comment 4 asks if there is a ground water elevation error resulting from UC and Zeneca using the North American Vertical Datum of 1988 (NAVD 88) and the National Geodetic Vertical Datum of 1929 (NGVD 29), respectively. No revision to the memorandum is necessary; however, please provide a date when this issue will be resolved and DTSC will be notified.
4. DTSC comment 8 stated that the MCL for chromium be revised from 100 ug/l to 50 ug/l in Section 6.3. This revision was not made. In addition, revisions that were made to Table 5 (originally Table 4) as requested in DTSC's original comment 9 were not made to the text in Section 6.3 (Metals). Please revise the text in Section 6.3 to reflect the revised Table 5.
5. Page 4, Section 2.2., Drilling and Completion: The last paragraph of this section states that piezometer was completed using steel well casings, while earlier text and tables indicate that PVC casing was used. Please revise the document to resolve this inconsistency.
6. Table 5, State and Federal Water Quality Criteria: A review of Table 5 (originally Table 4) revealed incorrect or missing values. For example, the Human Health Risk Based SSGs and aquatic criteria for all receptors is missing the values for carbon tetrachloride and toluene; the values for the 40x and 160x Aquatic Criteria are incorrect (they are all less than the 5x criteria); and California MCLs are missing for 1,1-dichloroethene, 1,2-dichlorethane, and dichloromethane. DTSC did not confirm the other values listed on the table; however, all values should be checked and any necessary revisions made to the table. Please note that as US EPA updated their RSL values in June 2011, Table 4 should be compared to the updated values.

Please resubmit a response to comments and revised document within 30 days of the date of this letter. If you need more information regarding this matter, please contact Lynn Nakashima at (510) 540-3839 or lnakashi@dtsc.ca.gov.

Sincerely,



Lynn Nakashima, Project Manager
Senior Hazardous Substances Scientist
Brownfields and Environmental
Restoration Program
Berkeley Office - Cleanup Operations



Mark Vest, P.G.
Senior Engineering Geologist
Brownfields and Environmental
Restoration Program
Sacramento Office - Geologic Services

Phase I Groundwater Sampling Results Technical Memorandum

University of California, Richmond Field Station Site

January 12, 2011

Response to Comments

Department of Toxic Substances Control, July 21, 2011

August 22, 2011

Page 1 of 2

UC Berkeley Ref. No.	Page/ Sect No.	DTSC Comment	UC Berkeley Response
1		The response to DTSC comment 2 states "Suggested text regarding additional Investigation will not be included in the summary memorandum, because the continued groundwater monitoring program was approved by DTSC on March 29, 2011." The text in the DTSC comment was "Therefore, the last sentence of this section should state that additional investigation is needed to address previously Identified data gaps as well as new data gaps identified by this phase of investigation." Data gaps remain regarding known and potential contamination of soil, soil gas, and ground water at the field station. Accordingly, additional investigation is needed to address previously identified data gaps as well as new data gaps identified by this or other phases of investigation regardless of the ongoing ground water monitoring program. No revision to the memorandum is necessary.	Comment noted.
2	Page 2, Section 1.2	The response to DTSC comment 3 states "Text has been updated to state that piezometers are located in critical down gradient locations from previously identified data gaps." We are unable to locate the statement in the amended Tech Memo. Please provide the specific location where this revision was made.	Section 1.2 has been amended to state "The Phase I FSW field effort was conducted to address these data gaps through the installation of piezometers throughout the RFS (see Figure 3), which were strategically sited at critical down gradient locations from previously identified data gaps (see Figures 4 and 5)."
3		DTSC comment 4 asks if there is a ground water elevation error resulting from UC and Zeneca using the North American Vertical Datum of 1988 (NAVD 88) and the National Geodetic Vertical Datum of 1929 (NGVD 29), respectively. No revision to the memorandum is necessary; however, please provide a date when this issue will be resolved and DTSC will be notified.	UC Berkeley consulted with their surveyor and discovered that they had mistakenly labeled the survey as referencing the NAVD 88 datum, when in fact the survey was conducted using the NGVD 29 datum. RFS and Campus Bay surveys will continue to use the NGVD 29 datum to eliminate future discrepancies.
4	Page 15, Section 6.3	DTSC comment 8 stated that the MCL for chromium be revised from 100 ug/l to 50 ug/l in Section 6.3. This revision was not made. In addition, revisions that were made to Table 5 (originally Table 4) as requested in DTSC's original comment 9 were not made to the text in Section 6.3 (Metals). Please revise the text in Section 6.3 to reflect the revised Table 5.	The current California MCL is 50ug/L and the current Federal MCL for total chromium is 100ug/L. Table 5 and Table 8 in the Final Technical Memorandum include these values. Section 6.3 has been amended to state, "No concentrations exceeded the Federal MCL of 100 µg/L; however at one location, FG, chromium was detected at 50 µg/L, which is the California Department of Public Health MCL."
5	Page 4, Section 2.2	Page 4, Section 2.2., Drilling and Completion: The last paragraph of this section states that piezometer was completed using steel well casings, while earlier text and tables indicate that PVC casing was used. Please revise the document to resolve this inconsistency.	Section 2.2 has been amended to state, "Steel well christy boxes were used to complete the piezometers."

Phase I Groundwater Sampling Results Technical Memorandum

University of California, Richmond Field Station Site

January 12, 2011

Response to Comments

Department of Toxic Substances Control, July 21, 2011

August 22, 2011

Page 2 of 2

UC Berkeley Ref. No.	Page/ Sect No.	DTSC Comment	UC Berkeley Response
6		Table 5, State and Federal Water Quality Criteria: A review of Table 5 (originally Table 4) revealed incorrect or missing values. For example, the Human Health Risk Based SSGs and aquatic criteria for all receptors is missing the values for carbon tetrachloride and toluene; the values for the 40x and 160x Aquatic Criteria are incorrect (they are all less than the 5x criteria); and California MCLs are missing for 1,1-dichloroethene, 1,2-dichloroethane, and dichloromethane. DTSC did not confirm the other values listed on the table; however, all values should be checked and any necessary revisions made to the table. Please note that as US EPA updated their RSL values in June 2011, Table 4 should be compared to the updated values.	The values in Table 5 have been reviewed and updated from the Arcadis October 2010 Quarterly Groundwater and Surface Water Monitoring Report for the Human Health Risk Based SSGs and Aquatic Criteria, the California Department of Public Health's website comparing California and Federal MCLs (http://www.cdph.ca.gov/certlic/drinkingwater/Documents/DWdocuments/EPAandCDPH-11-28-2008.pdf), and the EPA's website for the 2011 RSLs (http://www.epa.gov/region9/superfund/prg/).