

**Draft**

## **Field Sampling Workplan**

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

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*Prepared for*  
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## ACRONYMS AND ABBREVIATIONS

AST	Above ground storage tank
BAPB	Biologically active permeable barrier
Bay Trail	East Bay Regional Parks District's Bay Trail
CCR	Current Conditions Report
CHHSL	California Human Health Screening Level
CSM	Conceptual site model
DQO	Data quality objectives
DTSC	Department of Toxic Substances Control
DU	Decision unit
EERC	Earthquake Engineering Research Center
EPA	U.S. Environmental Protection Agency
ER-L	Effects-range low
ER-M	Effects-range median
FPL	Forest Products Laboratory
FSP	Field Sampling Plan
FSW	Field Sampling Workplan
GW	Groundwater
HSP	Health and Safety Plan
IA	Investigation area
MCL	Maximum contaminant level
MI	Multi-increment
NAWQC	National Ambient Water Quality Control
NOAA	National Oceanic and Atmospheric
NRLF	Northern Regional Library Facility
OHSA	Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
QAPP	Quality and Assurance Project Plan
RAO	Remedial action objectives
RI/FS	Remedial Investigation/Feasibility Study
RFS	Richmond Field Station
SVOC	Semivolatile organic compounds
TCRA	Time critical removal action
Tetra Tech	Tetra Tech EM Inc.



## ACRONYMS AND ABBREVIATIONS (continued)

TPH	Total petroleum hydrocarbons
UC	University of California
UT	Utilities
VOC	Volatile organic compounds
WTA	Western Transition Area
WTL	Wood treatment laboratory

## **1.0 PROJECT DESCRIPTION**

The University of California (UC), Berkeley, prepared this Field Sampling Workplan (FSW) in response to the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), Site Investigation and Remediation Order No. IS/E-RAO 06/07-005. In response to the Order, UC Berkeley prepared a Current Conditions Report (CCR) ([Tetra Tech EM Inc. \[Tetra Tech\] 2008](#)). The final CCR, dated November 21, 2008, provided a comprehensive summary of current conditions at the Richmond Field Station (RFS) in accordance with the DTSC Order, including the 96 acres of upland and 13 acres of tidal marsh and transition habitat.

The CCR identified numerous data gaps warranting additional characterization or evaluation at the RFS. Section 5.3.1 of the Order requires preparation of a FSW to conduct site investigations to address these data gaps. The objective of the site investigations are to investigative data gaps to complete a final remediation investigation report and baseline health risk assessment.

The FSW is intended to be used as a facility-wide guide for the field, laboratory, and data reporting efforts associated with sampling and reporting to address the data gaps at RFS.

The RFS is an academic teaching and research facility, located adjacent to the San Francisco Bay and 6 miles northwest of the UC Berkeley Central Campus. RFS has been used primarily for large-scale engineering research since 1950.

### **1.1 FIELD SAMPLING WORKPLAN COMPONENTS**

This section describes the elements included in the FSW. The FSW is a facility-wide document that includes two appendices: a facility-wide planning Quality Assurance Project Plan (QAPP), and a facility-wide Health and Safety Plan (HSP). This primary document is intended to address the general, facility-wide strategy and protocols for the field investigation. Site-specific field sampling plan (FSP) addenda will be prepared to address site-specific approaches in the various investigation areas. Together, the FSW, QAPP, HSP, and FSP addenda will meet the intended purpose of the FSW as defined in the DTSC Order.

#### **1.1.1 Field Sampling Workplan**

The FSW outlines the project background, objectives, conceptual site model, roles and responsibilities, site prioritization, and schedule for investigating RFS. The FSW also includes remedial action objectives and overall data quality objectives.

#### **1.1.2 Quality Assurance Project Plan**

The QAPP (Appendix A) establishes criteria for data quality assurance and control, and serves as a reference for facility-wide activities such as field data collection and sample analysis. The QAPP includes a brief history and background of RFS, quality assurance objectives, sampling procedures, sample handling protocols, laboratory procedures, data validation and reporting, internal quality review, performance monitoring, data evaluation and assessment procedures,

quality assurance reporting, and laboratory certification. The QAPP includes project organization and responsibilities with respect to sampling and analysis.

The DTSC approval of the QAPP will enable the RFS project team to prepare site-specific FSP addenda that incorporate by reference the facility-wide QAPP for data quality and sample collection, ensuring consistent quality throughout the project.

### **1.1.3 Health and Safety Plan**

The HSP (Appendix B) assesses the type, risk level, and severity of hazards for the project, and identifies safe work practices and appropriate personal protective equipment for site personnel in accordance with California and Federal Occupational Safety and Health Administration (OHSA) standards. The HSP includes a brief site history and background, chemicals of potential concern, a description of standard work practices, hazard assessment, and health and safety requirements.

### **1.1.4 Field Sampling Plan Addenda**

FSP addenda identify the site-specific data gaps, and data collection approaches and activities to successfully complete each phase of the site investigations. Each FSP addendum will include site-specific background and history, purpose for sampling, data quality objectives, sample locations, site-screening levels, and chemicals of potential concern. Each FSP addendum will reference the facility-wide QAPP for general sampling procedures and data collection protocols applicable to all data collection at RFS.

## **1.2 PHYSICAL SETTING**

The RFS is located at 1301 South 46th Street, Richmond, California, along the eastern shoreline of the Richmond Inner Harbor of 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, UC 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.

In this FSW, the RFS is described in terms of types of habitat because future use and potential receptors vary by the type of habitat available. 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 and Hoffman Boulevard 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



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## FIGURE 1 SITE LOCATION MAP

Field Sampling Workplan





300 0 300  
Feet

- Property Boundary
- - - - - Approximate Property Boundary

Notes:  
 EBRPD East Bay Regional Parks District  
 EERC Earthquake Engineering Research Center  
 EPA Environmental Protection Agency  
 NRLF Northern Regional Library Facility  
 RFS Richmond Field Station



Richmond Field Station  
University of California, Berkeley

## FIGURE 2 SITE MAP

Field Sampling Workplan



the north, the RFS connector trail to the East Bay Regional Park District Trail (Bay 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](#)).

### 1.3 HISTORY

Between the 1880s and 1948, prior to UC ownership, the California Cap Company operated facilities on portions of the RFS property for the manufacturing of blasting caps, shells, and explosives ([UC Berkeley 1973](#)). Two small companies, the U.S. Briquette Company and the Pacific Cartridge Company, are presumed to have operated on a portion of the RFS property.

By 1920, the California Cap Company was the only remaining explosives manufacturer on site. Operations of the California Cap Company plant included manufacturing explosives (primarily mercury fulminate), shells, and blasting caps; testing explosives; and storing explosives ([URS Corporation 1999](#)). All components of the blasting caps were manufactured on site, including explosives, shells, copper containers, tin boxes, paper cartons, and insulated wire.

In October 1950, the California Cap Company property was purchased by UC with the agreement that the California Cap Company would remove all hazardous materials from the property. However, subsequent site observations and testing revealed the presence of hazardous materials on RFS. For example, several explosions reportedly occurred between 1950 and 1953 during a controlled burn for clearing. These explosions likely were associated with residual chemicals used by the California Cap Company. Previous investigations in the test pit and explosive storage area found a single detection of explosives at a concentration close to the detection limit ([URS Corporation 2000](#)).

The RFS was initially established by UC Berkeley for large-scale engineering research that required significant space and resources that were not available on UC Berkeley's central campus in downtown Berkeley. Studies more suited to an off-campus location included research on solid waste and sewage, transportation and lighting studies, and beach erosion modeling ([McGauhey 1974](#)). Research projects have been and are conducted under the supervision of professors from numerous UC Berkeley colleges and departments. Current research activities are conducted by the College of Engineering, the College of Natural Resources, Art Practice, the Center for Tissue Engineering, Earthquake Engineering, the Institute for Transportation Studies, the Center for Occupational and Environmental Health's Ergonomics Program, the Northern Regional Library Facility, and others. The research is performed by graduate students, professors, and researchers, supplemented by support staff and technicians ([UC Berkeley 2006](#)).

In addition to UC Berkeley-related operations, the UC Regents have leased space to non-UC Berkeley tenants. Current tenants include the U.S. Environmental Protection Agency (EPA) Region 9 Laboratory; Schlumberger, Inc.; The Watershed Project; and Stratacor, Inc. In 1989, UC management estimated that 250 to 300 people worked at the RFS ([Ensco Environmental Services, Inc. 1989](#)). Current staffing remains at around 300 people.

Many of the RFS buildings historically housed (and currently house) offices, laboratories, warehouses, and workshops used to support engineering projects ([UC Berkeley 2006](#)). Many of the buildings used by the California Cap Company were torn down when UC Berkeley purchased the RFS property, but some building still remain—including two buildings that were formerly homes and several buildings used for a laboratory, offices, and storage. In a few cases, RFS

moved buildings to new locations on the property ([UC Berkeley 2006](#)). A summary of historical academic research and teaching activities associated with the RFS is presented in the final CCR ([Tetra Tech 2008](#)).

## **2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND DATA GAPS**

Section 2 presents a summary of previous investigations of contamination present at RFS. Sampling results documented through November 21, 2008, are presented in detail in the CCR ([Tetra Tech 2008](#)).

### **2.1 SUMMARY OF PREVIOUS SITE INVESTIGATIONS**

This section presents a summary of the site investigations that have been performed at the RFS. Numerous extensive investigations have been conducted at the RFS that have focused on known and suspected sources and their contaminants. These investigations have included characterization of soil, sediment, surface water, groundwater, and indoor air quality. Information provided in this section is intended to provide an overview of previous investigations; specific sampling locations, chemicals, and results are provided in the reference documents.

#### **2.1.1 Soil Investigations in RFS Upland Area**

Soil samples collected from the Upland Area have been analyzed primarily for metals and polychlorinated biphenyls (PCB), and on a more limited basis, for pesticides, semivolatile organic compounds (SVOC), volatile organic compounds (VOC), explosives, and total petroleum hydrocarbons (TPH). Additionally, soil and groundwater samples were also collected in the former research well field area, located in the central portion of the RFS Upland Area, to determine the presence or absence of radionuclides.

Remediation activities performed in 2004 consisted of: (1) excavating soil at numerous locations in the Upland Area of the RFS where elevated concentrations of metals and PCBs were previously identified and (2) excavating sediment to widen an existing channel and creating a new channel in the north-central portion of Western Stege Marsh. The remediated portions of the Upland Area were backfilled with clean soil after excavation. Another small area near the former Forest Products Laboratory (FPL) Wood Treatment Laboratory (WTL) area was excavated and backfilled in October and November 2007. The only known remaining upland areas with elevated concentrations of chemicals in soil are near the former California Cap Company Mercury Fulminate Plant and isolated areas of pyrite cinders.

#### **2.1.2 Soil Investigations in RFS Transition Area**

The eastern portion of the Transition Area was remediated during several phases between 2002 and 2003, and the areas were backfilled with clean soils and sediments. The western portion of the Transition Area, including the Bulb, consists of fill material from unknown sources placed onto the former tidal mudflat and has not been subject to remediation. Soil samples collected in the western portion of the Transition Area have been analyzed for metals, pesticides, and PCBs. The highest concentrations of chemicals detected in soil in the Transition Area are primarily found in subsurface samples in the sediments of the former tidal mudflat beneath the upland fill material.



### **2.1.3 Off-Site Property Areas to the North and East Investigations**

As previously described, RFS is bordered by other former and current industrial operations. Soil samples were collected from the Off-Site Property North Area for PCB analysis and from the Off-Site Property East Area at five locations for analyses of metals and pesticides to evaluate whether historic industrial operations in either direction have impacted RFS.

### **2.1.4 Investigations in Western Stege Marsh**

Remediation of the eastern portion of the Western Stege Marsh was performed in two phases in 2002 and 2003. The remediation activities in the marsh included excavation of sediments down to clean, stiff tan clay, followed by backfilling with clean bay mud. As a result of the completed remediation activities, an extensive area of pollutant source material and most of the contaminated sediments present in the eastern portion of the Western Stege Marsh were removed. Since the remediation, sediment samples taken from the eastern portion of Western Stege Marsh have been analyzed for metals, PCBs, and pesticides.

### **2.1.5 Backfill Soils and Sediment**

Numerous samples have been collected from the soil and sediment that were used as clean backfill in the areas remediated between September 2002 and November 2004 under the oversight of the San Francisco Bay Regional Water Quality Control Board and the time-critical removal actions (TCRA) that were performed under the oversight of DTSC in the vicinity of the former FPL WTL and the two former campfire locations in the Western Transition Area (WTA).

### **2.1.6 Surface Water Investigations**

As part of the project's Groundwater, Surface Water, and Sediment Monitoring Plan, surface water samples were collected from three locations in Western Stege Marsh and one at the Meeker Slough Bay Trail bridge near the Marina Bay Housing Development starting in 2006 through the present (Blasland, Bouck, and Lee 2004d). As part of the plan storm-water runoff samples were collected during rain events in November 2006, April 2007, January 2008, and December 2008 from five locations: the Eastern Storm Drain outfall, the Western Storm Drain outfall, Meeker Culvert, Meeker Tidal Creek, and at the Meeker Slough Bay Trail bridge.

### **2.1.7 Groundwater Investigations**

Three groundwater zones (shallow, intermediate, and deep) have been identified at RFS; however, most of the groundwater data for RFS has been collected from the shallow groundwater zone, with approximately 110 samples collected from 95 locations. Shallow zone samples were analyzed for metals, VOCs, pesticides, and PCBs. Metals were the most frequently analyzed group with only a small percentage of samples analyzed for other groups of chemicals. Four groundwater samples were collected from the intermediate zone in three locations along the eastern property boundary, and three groundwater samples were collected in the deep zone from three locations in the Geosciences well field.

## 2.2 DATA GAPS

The CCR (Tetra Tech 2008) identified data gaps in several areas that warrant additional characterization. The data gaps identify areas where a contaminant release is suspected or where site-specific data does not exist to confirm that no contaminant release has occurred. This section summarizes the specific data gaps identified in the CCR. Section 3 provides the strategy to address the overall characterization of RFS, including these specific data gaps. Details regarding the sampling strategies for each data gap will be included in the site-specific FSPs prepared as addenda to this FSW.

The data gaps have been categorized according to three primary sources of concern: (1) soil, (2) groundwater, and (3) utilities. Investigation strategies presented in Section 4 are also organized according to the three sources; however, UC Berkeley understands that investigations may address multiple sources, media, and pathways, depending on initial sampling results. For example, if contaminant releases are detected in groundwater, a soil-gas investigation may be warranted.

### 2.2.1 Soil

Soil data gaps identified in the CCR are generally related to possible surface or near-surface spills associated with historic and current activities at RFS.

**Current and Historic Research Facilities.** Many current and historical research facilities used or stored hazardous chemicals at RFS. Although there are no indications from any other sources that spills have occurred in these areas, there has been limited or no sampling conducted in these areas. These areas include the earthquake engineering facilities at Buildings 420 and 421, and Buildings 102, 110, 111, 112, 113, 114, 117, 118, 121, 125, 138, 150, 151, 158, 175, 177, 197, 278, 280A, 280B, 450, 460, 470, 474, 478, 480, and 482. In addition, spills have been reported in the vicinity of Building 120 and the RFS Corporation Yard; and these areas are also included as data gaps as no site-specific data is available for these two areas to confirm or deny releases have occurred.

**Aboveground Storage Tanks (AST).** Aboveground storage tanks are present at RFS. The ASTs are in good condition and there have been no reports of releases from the ASTs; however, no site-specific data is available for the vicinity of the tanks to confirm or deny releases have occurred.

**PCB-Containing Transformers.** Previously, PCB-containing transformers have existed on the RFS property. These transformers have either been replaced or retrofitted. Some of the transformers were retrofitted on their pads, and some were stored with other electrical equipment on a concrete pad in the northern portion of Building 280B. While there are no records of PCB leaks or spills, samples will be collected in the areas where the former PCB-containing transformers were located, retrofitted, or stockpiled to confirm or deny releases have occurred.

**Western Transition Area (WTA).** The Bulb area, located in the WTA, was identified as a data gap based on an historical interview with a former employee who claimed debris may have been dumped in this area. This area has been investigated, using

Geoprobe borings and a magnetic survey. The magnetometer showed a strong anomaly southwest of the concrete pad in the Bulb. This area will be further investigated to determine the source of the anomaly and to confirm or deny the possibility of buried debris. In 2008 a TCRA was performed in this area to remove a small patch of ash and debris with detected concentrations of PCBs. During the excavation of Campfire Area II, debris including miscellaneous laboratory glassware was noted in excavated soils and excavation sidewalls. After DTSC approval, these areas were lined with clear, 6 mil plastic, sample locations and excavation extents surveyed, and backfilled with clean soils (Tetra Tech 2009).

**California Cap Company Operations.** The former operations of the California Cap Company have been identified as a data gap. Specifically, the former California Cap Company Test Pit and Dry House were identified as areas where explosions may have occurred during California Cap Company operations. No site-specific characterization data for explosive residues is available for these areas. In addition, no site-specific characterization data exists for the California Cap Company's tram lines. The construction, use, maintenance, or history of releases along the former tram lines is not known.

**Other Former Operations.** The U.S. Briquette Company and Pacific Cartridge Company have been identified on historical Sanborn maps from 1912 and 1916 as operating on the property when it was owned by the California Cap Company. No site-specific characterization data exists for the areas where these companies reportedly operated.

**Western Stege Marsh.** Although the eastern portion of Western Stege Marsh has been remediated, additional information is needed to determine if the surface water and sediment concentrations in the native marsh pose a significant risk to human and ecological receptors.

## 2.2.2 Groundwater

Groundwater data gaps identified in the CCR are related to general comments regarding limited hydrogeologic and groundwater data at RFS, as well as several site-specific data gaps.

**Site-Wide Groundwater Conditions.** Additional data is needed to evaluate general hydrogeologic information for the shallow, intermediate, and deep groundwater zones in various areas across RFS. This includes collecting general hydrogeologic information (groundwater elevations and lithology) to generate a hydrogeologic model, and groundwater quality data (chemical concentrations, total dissolved solids concentrations, metals bioavailability data, etc.).

**Northeastern Property Boundary.** Additional data is needed for the characterization of groundwater near Building 478 where shallow-zone groundwater containing VOCs has been identified in the vicinity of the adjacent Campus Bay Site Lot 1 removal action performed by Cherokee Simeon Ventures I, LLC in the summer of 2008.

**Eastern Property Boundary.** Additional data is needed to characterize the shallow, intermediate, and deep groundwater zones along the portion of the RFS/former Zeneca site property boundary between the area south of the Building 478 area and the southern end of the slurry wall, where metals, pesticides, and VOCs have been identified in groundwater.

**The Biologically Active Permeable Barrier wall.** The effectiveness of the portion of the BAPB wall located on the RFS property has yet to be assessed, and additional information is needed to characterize the shallow and intermediate zones' groundwater quality in the vicinity of the wall.

**Engineering Geosciences Well Field.** The Geosciences Well Field was installed in the 1980s and has been used and continues to be used primarily for research on borehole-to-surface electrical resistivity to accurately map subsurface groundwater flow. No site-specific characterization data is available for these wells.

**Western Transition Area.** Groundwater conditions at the WTA, including the southern portion of the Western Storm Drain line where metals (cadmium, copper, mercury, nickel, and zinc) and PCBs may be present at elevated concentrations, are unknown.

### 2.2.3 Utilities

The CCR identified data gaps related to the possible transport of contaminants through or along utility lines throughout RFS. These utility lines, including current and former sanitary sewer and storm drain lines operated by UC Berkeley and the California Cap Company, and former hydraulic and fuel lines used by the California Cap Company may have served as pathways for contaminants to travel across the RFS. Contaminants may be present in the lines or in nearby soil and groundwater based on direct releases from the lines or transport of contaminants to the storm drains via stormwater.

### 3.0 CONCEPTUAL SITE MODEL

This section presents a summary of the Conceptual Site Model (CSM) for RFS; a detailed analysis is presented in the CCR ([Tetra Tech 2008](#)). The CSM is based on the historical operations, sources for chemical releases and the current environmental data, all of which are presented in the CCR. The CSM describes the possible migration of potential contaminants through the primary pathways in soil, water, and utilities. In addition, the possible exposure pathways for both human and ecological receptors for the transport media are described.

#### 3.1 SOURCES, MIGRATION PATHWAYS, AND EXPOSURE

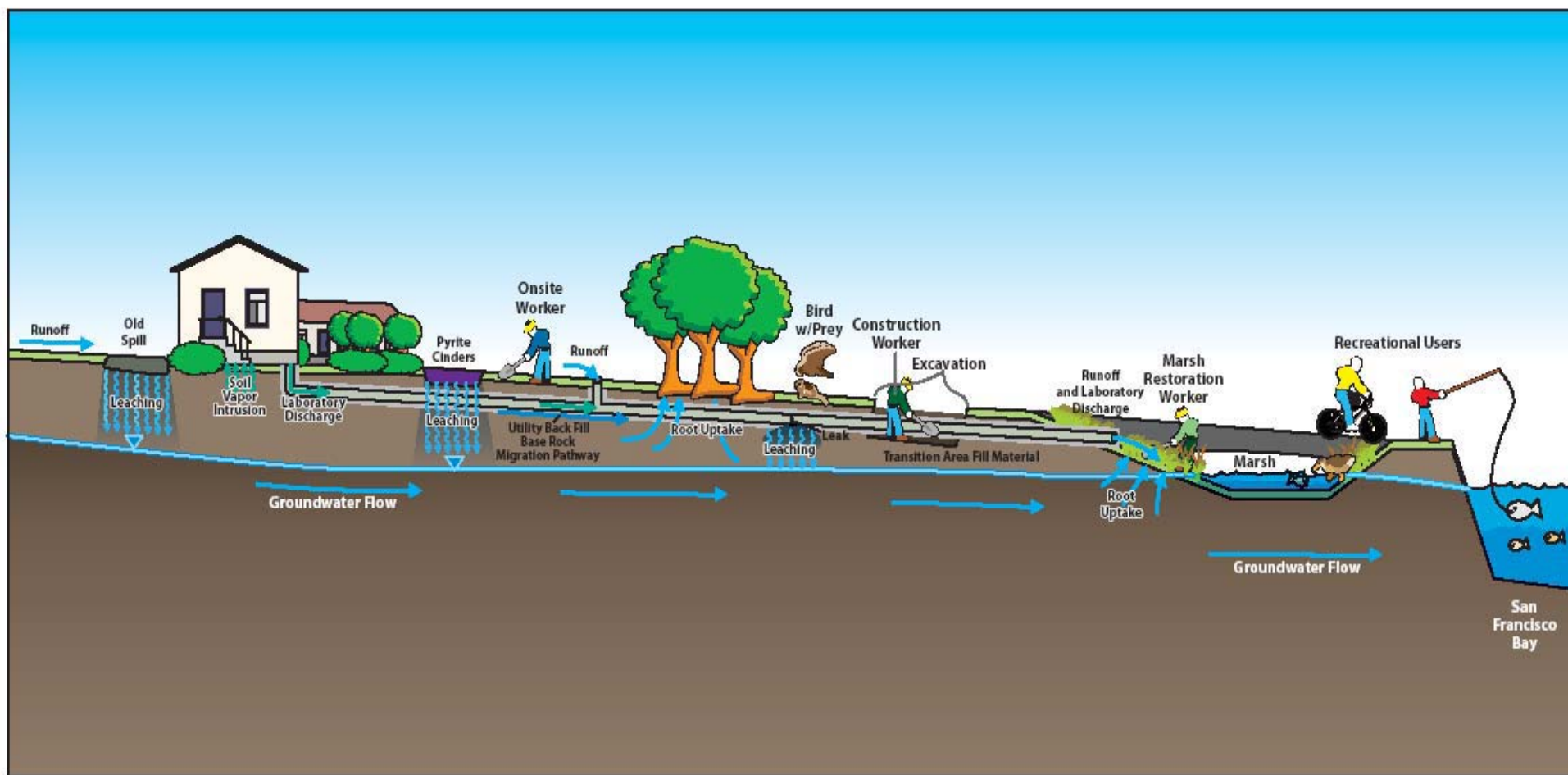
Possible sources of contamination include past industrial operations by the California Cap Company, past manufacturing operations at the adjacent former Zeneca site, current and historical research-related activities, and possibly industrial operations from current or former neighboring properties such as the Bio-Rad Laboratories, the former Pacific Gas & Electric facility, the former Liquid Gold facility and the former Kaiser Shipyard and other activities in the area that is now the Marina Bay housing development ([Tetra Tech 2008](#)). On-site potential sources are discussed above in Section 2.2, Data Gaps.

On- and off-site sources have affected the RFS in three primary ways: (1) direct release of chemicals to soils and sediments at the RFS, (2) transport of chemicals onto the RFS and into the marsh and slough areas via surface water overland flow, storm drain and sanitary sewer flows, and groundwater transport, and (3) possible influx of contaminants from the San Francisco Bay. A depiction of the sources, migration pathways, and possible receptors is shown on [Figure 3](#).

A complete exposure pathway between the contaminated medium to the potential receptors must exist in order for exposure to humans or ecological receptors to occur. The following potential primary chemical migration pathways were evaluated at RFS:

- Leaching from soil to groundwater by infiltrating precipitation or as a result of fluctuating groundwater levels
- Migration from groundwater to surface water through direct discharge
- Direct dermal contact with surface soil, subsurface soils, and surface water
- Ingestion of soil, subsurface soils, and surface water
- Wind entrainment of dust-size particles from surface soils to the atmosphere or to surface water
- Transport of soil or sediment to surface water with overland flow of stormwater
- Transportation of contaminants throughout the site via underground utility corridors
- Sediment transport within the marsh from tidal, wind, and wave action

Both humans and wildlife use the Upland Area, Transition Area, and Western Stege Marsh areas of RFS, and thus may be exposed to chemicals in soils, sediments, groundwater, and surface



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### FIGURE 3 CONCEPTUAL SITE MODEL

Field Sampling Workplan

water. The primary human receptors that may be exposed to the remaining chemicals at RFS include UC Berkeley researchers and employees, RFS staff, RFS tenants, visitors to the Bay Trail and RFS connector trail, and workers planting and weeding in the marsh. Most workers would be exposed only to surface soils from dust or incidental contact and any potential volatilization. Construction workers performing intrusive activities could be exposed to chemicals present in deeper soils. Visitors are likely to be exposed only to dust emitted from RFS surface soils and incidental contact with surface soils along the Bay Trail.

Native and non-native plants persist in all of the habitats present throughout the RFS and provide ample roosting and foraging habitat for many species. Many special-status plant and animal species are both desired and present on the RFS. Many of the invertebrates, reptiles, birds, and mammals discussed above would be expected to visit and forage at the Marsh when the tide is low.

Invertebrates are found in the inundated marsh channels, within the sediment layer, and attached to rocks, debris, or vegetation. These organisms feed on detritus or other sediment-dwelling organisms and are an essential prey for birds and mammals associated with aquatic environments.

Populations of the endangered California clapper rail are restricted to San Francisco Bay estuaries and marshes. They are known to reside year-round at the RFS and breed from February to late August, using both the Marsh and Upland Area for nesting sites and cover. Birds found foraging and nesting within the marsh and mudflat typical of the landscape include snowy egret, black-crowned night heron, great blue heron, long-billed curlew, lesser scaup, and Caspian tern. Three subspecies of salt marsh song sparrow are also possible residents: the Alameda song sparrow, San Pablo song sparrow, and Suisun song sparrow. Gulls, teals, ducks, and geese also may occur on the RFS throughout the year.

### **3.2 SOIL MIGRATION AND EXPOSURE**

Metals and PCBs are the most prevalent of the chemicals of potential concern found in surface and subsurface soils at RFS. Pesticides and SVOCs have also been found in some locations. PCBs and pesticides typically have a slow rate of adsorption and desorption between sedimentary particles and surrounding water. They tend to migrate very little from their initial release point and are not likely to leach from surface soils to subsurface soils and groundwater. Volatile and semi-volatile organic compounds have low sorption capacities so they may not be retained in the soil. These organic compounds tend to leach into the underlying groundwater or volatilize into the soil gas.

The behavior of metals in soils is influenced by the geochemical environment. Factors that determine the geochemical environment include soil pH, oxidation-reduction potential, presence of adsorbents, presence of complexing agents, and concentrations of other elements. In addition to these chemical processes, physical processes such as the amount of precipitation infiltration can also influence the fate of metals. The geochemical environment in the upland soils at RFS is conducive to sorption of metals. The soil in the tidal marsh prior to remediation possessed geochemical characteristics that could have contributed to the migration of metals into groundwater and tidal slough. However, it currently has a geochemistry that tends toward reducing the solubility of metals and increasing the likelihood that the metals remained sorbed in the soils.

### ***Leaching***

The primary mechanism of migration of chemicals from surface soil to subsurface soil and shallow groundwater at RFS is most likely through leaching by infiltrating precipitation. As a result of increased precipitation during the wet season (December through March), the water table is expected to be higher in the winter than during the dry season (April through November). Increased leaching of chemicals may occur during the wet season due to increased infiltration and increased groundwater contact with chemicals in soil. The pH and alkalinity of the infiltrating precipitation relative to the soil solution or porewater in sediment can also exert an influence on leaching. However, leaching of contaminants from surface soils to subsurface soils and groundwater is assumed to be a small factor in the overall onsite migration of contaminants due to the chemical and physical properties of both the soil and contaminants at RFS.

### ***Adsorption to Sediment***

A majority of the contamination in the surface soils at the RFS occurring from a spill would be assumed to have migrated little from its original release point. This is due to the nature of the expected contaminants at RFS and the properties of the on-site soils. PCBs and pesticides are strongly adsorbed to soil particles and are not readily leached. Metals are dependent upon the geochemical environment which at the RFS is conducive to soil sorption. For these reasons, any releases of contaminants to the surface soils at RFS are assumed to still be near-surface. The migration of contaminants due to the physical transportation of sediments to which they are adsorbed is discussed following sections.

### ***Exposure to Human Receptors***

On-site workers may go outside and walk portions of the RFS and may also conduct projects or testing outdoors. In addition, recreation activities such as hiking, jogging, or bird watching tend to occur on the nearby public access trails and parts of the surrounding marsh. As a consequence of outside activities, these people may contact surface soils, resulting in dermal (skin) contact with chemicals in soils. Direct soil contact could also result in incidental ingestion of chemicals in the soils that may adhere to hands.

In addition to office workers and researchers, on-site workers may be involved with or employed as site maintenance workers. These workers could be involved with landscape or building maintenance, including simple construction in support of research projects. These types of workers may have more opportunity for soil contact (such as incidental soil ingestion and dermal contact with soil). Construction by these or similar workers could also result in contact with deeper soils and possibly shallow groundwater, resulting in incidental ingestion of subsurface soils and dermal contact with soils and groundwater. Although this work would be expected to occur for a shorter period, these exposures may be higher than for other on-site workers. RFS on-site maintenance staff received the 40-hour OSHA Hazardous Waste Operations and Emergency Response training (with annual 8-hour refresher courses) and UC Berkeley has implemented a Job Safety Analysis procedure and developed an interim soil management plan to ensure that on-site maintenance workers and contractors follow protocols for safe handling of soil at the RFS. In addition, UC Berkeley developed an on-line training system for all onsite workers to inform them of the history, chemicals of possible concern, prohibitions on digging in soil and impacting sensitive ecological habitats (such as the California Clapper Rail habitat), and general health and safety practices at the RFS.

### ***Exposure to Ecological Receptors***

All ecological receptors are subject to potential dermal contact with any contaminants in the soil on site. Grasses, shrubs and trees could potentially be exposed to contaminants through the root



uptake of soil and sediment. Invertebrates can take up contaminants in soil by osmosis and ingestion of sediment and prey. Additionally, birds and mammals can be exposed to contaminants through the ingestion of dirt on the plant surface and through cleaning and grooming.

### **3.3 WATER MIGRATION AND EXPOSURE**

Migration of soluble contaminants in water potentially occurs in all three zones of groundwater, surface water, and sanitary sewers. In addition, migration also occurs through the transport and deposition of contaminants adsorbed to soil sediments that are eroded by stormwater runoff.

#### ***Groundwater***

Groundwater underlying the RFS exists in three separate zones: shallow, intermediate and deep. The overall hydrology at the site is currently unknown, but it is assumed that a majority of the groundwater flows in the general south-southwest direction towards the San Francisco bay. Contamination of groundwater occurs through the leaching of contamination down through surface and subsurface soils into the shallow groundwater zone. Although the soil conditions are more favorable for sorption, there is known contamination of metals and pesticides in the groundwater along the eastern property boundary. In addition, tetrachloroethylene, trichloroethylene, and cis-1,2-dichloroethylene have been identified in the shallow groundwater located near the RFS and former Zeneca property boundary in the vicinity of RFS Building 478. Because they are soluble in groundwater, these solvents are more mobile than metals and also readily volatilize to soil gas.

The overall groundwater hydrology at the site is currently unknown, but it is assumed that a majority of the groundwater flows in the general south-southwest direction towards the San Francisco bay. Migration of chemicals from groundwater to surface waters may occur if groundwater discharges to the San Francisco Bay; however, the rate of discharge is expected to be low because of the low permeability of the predominant soils at RFS.

#### ***Surface Water and Sediment Transport***

Many contaminants, such as metals and hydrophobic organic compounds, readily adsorbed to clay and silt-sized sediment particles. Therefore, an important and often dominant transport mechanism for these chemicals in the aquatic environment is the movement of sediment particles. If surface sediments are eroded and suspended in the water column, they can be transported through surface water runoff and storm drains into the tidal marsh. Once in the marsh, contaminants adsorbed to sediments can be moved by tidal action or waves and deposited in areas of reduced speed.

Four processes primarily act to transport suspended sediments in the RFS region:

- Tidal exchange of sediments through the marsh and sloughs. Tidal exchange is responsible for sediment exchange to and from the central San Francisco Bay. The net flux of sediments depends on conditions in the marsh and sloughs, sediment load in the central San Francisco Bay, and seasonal events.
- Delivery of sediments to the marsh and sloughs by upland runoff, which occurs only during seasonal events.

- Delivery of sediments through sloughs by upland runoff into sloughs.
- Wind and wave activity from the San Francisco Bay. Wind and waves generally mobilize sediments through the San Francisco Bay. The net effect of this mobilization can both deliver sediment from the San Francisco Bay and remove sediment from the shoreline regions.

The interplay of these processes is seasonally dependent, but no data is currently available to make any conclusions on the magnitude of each relationship.

#### ***Exposure to Human Receptors***

On-site workers that are outside during a storm event may be in contact with runoff possibly resulting in dermal contact or incidental ingestion of soluble or suspended contaminants. On-site workers involved with landscaping, building maintenance or simple construction could possibly come in dermal contact with shallow groundwater. Recreation activities such as hiking or bird watching along public access paths also result in the possibility of dermal or incidental ingestion. Anglers, due to the nature of their activity, are potentially more at-risk for dermal contact and incidental ingestion of surface waters. Additionally, this group of receptors could be exposed to chemicals that originate in sediments or surface water, accumulate in the food chain, and ultimately get taken up by fish in this portion of the bay.

#### ***Exposure to Ecological Receptors***

All ecological receptors are subject to potential dermal contact with any contaminants in the water onsite. Small plants could potentially be exposed to contaminants through the root uptake of sediment and surface water while shrubs and trees can extend roots down several feet to reach shallow groundwater. Aquatic and benthic invertebrates as well as fish can take up contaminants in water by osmosis and ingestion of detritus, suspended sediment and prey. Additionally, birds and mammals can be exposed to contaminants through the ingestion of surface water.

### **3.4 MIGRATION ALONG UTILITIES AND EXPOSURE**

On- and off-site stormwater drainage systems likely contributed to the transport of contaminants to the RFS upland and marsh areas. The configuration of the Western Storm Drain line from eastern and northern off-site properties that discharged into the marsh has changed over the years. Prior to the construction of the City of Richmond Wastewater Treatment Plant in the 1950s, the Western Storm Drain line appears to have been the primary sewer line in the area, conveying stormwater and sewage (including industrial wastes) from an undelineated upstream area of the City of Richmond directly to the western portion of Western Stege Marsh and Meeker Slough. After the City of Richmond Wastewater Treatment Plan was constructed, the line continued to be used by the City of Richmond as a sanitary sewer overflow line until the northern portion of the line was disconnected by UC Berkeley from the City of Richmond's sanitary sewer system by UC Berkeley in 2004.

In addition, a historic sanitary sewer line traversed the former tidal mudflat area. This sanitary sewer line drained the eastern portion of the California Cap Company, and later RFS, and portions of the former Stauffer site and Harbor Front properties to the north and east of the former Stauffer site. A large portion of this sanitary sewer line was removed during remediation activities in 2003 and replaced with a new section of sanitary sewer line that is now located further north of the former sanitary sewer line orientation.

It is believed that these drainage systems may have facilitated the transport of soluble contaminants throughout the RFS. Contaminants adsorbed to eroded sediment suspended in runoff can be conveyed through these sewers as well. Also, contaminants located in the subsurface soil but not originating from the sewers may be migrating along the backfill material for the lines. Although it has been confirmed that the storm drain previously discharged directly into the tidal marsh, it is unknown whether any of the contaminants may have migrated from the sewers into the surrounding soil and groundwater due to breaks or leaks in the lines.

Hydraulic and fuel oil lines were originally installed by the California Cap Company and run throughout the RFS. During their time of operation, these lines may have leaked fuel oil at any portion along their lines into the surrounding subsurface soil and groundwater. In addition, contaminants in the subsurface soil may be migrating along the backfill material, if present.

***Exposure to Human Receptors***

On-site workers who may enter or perform maintenance on the utility lines could potentially have dermal contact or incidental ingestion of contaminants. All other exposure pathways for human receptors are the same as those listed above for soil and water.

***Exposure to Ecological Receptors***

The exposure pathways for all ecological receptors are the same as those listed above for soil and water.

## 4.0 SITE INVESTIGATION APPROACH

This section provides the overall strategy and technical approaches to address the data gaps identified in the CCR (Tetra Tech 2008). The remedial action objectives, site investigation strategy, facility-wide data quality objectives, and the schedule for field events and data review are presented below.

### 4.1 REMEDIAL ACTION OBJECTIVES

Section 5.1.2 of the Order presents the remedial action objectives (RAO) for the site. The RAOs include:

- The reasonably foreseeable future land use of the site is commercial/educational and open space. Therefore, RAOs for contaminated media shall be developed that are protective of adults and children in a commercial/education scenario and as recreational users of open space.
- Western Stege Marsh is a sensitive habitat for the endangered California Clapper Rail. Therefore, RAOs for contaminated media shall be developed that are protective of endangered and threatened species that have been identified at the site, and their habitat.
- The coastal terrace prairie is a sensitive habitat for native grasses and forbs. Therefore, RAOs for contaminated media shall be developed that are protective of sensitive species and their habitat.

The data collected during the FSW field activities will meet these RAOs as they are further developed and refined in the remedial investigation report.

### 4.2 STRATEGY, PRIORITIZATION, AND DATA EVALUATION

The purpose of the site investigation is to identify immediate or potential risks to public health and the environment, in order to prioritize and implement response actions, as stated in Section 5.1.1 of the Order. The Order states that site priorities should be developed and modified through the course of the investigations. This section presents the site prioritization strategy for implementation of the site investigation.

#### 4.2.1 Strategy

The investigation strategy has been designed to confirm or deny the presence of primary contaminant sources identified as data gaps within the CCR. These primary sources consist of possible contaminants present in soil, groundwater, and former and current utilities. The investigation is organized by the primary sources:

**Soil Data Gaps.** The possible presence of contaminant spills or releases has been identified as a data gap. Soil data gaps will be investigated through the characterization of near-surface soils throughout the RFS. While specific data gaps were identified in Section 2.2, the strategy proposed for investigating soil releases encompasses the entire

RFS. Use of multi-incremental (MI)/decision unit (DU) sampling will be the primary technique to address the soil data gaps. MI/DU sampling has been developed as a sampling technique to greatly increase sample result confidence and identify possible spill areas. The requirement for subsurface sampling will be determined following review of the near-surface sampling results.

**Groundwater Data Gaps.** The possible presence of contaminants in groundwater at RFS has been identified as a data gap. The groundwater data gap will be addressed through the collection of groundwater grab samples through Hydropunch samples. Grab sample results will be evaluated to determine subsequent optimal placement of piezometers and additional sampling locations, if necessary. If analytical results support the presence of an unidentified source, additional soil or utility sampling may be conducted.

**Utility Data Gaps.** The possible presence of contaminant spills or releases through former and current utilities at RFS has been identified as a data gap. Utilities will first be investigated through the installation and analysis of passive soil gas devices such as a GORE™ Module. Areas identified to be of potential concern through passive soil gas sampling will be followed by active soil gas methods, if necessary. The strategy will be conducted in several phases, beginning with primary utility corridors closest to the marsh or utility outfalls, then proceeding upland along the primary corridors, and finally toward lateral corridors to specific buildings if necessary. Analytical results from each phase of the utility investigation will be evaluated to determine the need for additional passive sampling, active soil gas sampling, soil sampling, or groundwater sampling.

#### **4.2.2 Prioritization**

Given the broad scope of activities necessary to address the three categories of data gaps, the planned field investigations are divided into manageable-sized study areas in a phased approach, thus enabling UC Berkeley to accelerate the investigation of data gaps that are perceived as higher priorities. The approach also allows for field investigations to coincide with work constraints in the Western Stege Marsh and Transition Area as a result of the California Clapper Rail breeding season as no activities may occur from February 1 to August 31.

Field activities are divided into five field study phases: Phases I through V. Investigation areas for each primary source (soil, groundwater, and utilities) for each of the five phases are described in Table 1. Soil investigation areas are presented on [Figure 4](#). Site-specific sampling strategies and groundwater and utility investigation areas will be included in the FSP addenda to this FSW. In the event that the proposed scope for each phase changes based on updated sampling information, Table 1 and [Figure 4](#) will be modified and this FSW will be updated.

#### **4.2.3 Data Evaluation**

The objectives of the site investigations are to identify immediate or potential risks to public health and the environment and prioritize and implement response actions using removal actions and operable units, if appropriate, based on the relative potential risks at the site. As a first step in determining immediate or potential risk, field sampling data will be evaluated to either confirm or deny the release of a hazardous substance, as defined in the DTSC Order. Site- and chemical-specific screening levels will be developed within each FSP addendum, and may be included as

Table 1: Site Prioritization

Primary Sources	Phase I	Phase II	Phase III	Phase IV	Phase V
Soil	IA1-1: Building 478	IA2-1: North Meadow	IA3-1: 450s	IA4-1: Northwest Meadow	Remaining soil data gaps
	IA1-2: East Meadow	IA2-2: Cap Company North	IA3-2: 580 Meadow	IA4-2: Building 280	IA5-1: Old Marsh
	IA1-3: Corporation Yard	IA2-3: Cap Company South	IA3-3: Eucalyptus Meadow	IA4-3: Big Meadow	IA5-2: New Marsh
	IA1-4: U.S. Briquette Company	IA2-4: Cap Company West	IA3-4: EERC Pavement	IA4-4: NRLF	
		IA2-5: Mercury Fulminate Area	IA3-5: WTA West	IA4-5: Geosciences Well Field	
		Phase I soil data gaps	IA3-6: Western Transition Area	IA4-6: Building 277	
			IA3-7: Magnetic Anomaly	IA4-7: EPA Meadow West	
			IA3-8: Eastern Transition Area	IA4-8: EPA Meadow North	
			IA3-9: BAPB area	IA4-9: EPA Laboratory	
			Phase II soil data gaps	Phase III soil data gaps	
Groundwater	GW1: Building 478 Area	Phase I GW data gaps	GW6: Western Transition Area	GW8: Geosciences Well Field	Remaining GW data gaps
	GW2: Building 120 Area		GW7: Building 175/Building 177	Phase III GW data gaps	
	GW3: Property Boundary		Phase II GW data gaps		
	GW4: BAPB				
	GW5: Site-wide Groundwater				
Utilities	UT1: Select utility locations	UT2: Utilities, near discharge points	UT3: Utilities, upline	UT4: Utilities, laterals	Utilities, data gaps

Notes:

BAPB

EERC

EPA

GW

IA

NRLF

UT

WTA

Biologically active permeable barrier

Earthquake Engineering Research Center

Environmental Protection Agency

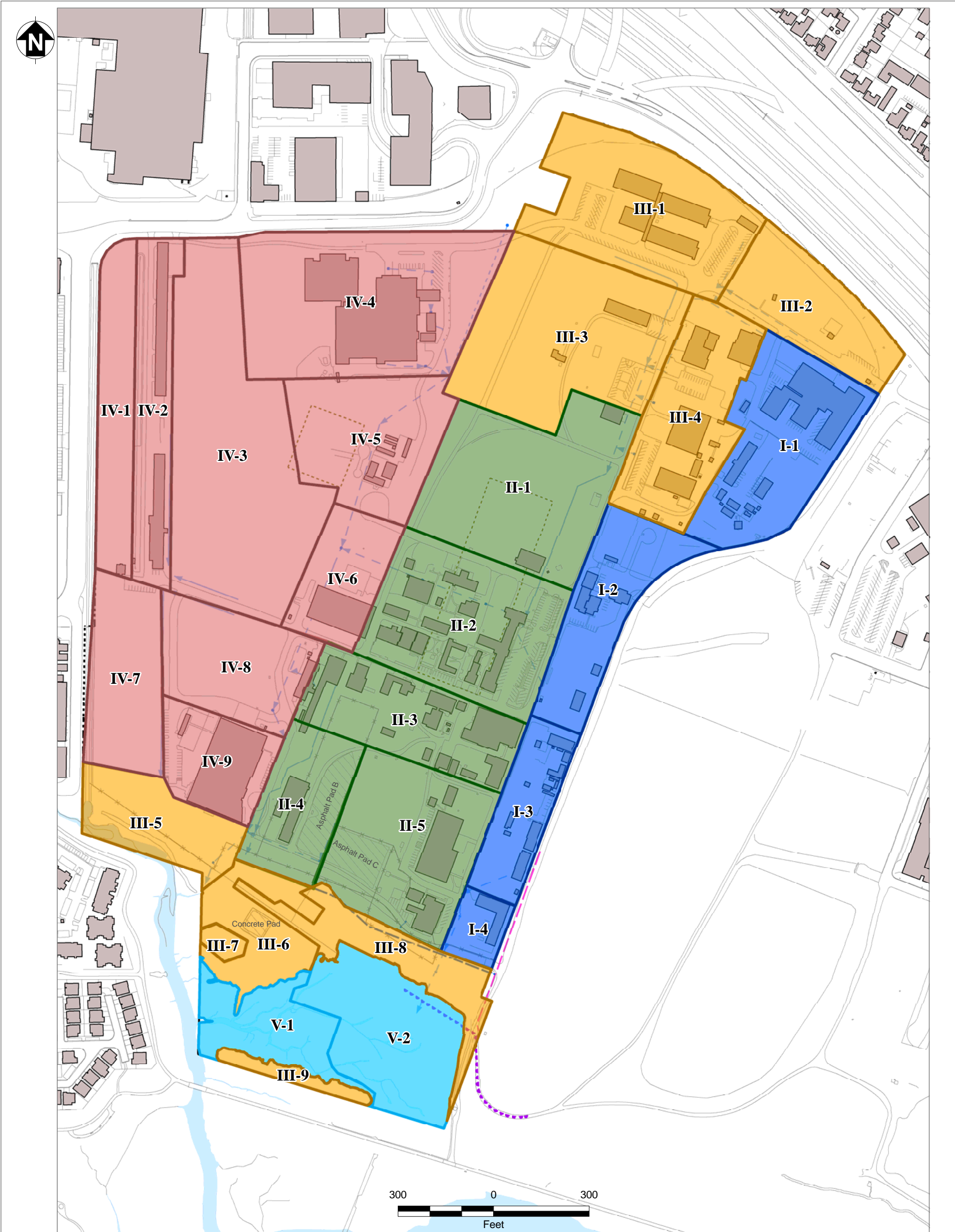
Groundwater

Investigation areas

Northern Regional Library Facility

Utilities

Western Transition Area



- Existing Building  
(Building Numbers Shown in Blue)
- Surface Water
- Asphalt/Concrete Pads
- Well Field Boundary
- Property Boundary
- Approximate Property Boundary
- Fenceline
- Biologically Active Permeable Barrier Wall
- Former Seawall (Approximate)
- Slurry Wall
- Storm Drain Lines:
  - Open Swale
  - Underground Culvert
  - Underground Culvert, Abandoned (Grouted at Manholes)

- Soil Investigation Areas**
- Phase I
  - Phase II
  - Phase III
  - Phase IV
  - Phase V



Richmond Field Station  
University of California, Berkeley

**FIGURE 4**  
**SOIL INVESTIGATION AREAS**

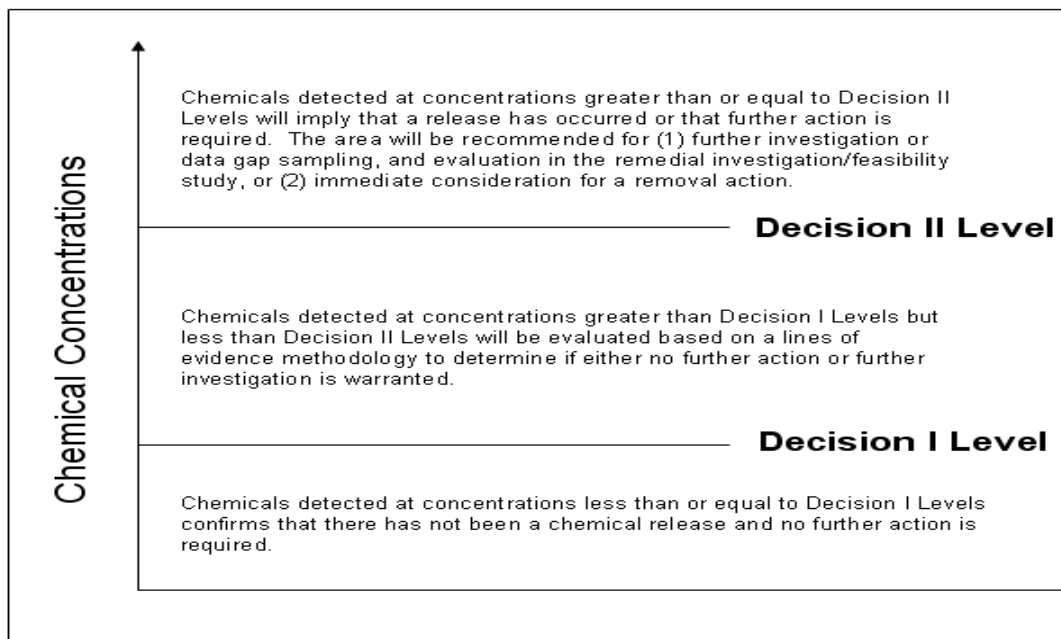
Field Sampling Workplan



an addendum to this FSW, if appropriate. Screening levels will be developed to support the determination of confirming or denying a release of hazardous substance. The methodology for applying the screening levels to the data evaluation is presented below.

**Decision I Levels.** Chemical detected at concentrations less than or equal to Decision I Levels will provide adequate justification to deny the presence of a hazardous release, unacceptable spill, or hot spot at the sampling location. Decision I Levels for each constituent will be based on existing state and federal criteria or site-specific criteria. Examples of state and federal criteria include the California Human Health Screening Levels (CHHSL), EPA's Residential Soil Regional Screening Levels (formerly the Preliminary Remediation Goals), National Oceanic and Atmospheric Research Effects Range Low and Median (NOAA ER-L and ER-M), National Ambient Water Quality Criteria (NAWQC), and National Drinking Water Maximum Contaminant Levels (MCL). An example of site-specific criteria include background concentrations.

**Decision II Levels.** Chemicals detected at concentrations greater than or equal to Decision II Levels will imply that a release has occurred or that further action or investigation is required. Decision II Levels for each constituent will be based on state or federal criteria or site-specific criteria similar to those listed for the Decision I Levels, but modified to reflect site-specific conditions such as commercial-use CHHSLs or Tier II exposure concentrations.



Investigation areas with concentrations less than or equal to Decision I Levels will be recommended for no further action.

Investigation areas with concentrations greater than Decision II Levels will be recommended for (1) further investigation or data gap sampling, and evaluation in the remedial investigation/feasibility study, or (2) immediate consideration for a removal action.



Chemicals detected at concentrations greater than Decision I Levels but less than Decision II Levels will be evaluated based on a lines-of-evidence approach. Information to be considered in the lines of evidence will include, but not be limited to, site concentrations, chemical traits (toxicity, mobility, etc.), chemical concentrations at adjacent investigation areas, depth of contamination, site cover and controls, and current site activities. Based on the lines-of-evidence approach, these investigation areas will be either (1) recommended for no further action consistent with the Decision I Level recommendations, or (2) recommended for further evaluation consistent with the Decision II Level recommendations.

#### 4.3 DATA QUALITY OBJECTIVES

Data quality objectives (DQO) are intended to assist with the collection of the appropriate data required to support defensible decisions. The DQO process is a seven-step iterative planning approach used to prepare plans for environmental data collection activities. It provides a systematic approach for defining the criteria that a data collection design should satisfy, including when, where, and how to collect samples or measurements; determination of tolerable decision error rates; and the number of samples or measurements that should be collected (EPA 2006). The seven steps are as follows:

**Step 1: State the Problem.** Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem; develop conceptual site model.

**Step 2: Identify the Goals of the Study.** Identify the questions and goals of the project which require new environmental data to address the stated problem.

**Step 3: Identify Information.** Identify the information needed to support the decision and specify which inputs require new environmental measurements.

**Step 4: Define the Boundaries of the Study.** Specify the spatial and temporal aspects of the environmental media that the data must represent to support the decision.

**Step 5: Develop the Analytical Approach.** Develop a logical “if . . . then” statement that defines the conditions that would cause the decision maker to choose among alternative actions.

**Step 6: Specify Performance or Acceptance Criteria.** Specify the decision maker’s acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data.

**Step 7: Develop the Plan for Obtaining Data.** Identify the most resource-effective sampling and analysis design for generating data that is expected to satisfy the DQOs.

DQOs have been established consistent with the RAOs and overall site investigation strategy presented above in Sections 4.1 and 4.2. DQOs have been established for soil; groundwater; and utilities. The DQOs presented in this document are intended to be broad and comprehensive. Site-specific DQOs will be established in the FSP addenda to this document.

### 4.3.1 Soil Data Gaps

#### Step 1: State the Problem

- Limited site-specific characterization data is available to confirm or deny releases of hazardous chemicals from current or previous activities at the site.
- If present in surface soils, contaminants may have migrated to subsurface soils or shallow groundwater.
- If contaminants are present in surface soils, subsurface soils, or shallow groundwater, there is the potential for unacceptable exposure to both human and ecological receptors.

#### Step 2: Identify the Goals of the Study

- Were there any undocumented spills or releases of chemicals into the soil from previous activities at the RFS?
- Are there any contaminants in the soils that confirm a hazardous substance release or that present unacceptable site hazards?
- Are there contaminants present in the surface or subsurface soils that could be contributing to preferential pathway or groundwater contamination?
- Are contaminants present within the study area in quantities or concentrations that would require inclusion in the Remedial Investigation/Feasibility Study (RI/FS)?
- Are contaminants present within the study area in quantities or concentrations that would require an immediate response?

#### Step 3: Identify Information Inputs

- Information from historical documents
- Interviews of current and former employees
- Previously collected environmental data (sampling locations and concentrations)
- Concentrations in surface soils of metals, PCBs, polycyclic aromatic hydrocarbons (PAHs), VOCs, SVOCs, pesticides and other contaminants, measured during phased sampling using appropriate EPA SW-846 Methods

#### Step 4: Define the Boundaries of the Studies

- All reasonably accessible surface soils located within the property boundaries of the RFS
- Surface soils from 0 to 2 feet below ground surface will be the first areas investigated.
- Vertical expansion of the study areas to subsurface soils may be necessary if contamination is present in the surface soils.
- Vertical and lateral expansion of the study areas to groundwater may be necessary if contamination is present in the subsurface soils.
- Lateral expansion of the study areas to preferential pathways may be necessary if contamination is present in subsurface soils near preferential pathways.
- There are no temporal boundaries associated with this investigation.

#### Step 5: Develop Decision Rules

- If surface soil contaminants are detected at concentrations at or less than Decision I Levels, then the data confirms that there has not been a contaminant release and no further action is required.
- If surface soil contaminants are detected at concentrations exceeding Decision I Levels but less than Decision II Levels, proceed with evaluation of lines of evidence to determine if either no further action or further investigation is warranted.
- If surface soil contaminants are detected at concentrations exceeding Decision II Levels, expand the vertical boundary of the study area to subsurface soils.

- If subsurface soil contaminants are detected at concentrations less than Decision I Levels, no further action is required for subsurface soils.
- If subsurface soil contaminants are detected at concentrations exceeding Decision I Levels but less than Decision II Levels, proceed with evaluation of lines of evidence to determine if either no further action or further investigation is warranted.
- If contaminants are detected in the subsurface soils at concentrations exceeding Decision II Levels, expand the vertical and lateral boundary of the study area to include groundwater, surface water, sediment, and preferential pathways as appropriate.
- If any contaminants are detected at concentrations exceeding Decision II Levels, the area will be recommended for one or several of the following: further data evaluation or data gap sampling, inclusion in the RI/FS, or immediate consideration for removal action.

#### Step 6: Specify Performance or Acceptance Criteria

- Use of MI/DU sampling will maximize the confidence of confirming or denying the presence of unacceptable hazardous concentrations at each site. The site-specific FSP addenda will present specific numeric performance and acceptance criteria.
- Decision I and Decision II Levels are site and contaminant specific. The screening levels will be established in the site-specific FSP addenda. The screening levels will be developed through evaluation of several values, including background concentrations, unrestricted use CHHSLs, commercial use CHHSLs, and other risk-based values.

#### Step 7: Optimize Design for Obtaining Data

- The entirety of the RFS will be divided into five individual phases of soil investigation called Investigation Areas (IA).
- Each IA will be divided into a number of subareas and each subarea will be divided into individual DUs.
- The DUs will be sampled using MI sampling and the samples will be sent to the laboratory for analysis.
- The laboratory results will be analyzed and determinations will be made.
- If warranted by laboratory results, additional surface or subsurface samples will be collected using the same methodology during the next phase of the investigation.

### **4.3.2 Groundwater Data Gaps**

#### Step 1: State the Problem.

- Additional characterization of the groundwater at RFS is needed to develop a hydrogeologic model of the site and to improve the understanding of overall groundwater quality.
- Additional characterization of groundwater is needed to improve the understanding of groundwater quality for specific locations of known or possible contamination.
- If contaminants are present in shallow groundwater, there is a possibility for exposure to both human and ecological receptors.

#### Step 2: Identify the Goals of the Study

- What is the general hydrogeology at RFS?
- What is the prevailing hydraulic gradient of the groundwater at RFS?
- Are contaminants migrating on site, in any of the groundwater zones, from the former Zeneca site where metals, pesticides and VOCs have been identified in the groundwater?
- Are metals, PCBs, VOCs, PAHs, pesticides, or other contaminants present within the study area in quantities or concentrations that would require inclusion of the area into the RI/FS?
- Are metals, PCBs, VOCs, PAHs, pesticides, or other contaminants present within the study area in quantities or concentrations that would require remedial action?
- Are metals, PCBs, VOCs, PAHs, pesticides, or other contaminants present within the study area in quantities or concentrations that would require an immediate response?

#### Step 3: Identify Information Inputs

- Information from historical documents
- Interviews of current and former employees
- Previously conducted sampling locations and concentrations
- Boring logs and depth-to-water measurements
- Concentrations in groundwater of metals, PCBs, PAHs, VOCs, SVOCs, pesticides and other contaminants measured using appropriate EPA SW-846 Methods

#### Step 4: Define the Boundaries of the Study

- The study area is all groundwater located within the property boundaries of the RFS.
- The shallow groundwater zone is primarily of interest with minor investigations in the intermediate and deeper groundwater zones
- Horizontal expansion of the study area may be necessary to investigate potential groundwater plumes if contamination is present in subsurface soils or groundwater.
- There are no temporal boundaries associated with this investigation.

#### Step 5: Develop the Decision Rules

- If contaminants are not detected or detected in groundwater at concentrations at or less than Decision I Levels, no further action is required.
- If contaminants are detected at concentrations exceeding Decision I Levels but less than Decision II Levels, proceed with evaluation of lines of evidence to determine if either no further action or further investigation is warranted.
- If contaminants are detected at concentrations exceeding Decision I Levels, expand the lateral or vertical boundary of the study area to subsurface soils.
- If any contaminants are detected at concentrations exceeding Decision II Levels, the area will be recommended for one or several of the following: further data evaluation or data gap sampling, inclusion in the RI/FS, or immediate consideration for interim remedial action.

#### Step 6: Specify Performance or Acceptance Criteria

- Decision I and Decision II Levels are site and contaminant specific. The screening levels will be established in the site-specific FSP addenda. The screening levels will be developed through evaluation of several values, including NAWQCs, MCLs, and other risk-based values.

#### Step 7: Optimize Design for Obtaining Data

- Groundwater data gaps will be addressed through the collection of groundwater grab samples. Grab sample results will be evaluated to determine subsequent optimal placement of piezometers, if necessary.
- Following receipt and review of the laboratory results from either the groundwater or soil investigations, additional groundwater samples will be collected using the same methodology, if necessary.

### **4.3.3 Utility Data Gaps**

#### Step 1: State the Problem.

- Utility lines that traverse the RFS, specifically storm sewer, sanitary sewer, fuel oil and hydraulic lines, may have served as sources or preferential pathways for potential contaminant migration.
- If chemicals were disposed via a drain in a laboratory and there was a leak in the sanitary sewer line, the contamination could migrate into the backfill or surrounding native soil, and spread from its source.

#### Step 2: Identify the Goals of the Study

- Were there ever any spills or significant releases of contaminants originating from utility lines?
- Are contaminants present in the subsurface soils that could be migrating along the trench backfill material (if present) for the lines, but not originating from the lines?
- Are contaminants present within the study area in quantities or concentrations that would require inclusion in the RI/FS?
- Are contaminants present within the study area in quantities or concentrations that would require remedial action?
- Are contaminants present within the study area in quantities or concentrations that would require an immediate response?

#### Step 3: Identify Information Inputs

- Information from historical documents.
- Interviews of current and former employees
- Concentrations in subsurface soil gas of from passive soil gas sampling and any subsequent active soil gas, soil, or groundwater samples.

#### Step 4: Define the Boundaries of the Study

- All utilities located within the property boundary of the RFS
- The study area will begin in the southern end of the property, targeting areas where contamination may have migrated naturally, due to gravity.
- The initial investigation will identify main utility lines
- The study area will expand upland, as deemed necessary by the results of the sampling results along the main lines.
- The study area will target lateral lines based on sampling results from the main lines.

#### Step 5: Develop the Decision Rules

- If contaminants are not detected or detected in soil gas at concentrations at or less than Decision I Levels, no further action is required.
- If contaminants are detected at concentrations exceeding Decision I Levels but less than Decision II Levels, proceed with evaluation of lines of evidence to determine if either no further action or further investigation is warranted.

- If contaminants are detected at concentrations exceeding Decision II Levels, expand the investigation to include any lateral lines, subsurface soils, or groundwater, as appropriate.
- If any contaminants are detected at concentrations exceeding Decision II Levels, the area will be recommended for one or several of the following: further data evaluation or data gap sampling, inclusion in the RI/FS, or immediate consideration for removal action.

#### Step 6: Specify Performance or Acceptance Criteria

- The Decision I Levels and Decision II Levels are site and contaminant specific. The screening levels will be established in the site-specific FSP addenda.

#### Step 7: Optimize Design for Obtaining Data

- Utilities will be investigated through the installation and analysis of passive soil gas devices. The strategy will be conducted in several phases, beginning with primary utility corridors closest to the marsh, then proceeding upland along the primary corridors, and finally toward lateral corridors to buildings if necessary.
- Analytical results from each phase will be evaluated to determine the need for additional passive sampling, active soil gas sampling, soil sampling, or groundwater sampling.

## **4.4 SCHEDULE**

This section establishes the procedures for document submittals, reviews, and schedule changes for implementing the scope of work under the Order. UC Berkeley will implement the planning activities, field investigations, and report preparation in accordance with the schedule, as shown on [Figure 5](#).

### **4.4.1 Document Submittal and Review**

UC Berkeley is responsible for preparing and distributing documents to DTSC on or before the corresponding deadline. Both parties may determine that specific documents require less or more than the specified review period and alter the review schedule accordingly. UC Berkeley will be available to DTSC during the review periods to respond informally to questions and comments on draft documents.

At or before the close of the DTSC review periods, DTSC will transmit its written comments to UC Berkeley. Both parties will meet prior to 15 calendar days of the close of the review period to discuss comments.

Following the close of the review periods, UC Berkeley will give full consideration to all DTSC and other government agency comments, and will revise any reports to address DTSC written comments.

### **4.4.2 Changes to Schedule**

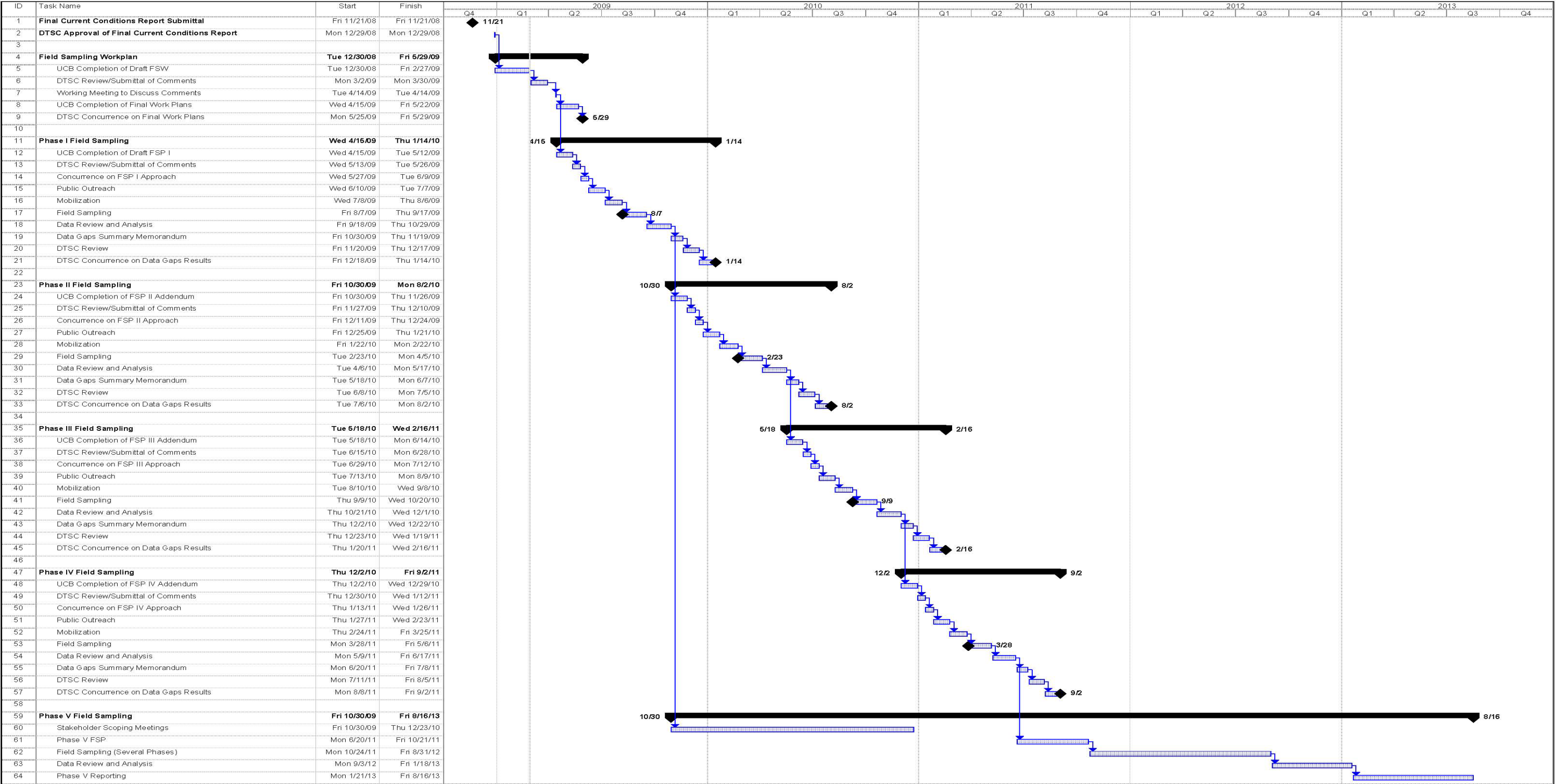
The schedule for implementing field programs and report preparation is dependent on UC Berkeley and DTSC concurrence regarding the scope of the field program or response to comments for a report. UC Berkeley may request an extension of any deadline for good cause. UC Berkeley will identify the length and cause of the extension requested.

If DTSC grants the extension, UC Berkeley will extend the affected timetable and deadline or schedule accordingly. If DTSC does not concur in the requested extension, it will include an explanation of the basis for its position.

#### **4.4.3 Documentation**

Monthly Summary Reports, which are prepared by UC Berkeley in accordance with Section 6.3 of the Order, will include a description of any schedule changes and the reasons for such changes.

UC Berkeley will issue as-needed revisions to [Figure 5](#) for any schedule changes. Items that are critical-path dependent will be updated in the event of any schedule change.



Richmond Field Station  
University of California, Berkeley

**FIGURE 5  
SCHEDULE**

Field Sampling Workplan



## 5.0 PROJECT ROLES AND RESPONSIBILITIES

This section presents key staff and responsibilities. Additional project organization information pertaining to sampling and laboratory quality is presented in the QAPP.

**Table 2: Richmond Field Station Roles and Responsibilities**

Name and Affiliation	Roles	Responsibilities
Greg Haet, UC Berkeley Office of Environment, Health & Safety	Project Coordinator	Directs environmental health and safety compliance of the project. Receives notices, comments, approvals, and related communications from DTSC and forwards them to Respondents' representatives. Reports to and interacts with the DTSC for all Order tasks and/or public outreach.
Gwojen Fung, UC Berkeley Capital Projects	Project Manager	Manages contracts, schedules, and budgets. Authorizes work to proceed.
Karl Hans, UC Berkeley Office of Environment, Health & Safety	Project Scientist/ On-Site EH&S Coordinator	UC on-site environmental health and safety project coordinator at the Richmond Field Station. Assists in managing the project and in reporting to and interacting with the DTSC and Respondents. Reviews all submittals and notifications to DTSC and other agencies for quality and completeness.
Jason Brodersen, P.G. (Tetra Tech EM Inc.)	Project Consultant/Project Geologist/	Provides direction and supervision of hazardous waste site cleanup work. Provides expert advice on environmental management during investigation and remediation phases of the project. Primary author and coordinator of completion Order required reports and other technical deliverables.
Gene Barry, P.E. (4LEAF, Inc.)	Project Construction Manager	Performs construction management and oversight duties during various construction phases of the project and other on-site activities. Assists the project consultant and project coordinators in managing project information and data and completion of project deliverables.
Anthony Garvin (UC Office of the General Counsel)	Respondent Representatives	Provide input to and receive input from Project Coordinator regarding project management, task completion, and DTSC interaction.
Brian Spiller (Zeneca)		
John Edgcomb (Edgcomb Law Group- Zeneca/Bayer CropScience)		
Bill Marsh (Edgcomb Law Group - Zeneca/Bayer CropScience)		

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