FINAL DRAFT
COMPREHENSIVE SITE-WIDE SAMPLING AND ANALYSES PLAN

Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

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PROFESSIONAL CERTIFICATION

This *Comprehensive Site-Wide Sampling and Analyses Plan* for the Former Romic Environmental Technologies Corporation Facility, located at 2081 Bay Road in East Palo Alto, California has been prepared by and under the direct supervision of a California Professional Geologist.

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ACRONYMS

1,1-DFA	1,1-difluorethane
µg/L	micrograms per liter
AOC	Area of concern
ASTM	American Society for Testing and Materials
bgs	below ground surface
°C	Celsius
CAM	California Assessment Manual
CEQA	California Environmental Quality Act
CMIP	Corrective measures implementation plan
COCs	Constituents of concern
CPT	Cone penetrometer test
CSAP	Comprehensive Sampling and Analysis Plan
DPT	Direct push technology
DQO	Data quality objective
DTSC	Department of Toxic Substances and Control
DWR	Department of Water Resources
ERD	Enhanced reductive dechlorination
FEMA	Federal Emergency Management Agency
ft/ft	Feet/foot
GCC	Groundwater Committee of the California
HASP	Health and Safety Plan
HLA	Harding Lawson and Associates
IDW	Investigation derived waste
LA	Los Angeles
MCL	maximum contaminant level
mL/min	milliliter per minute
msl	mean sea level
NHPA	National Historical Preservation Act
NPDES	National Pollution Discharge Elimination System
PCBs	Polychlorinated biphenyls
PG&E	Pacific Gas and Electric

PID	Photo-ionization detector
PPE	Personal protection equipment
PVC	Poly vinyl chloride
QA/QC	Quality assurance/quality control
RBD	Ravenswood Business Development
RCRA	Resource Conservation and Recovery Act
RBTCs	Risk Based Target Concentrations
Romic	Romic Environmental Technologies Corporation
RWQCB	Regional Water Quality Control Board
SMP	Soil Management Plan
SOPs	Standard Operating Procedures
SVOCs	Semi-volatile organic compounds
SWMUs	Solid Waste Management Units
TCLP	Toxicity characteristic leaching procedure
TPH	Total petroleum hydrocarbon
USEPA	United States Environmental Protection Agency
USCS	Unified soil classification system
USA	Underground Service Alert
VOCs	Volatile organic compounds

1.0 Introduction

Bay Enterprises has completed Phase I Closure activities for the former Romic Environmental Technologies Corporation (Romic) recycling and process facility located at 2081 Bay Road in East Palo Alto, California ("Site"; Figure 1). Operations ceased in the fall of 2007, and removal of Site structures such as buildings and tanks was completed during Phase I Closure by May, 2010. Phase I Closure included the removal and decontamination of above ground portions of the Hazardous Waste Management Units (HWMUs). Phase II of the closure will begin with the investigation to evaluate chemical releases to the subsurface, followed by development of corrective measures implementation planning based on the findings of this investigation. The Final Remedy phase will be the remediation of Site contaminants and remaining concrete foundation and pavement. This document is the Site-wide Comprehensive Sample and Analysis Plan (CSAP) for the subsurface investigation. Indoor air sampling is no longer included in this CSAP, because none of the original building structures remain.

The Final Remedy decision for the Site was prepared and finalized by the United States Environmental Protection Agency (USEPA) on July 28, 2008 (USEPA, 2008). USEPA coordinated with the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) and the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) (collectively refered to in this document as the "Joint Agencies") in selecting the remedy. The Final Remedy selected by the USEPA includes the following:

- A Site-wide subsurface investigation;
- Groundwater and soil remediation;
- Groundwater and surface water monitoring;
- Financial assurance for construction, operation, monitoring, and maintenance of the groundwater, and soil remediation system;
- Land use restrictions with a risk management plan;
- Five-year remedy performance evaluation reports; and
- Progress reports.

The Final Remedy to address soil and groundwater contamination will use enhanced bioological treatment, monitored natural atenuation, excavation and removal of contaminated soils, and maintenance of the existing Site cover. The Final Remedy also includes cleanup objectives that specify action levels for groundwater, surface water, and indoor vapor intrusion for future redevelopment (USEPA, 2008).

Data collected as part of the subsurface investigation will be used in conjunction with the USEPA's Final Remedy decision to develop the corrective measures implementation plan (CMIP). The CMIP defines and provides the details of how the selected remedy will be implemented. Data collected as part of this investigation will be evaluated to ensure there is adequate information to implement the Final Remedy. Currently, no plans for future redevelopment or reuse of the Site have been developed. The CSAP is not intended to satisfy all potential characterization requirements that may be imposed for future redevelopment of the Site.

1.1 Purpose and Goals

The CSAP is a comprehensive but phased approach which facilitates facility closure with Site corrective action. The purpose of the CSAP is to identify the nature and extent of soil contamination in the vadose zone across the entire facility. In addition, the nature and extent of groundwater contamination and soil vapor (also referred to as "soil gas") will be evaluated in some areas of the Site. The goal of this CSAP is to identify areas that will be characterized and describe the scope of the investigation. The results of the investigation will primarily be used to complete closure of the permitted units under RCRA and to develop the CMIP. In addition, the investigation data will be screened against risk-based criteria to identify areas of the Site that are not impacted and to facilitate segregation and closure of those non-impacted areas. Based on discussions with USEPA and DTSC, closure of non-impacted areas may include additional soil vapor sampling; however the scope and organization of any additional vapor sampling will be developed after the CSAP program is completed.

Aboveground closure was detailed in the *Draft Facility Closure Plan* submitted to DTSC on April 7, 2008 (Clean Harbors, 2008) and the *Facility Closure Certification Report* (Bureau Veritas 2009) and addendums (Bureau Veritas 2010). CSAP activities can be conducted with minimum access issues now that facility structures have been removed.

The key steps in the Site closure process are summarized below:

- Completion of facility closure and removal of Site structures.
- Development and implementation of the CSAP.
- Development and implementation of a CMIP from CSAP data.
- Completion of post-remediation confirmation sampling.

1.2 Joint Agency Guidance

This CSAP is the result of meetings, negotiations, draft reviews, and correspondence between Romic, the USEPA, DTSC, and RWQCB between 2008 and 2011. As a product of early meetings in this process, the USEPA, DTSC, and the RWQCB drafted a letter dated January 11, 2008 (Closure/Corrective Action Sampling and Analysis Plan, Romic Environmental Technologies Corporation, East Palo Alto, California) that outlined guidance for this CSAP specific to the Site. The DTSC is the lead agency for facility closure; while the USEPA is the lead agency for subsurface Site remediation. Sampling and analysis of media at the Site is necessary for both facility closure and Site remediation. As described in the January 11, 2008 guidance letter, the CSAP includes the following elements:

- Purpose and Goals
- Tables and Maps
- Sampling Strategy and Grid System
- Depth of Sampling
- Analytical Methods
- Soil Media Cleanup Objectives
- Management of Excavated Soils
- Post Remediation Confirmation Sampling
- Background Data for Metals
- Quality Assurance/Quality Control (QA/QC)

In addition, the regulators provided comments on the preliminary scope, tables, and figures that were submitted on March 11, 2008. On April 24, 2008 USEPA, DTSC, and the RWQCB issued comments on the preliminary scope (USEPA, DTSC, and RWQCB Comments on Romic’s Draft Site Wide Sampling Strategy and Rationale, April 24, 2008). A meeting to discuss the comments was held on May 5, 2008 and a letter was issued on May 23, 2008 that summarized the key points and agreements for the comments (Summary of May 5, 2008 Meeting to Discuss Joint Agency Comments on Romic’s Draft Site Wide Sampling Strategy and Rationale, May 23, 2008). A Site walk was conducted on June 17, 2008 that included USEPA, DTSC, RWQCB, and Romic.

The *Draft Site-Wide Sampling and Analysis Plan, Former Romic Environmental Technologies Site, East Palo Alto, California* was submitted on July 31, 2008, and the Joint Agencies comments are summarized in a memo dated October 28, 2008. Additional program development discussions occurred with USEPA, DTSC, and RWQCB between the submittal date of the October memo and June 2009.

On August 13, 2009, ARCADIS submitted the *Comprehensive Site-Wide Sampling and Analysis Plan* (Second Draft) to the Joint Agencies. This second draft incorporated all of the comments and program discussions as described above. In a letter dated November 6, 2009, the Joint Agencies followed with comments on the August report, and Bay Enterprises responded to these comments in a letter dated December 31, 2009. A follow-up to the Bay Enterprises response to comments was prepared by the Joint Agencies and submitted on April 7, 2010. In addition to formally prepared letters, comments from the Joint Agencies have been submitted via emails and verbal discussions during the time period from April 2010 to March 2011. All written comments, emails, and verbal discussions regarding requested modifications to the August 13, 2009 document have been incorporated into this version of the CSAP.

2.0 Background

2.1 Site Location and Physical Description

The Site encompasses approximately 12.6 acres in East Palo Alto, San Mateo County, approximately 0.5 mile west of the San Francisco Bay (Figure 1). This area of East Palo Alto is zoned for light and heavy industrial use. Residential areas are located approximately 0.3 mile to the west and 0.4 mile to the south-southeast of the Site. Adjacent to the Site, primarily to the west and south, are auto-wrecking yards, an electrical substation, and a chemical manufacturing plant. Two tidal sloughs define the northern and eastern Site boundaries. Further east are a levee, presently used as a hiking and biking trail, and a 130-acre former saltwater evaporation pond now comprising marsh and wetlands.

Topographical elevations across the Site range between 5 and 11 feet above mean sea level (msl). Runoff follows surface topography and the adjacent areas to the north and west drain toward the Site. The Site is located within the 100-year flood plain established by the Federal Emergency Management Agency (FEMA, 1984), although Romic has added fill and levees to mitigate flooding hazards. Portions of the Site have been filled with various materials including silts, sands, and construction/demolition debris. A levee protects the Site from tides and storm surges on the northern and eastern property lines.

There are two unnamed tidal sloughs, to the north and east of the Site, which roughly correlate with the Site property boundaries in these areas. These sloughs drain surface water from the marshland area north of the Site. Surface water in the north slough drains into the east slough at the northeast corner of the Site. The east slough flows south along the eastern property boundary, and then turns east connecting to the San Francisco Bay.

The area along the Bay interior is currently undergoing a rejuvenation of public interest, and possible beneficial uses include wildlife habitat, preservation, and terrestrial and aquatic recreation. The Mid-peninsula Open Space District and several municipalities are considering land reclamation and redevelopment along the waterfront (Conor Pacific/EFW/Henshaw, 1999). Marshland near the Site may be suitable for endangered species such as the California clapper rail (*Rallus longirostris obsoletus*) and the salt marsh harvest mouse (*Reithrodontomys raviventris* [Harding Lawson and Associates (HLA), 1989]).

2.2 Geology and Hydrology

Bedrock in the area is Cretaceous to Jurassic in age and is part of the Franciscan Formation (Department of Water Resources [DWR], 1967). Near the Site, bedrock elevations have been reported to be approximately 880 feet below msl (the Groundwater Committee of California Regional Water Quality Control Board, San Francisco Region [GCCRWQCB], 2003).

The Site is located near the southwest shoreline of the San Francisco Bay. The Diablo Range to the east and the Santa Cruz Mountains to the west bound the north-south oriented San Francisco Bay and Bay plain. This structural depression extends north into the Petaluma, Napa, and Sonoma Valleys and south into the San Benito and Santa Clara Valleys.

The Site is located on the San Francisco-Marin or Bay geologic block defined by the San Andreas Fault to the west (9 miles) and the Hayward Fault to the east (10 miles). The inferred location of the San Jose Fault trace, which trends northwest to southeast, may be the western edge of the San Francisco Bay Block and lies relatively close to the Site (HLA, 1989). Surface expression of faulting in the Site vicinity has not been previously reported, and evidence of borehole faulting has not been noted. Faulting is not expected to be found at the Site, and therefore would not impact Site stratigraphy or groundwater flow.

The San Francisco Bay block began to subside in the late Pliocene and Pleistocene, allowing the ocean to transgress inland (Oakeshott, 1978). Worldwide climatic fluctuations during the Pleistocene created sea level fluctuations which filled and emptied the San Francisco Bay. These fluctuations allowed fluvial systems such as the Sacramento River to wash sediments out of the bay when sea level was low and deposit sediments when sea level was high. Highly heterogeneous, unconsolidated sequences of alternating estuarine (bay mud) and terrigenous alluvial clays, silts, and sands have accumulated.

Alluvial materials (the Niles and San Francisquito Cones) were shed from the Diablo Range and the Santa Cruz Mountains, respectively (DWR, 1967), which coalesce as alluvial fan deposits. These cones have depositional systems that inherently deposit highly heterogeneous materials. Steep topographical gradients near the sediment source deposit large grain sediments, and debris flows are common. Finer grain material is deposited as the energy of the depositional system decreases at the distal portions of the fan lobe. The Niles and San Francisquito Cones inter-finger in the subsurface of the San Francisco Bay Plain. These sediments are underlain by the Pleistocene Santa Clara Formation (Dibblee, 1966). These sediments comprise two regional aquifers, the Newark and the Centerville. In the immediate Site vicinity, the Newark aquifer has been loosely subdivided into three zones segregated by clays: the A-, B-, and C-zones. The Centerville aquifer is separated from the Newark aquifer by a regional (bay mud) clay aquitard. The Centerville aquifer has been referred to as the D-zone at the Site (Conor Pacific/EFW/Henshaw, 1999).

In addition to native unconsolidated material, extensive fill materials have been emplaced at the Site. The thickness of fill material at the Site ranges between 1 and 14 feet (Conor Pacific/EFW/Henshaw, 1999). The Site-specific geologic and hydrogeologic units are described further in subsequent paragraphs.

The A-zone consists of clayey to silty sands and gravels interbedded with dark silts and clays. Organic-rich layers with plant and root material have also been observed at the Site. The A-zone ranges in thickness from 7 to 24 feet, and in areas, extends to a depth of approximately -13 feet below msl. Underlying the A-zone is the locally-identified A/B aquitard, ranging between 8 and 25 feet in thickness (Conor Pacific/EFW/Henshaw, 1999). The A/B aquitard is considered laterally discontinuous (HLA, 1991).

The B-zone is similar in composition to the A-zone, with clayey to silty sands and gravels interbedded with sandy silts and clays. The B-zone is considered to be relatively laterally discontinuous and is thinner in the central and northern portions of the Site. The top of the B-zone is located between -10 and -25 feet below msl and ranges in thickness between 3 and 21 feet. Underlying the B-zone is the locally identified B/C aquitard, which ranges in thickness between 9 and 24 feet and contains carbonate fragments. The B/C aquitard is thickest in the northwest and southeast portions of the Site (Conor Pacific/EFW/Henshaw, 1999).

The C-zone is confined and consists of sand and silty sand interbedded with silt and clay lenses. The C-zone is reported to be relatively laterally continuous across the Site, ranging between 11 and 25 feet thick, and is thickest in the central and northern Site areas. The top of the C-zone has been found to range between -39 and -54 feet below msl. The C-zone and the underlying D-zone are separated by a laterally continuous clay aquitard that is found regionally. This unit is predominantly clay, but thin lenses of sand or gravel have been observed. The C/D aquitard is approximately 70 feet or greater in thickness (Conor Pacific/EFW/Henshaw, 1999).

The D-zone is confined and consists of clayey sands and gravels interbedded with clays and clay with gravel. The top of the unit is approximately -151 feet below msl and is approximately 30 feet thick. The D-zone is also underlain by clayey material (Conor Pacific/EFW/Henshaw, 1999).

Groundwater in all zones at the Site has, in the past, been reported to flow east toward the San Francisco Bay. Prior to remediation efforts, groundwater gradients in the A-, B-, and C-zones have been reported to be between 0.001 and 0.002 feet per foot [ft/ft] (Conor Pacific/EFW/Henshaw, 1999). The groundwater extraction and treatment system had been operated as a Site remediation strategy until approximately November of 2004. Local effects on groundwater levels had been attributed to the presence of several groundwater extraction wells. This system is no longer operational.

The A-zone has a downward hydraulic gradient, and the C-zone has an upward hydraulic gradient in relation to the B-zone (Conor Pacific/EFW/Henshaw, 1999). The D-zone also has an upward hydraulic gradient in relation to C-zone but is separated by a thick deposit of relatively low permeability clay. Tidal influence studies at the Site have determined that the mean water level elevation in the sloughs is 1.30 feet above msl and 1.9 feet above msl in the A-zone (Geomatrix and Papadopoulos, 1992). Thus, there exists a vertical hydraulic gradient from the A-zone toward the sloughs. The estimated groundwater flux between the A-zone and the sloughs is approximately 1.67 gallons per day (HLA, 1993). Vertical hydraulic gradients could also be affected by tidal fluctuations.

2.3 Operational History

Since the mid 1950s, the Site has generally been used to recycle or process chemicals. In 1956, a chemical processing plant was built and used by Hird Chemical Corporation. The Site was transferred to the Carad Chemical Corporation in 1959. In 1963, the Site was purchased by P. D. Electronics, and Romic began operating at the facility. The Site was purchased by Romic in 1979, and Romic operated the facility until the fall of 2007. Activities at the Site include solvent recycling (primarily distillation), fuel blending, wastewater treatment, and hazardous waste storage and transfer (Conor Pacific/EFW/Henshaw, 1999). A Site facility map is included as Figure 2.

Regulatory documents and records kept by Romic between 1963 and 1973 indicate that the Site handled waste paints, degreasing solvents, acrylic resins, thinners, vinyls, inks, light and heavy oils, miscellaneous flammables, and greases (Conor Pacific/EFW/Henshaw, 1999). After 1980, Romic characterized the materials handled at the Site as halogenated hydrocarbons, distillation bottoms, still bottoms, ink sludge, paint sludge, organic chemicals, polymeric coating wastes, and solvents.

One documented release of constituents of concern (COCs) to the environment occurred in 1973. During the winter season of 1972-1973, tidal flooding breeched the levees resulting in discharge from the ponds to the sloughs. The RWQCB issued an abatement order on March 23, 1973 (RWQCB, 1973) which estimated a release of approximately 20,000 gallons per day of waste liquids from the former east pond to the adjacent slough. As a result of the abatement order, Romic rebuilt levees, improved surface drainage, and connected to the sanitary sewer. The surface topography provides containment of fluids by sloping towards a central location where storm water was collected and managed under both industrial wastewater discharge and National Pollution Discharge Elimination System (NPDES) permits.

In 1983, the Site handled approximately 4,200,000 gallons of waste materials. As of 1989, the Site processed approximately 7,000,000 gallons of waste materials per year (HLA, 1989). Prior to operation closure in 2007, the Site was handling 35,000 tons of waste material per year. These wastes are byproducts of various industries including the following: chemical, paint, ink, semiconductor, airline, electronics, biotech, printing, and pharmaceutical. Previous releases of waste material have resulted in impacts to the soil and groundwater at the Site. The primary cause of soil and groundwater contamination is through the release of solvent waste material and recycled product in and around the central process areas. Releases have occurred as a result of accidental spills, tank and container overfills, flooding events, and breaks in transfer pipes. A trough connecting the central process area, former pond area, and the former wastewater receiving ponds also may have acted as a source of contamination (Figure 2).

The Site ceased operations in 2007 and surface closure activities were completed in 2010. The only above-grade structures that remain after surface closure are the concrete pavement, walls, tank pads and the parking lots. Romic also controls adjacent land to the south which it uses for surplus storage, and adjacent land to the west, which acts as a buffer area. The Site is surfaced with concrete, except the equipment storage yard and southern parking lot which are surfaced with compacted gravel. Soil berms have been constructed around the Site to prevent surface runoff entering from adjacent properties (HLA, 1989).

2.4 Surrounding Land Use History

There are several environmentally impacted areas in close proximity to the Site. Auto-wrecking yards are located immediately south and west of the Site. At these locations, some removal activities have been conducted to address petroleum- and lead-impacted soil (Conor/Pacific/EFW/Henshaw, 1999). Also south of the Site is the former Rhône-Poulenc facility (also known as the Zoecon site) that produced agricultural chemicals for decades (HLA, 1989 and Conor Pacific/EFW/Henshaw, 1999). This facility was remediated to address elevated arsenic concentrations in soil and groundwater (Conor Pacific/EFW/Henshaw, 1999). A Pacific Gas and Electric (PG&E) substation is also located close to the Site and could be a source of polychlorinated biphenyls (PCBs).

The former Romic facility is located entirely within the City of East Palo Alto's Ravenswood Business Development (RBD) District. This area is slated for commercial and light industrial development over the next decade, with no residential development allowed east of Pulgas Avenue. The RBD District encompasses approximately 200 acres, including the Four Corners Area (Bay/University Avenue). The Four Corners Area is primarily characterized by a mixture of retail and residential uses. Current use of the RBD District includes a combination of light and heavy industrial companies, wrecking and storage yards, non-conforming residential uses, and undeveloped parcels.

2.5 Permitted Units, Solid Waste Management Units, and Other Contaminant Sources

Romic operated over 20 permitted units as part of its operation (Figure 3). At least half of these units were tankfarms (some tankfarms were compounded into one permitted unit) and the remaining units were comprised of four storage areas, one sampling area, one high temperature unit, one liquefaction unit, and one truck wash. Further detail regarding the specific tanks and former units is presented in the *Draft Facility Closure Plan* submitted to DTSC on April 7, 2008 (Clean Harbors, 2008) and the *Facility Closure Certification*

Report (Bureau Veritas 2009) and addendums (Bureau Veritas 2010). The tankfarms contained tanks of various sizes associated with the operation of the facility. The tankfarms were all bermed or walled for containment purposes. Currently, all of the tanks in the tank farms have been removed and there is nothing in the storage areas. The permitted units and a brief description of each unit are summarized below:

- Drum Crusher (north storage building) – This unit is a warehouse that contained one fixed and one mobile drum crushers.

- South Drum Storage Building – This building stored containers of various sizes that held liquids associated with the operation.

- Drum Sampling Area – This unit was 125 feet in length and 74 feet in width. The unit stored containers of various sizes that held liquids associated with the operation.

- Liquefaction Unit – This unit occupied two levels in the drum and debris buildings. Tank PT-1 was part of the liquefaction unit.

- High Temp Unit – This unit had three components: tank HTU and two receiver tanks (HTU-1 and HTU-2). The tanks held a total permitted capacity of 1,931 gallons of liquids associated with the operation.

- Truck Wash Unit – The Truck Wash Unit consisted of a storage tank (TW-1) and a truck wash system. The truck wash system consisted of a four-compartment truck wash skid and a rack that holds a sprayer. The Truck Wash Unit secondary containment area measured 73 feet by 27 feet.

- West Storage Building #2 – The buildings that were part of the unit was the field services warehouse, clean product storage area, and scrubber unit.

- Tankfarm A – The unit consisted of several tanks that held a total permitted capacity of 75,182 gallons of liquids associated with the operation.

- Tankfarm B – The unit consisted of several tanks that held a total permitted capacity of 23,715 gallons of liquids associated with the operation.

- Tankfarm CLR – The unit consisted of several tanks that held a total permitted capacity of 54,000 gallons of liquids associated with the operation.

- Tankfarm D – The unit consisted of several tanks that held a total permitted capacity of 23,500 gallons of liquids associated with the operation.

- Tankfarm E – This unit was planned but never constructed.

- Tankfarm F – This unit was planned but never constructed.

- Tankfarm G – This unit was not permitted to receive, store, or process hazardous waste.

- Tankfarm H – The unit consisted of several tanks that held a total permitted capacity of 105,600 gallons of liquid associated with the operation.

- Tankfarm I – The unit consisted of several tanks that held a total permitted capacity of 119,451 gallons of liquids associated with the operation.

- Tankfarm J – The unit consisted of several tanks that held a total permitted capacity of 1,740 gallons of liquid associated with the operation.

- Tankfarm K – This building stored containers of various sizes that held liquids associated with the operation.

- Tankfarm MNO – The unit consisted of several tanks that held a total permitted capacity of 105,600 gallons of liquids associated with the operation.

- Tankfarm Q – The unit consisted of several tanks that held a total permitted capacity of 494,324 gallons of liquid associated with the operation. Fourteen tanks out of the twenty-two tanks that are part of this unit were never permitted to receive, store, or process hazardous waste.

- Tankfarm S – This unit was planned but never constructed.

- Tankfarm T – This unit was planned but never constructed.

- Tankfarm U – This unit was planned but never constructed. It was designed to hold several tanks that would have had a total permitted capacity of 105,600 gallons of liquids associated with the operation.

Twenty different Solid Waste Management Units (SWMUs) were identified during the Resource Conservation and Recovery Act (RCRA) Facility Assessment (California State Department of Health Services Toxic Substances Control Program, 1989). These SWMUs are listed below:

- East Containment Pond

- West Containment Pond

- Waste Discharge Trough

- Historical Drummed Waste Storage Areas

- West Storage Area
- Process Area Sump
- Truck Parking Area
- Drummed Waste Staging Area
- Drum Crushing Area
- South Drum Storage Building
- North Drum Storage Building
- CSR Drum Storage Building
- Bulk Waste Storage Waste Area (Green Tanks)
- Bulk Waste Storage Area (Brown Tanks)
- Centrifuge
- Centrifuge Roll-off Bins
- Administration/Laboratory Building Septic Tank and Drainfield
- Process and Sanitary Sewer System and Wastewater Surge Tank
- Surge Tank Separator
- Runoff Sump Separator

In addition to the permitted units and SWMUs, three suspected contaminant source areas have been identified at the Site. These source areas are: the former pond area, and two former drum storage areas (Figures 2 and 3).

The Hird Chemical Corporation constructed the original processing facility in the mid-1950s. At that time, the east and west ponds were constructed in the northern portion of the Site. The ponds collected surface water runoff from the Site and adjacent properties. Wastewater and waste material were also reportedly discharged to the ponds. A wastewater discharge trough was used to transport fluids from the central processing area to the former east pond. An estimated 100,000 gallons per week of wastewater were discharged to these ponds in the early 1970s (HLA, 1989). Overflow from these ponds was transferred to the sloughs via an outfall pipe. In 1973, under the supervision of the United States Army Corps of Engineers, the outfall pipe was decommissioned by sealing it with concrete. Thereafter, wastewater was discharged to the sanitary sewer under a permit from the East Palo Alto Sanitary District. Near the end of the 1970s, the ponds were decommissioned, backfilled with concrete debris, blocks, and backfill material, and capped with concrete. Warehouses were built on top of the former ponds (Conor Pacific/EFW/Henshaw, 1999).

There were two drum storage areas onsite. The first drum storage (south of the drum sampling area and pond area) was on unlined or unpaved surfaces which could have allowed seepage of the drum contents such as contained wastes and reclaimed water to the soil column. The second drum storage area (southwest of the central processing area) was also on unlined or unpaved surfaces. Approximately 1,000 to 1,500 drums could have been present at any one time at the Site. The former drum storage areas were decommissioned and are now covered with pavement (Conor Pacific/EFW/Henshaw, 1999).

Other areas of concern at the Site include the following:

- A wastewater discharge trough moved wastewater from the central processing area to the former pond area. It is unknown if any releases have occurred from this trough.
- Process water was treated along the south central boundary of the Site at a treatment unit.
- An area of elevated volatile organic compounds (VOCs) exists in groundwater in the southwestern portion of the Site with no known source.
- The offsite auto-wrecking yards located to the south and west of the Site may be contributing to onsite contamination.

2.6 Previous Investigations

Environmental investigations were initiated at the Site in April 1985. These and subsequent investigations were performed to evaluate the nature and extent of chemical compounds in the soil, soil vapor, and groundwater beneath the Site, and to evaluate the Site's geotechnical and hydrogeological conditions, and the effects of tidal cycles on Site hydrogeology. Results of these investigations indicated the soil and groundwater are contaminated primarily with VOCs. However, semi-volatile organic compounds (SVOCs), metals, PCBs, total petroleum hydrocarbons (TPH), and mercury have also been detected at the Site. VOCs have been detected in soil vapor. Historical soil test results for VOCs and SVOCs, and for metals are presented in Figures 4 and 5, respectively.

In July 1987, HLA conducted a preliminary tidal influence study at the Site. It was determined that the sediments and the slough are connected albeit through very low permeability material (HLA, 1987). An estimated groundwater flux, from the A-zone to the tidal slough, was calculated to be approximately 1.67 gallons per day (HLA, 1991).

Romic implemented a groundwater extraction and treatment system as an interim remedial measure to address VOCs in the A- and B-zones. Beginning in May 1993, groundwater was extracted from six wells in the A-zone, and the extracted groundwater was treated by stream stripping and granular activated carbon. In September 1998, an additional extraction well was installed in the B-zone to extract water from the northern portion of the central processing area.

In January 2001, ARCADIS initiated two enhanced reductive dechlorination (ERD) pilot tests to evaluate the effectiveness of the ERD technology to reduce VOC contaminant mass at the Site. The ERD pilot test was successful, and in 2003, 2005, and 2007, the program was expanded into other areas of the Site as interim remedial measures. In February 2005, upon receipt of USEPA approval, the groundwater extraction and treatment system was shut down due to the success of ERD pilot tests and interim remedial measures.

Historical Site investigations and interim remedial measures are summarized in the *Corrective Measures Study Report* (ARCADIS, 2007).

3.0 Project Data Quality Objectives

Data quality objectives (DQOs) are quantitative and qualitative statements that specify the quality of the data required to support decisions during the project. The main objective is to ensure that the data collected are of sufficient quality and quantity to support remedial decision-making. Therefore, this project dictates sampling and analytical methods and QA/QC procedures to be followed. Appendix A contains the project specific QA/QC program. Appendix C contains the field documentation forms that will be used during the investigation, and Appendix D presents the standard operating procedures (SOPs) that will be followed during implementation of the CSAP.

The objectives for data collection are summarized below:

- Ensure that data collection and measurement procedures are standardized among all participants.
- Monitor the performance of the various measurement systems being used in the program to maintain statistical control and provide rapid feedback, so that corrective measures, if needed, can be taken before data quality is compromised.
- Periodically assess the performance of these measurement systems and their components.
- Verify that reported data are sufficiently complete, comparable, representative, unbiased, and precise, so they are suitable for their intended use.

The purpose of the sampling is to evaluate the nature and extent of soil contamination in the vadose zone across the Site, and groundwater contamination and soil gas in specific areas of the Site. The results of the investigation will primarily be used to complete Phase II closure of the permitted units under RCRA and to develop the CMIP. In addition, the investigation data will be screened against risk-based criteria to identify areas of the Site that are not impacted and to facilitate segregation and closure of those non-impacted areas. Data collected as part of the subsurface investigation will be used in conjunction with the USEPA's Final Remedy decision to develop the CMIP. All laboratory reporting limits for analysis will be below media cleanup objectives contained in the *Final Remedy Decision for Former Romic Environmental Technologies Corporation Facility* (USEPA, 2008) and the Site-specific risk based target concentrations (RBTCs) provided in Appendix B. Table A1 through A3 in Appendix A presents the laboratory reporting limits and compares these limits to USEPA media cleanup objectives and Site RBTCs.

4.0 Sampling and Analytical Program

4.1 Overview

This sampling and analytical program was developed to obtain adequate data to meet closure requirements, evaluate contamination in the subsurface, and implement the Final Remedy. Surface features were removed as part of the first phase of facility closure; therefore, all target sample locations will be accessible. Soil samples will be collected throughout the Site to assess the presence of contamination. A soil vapor survey will be conducted to evaluate potential contamination along the utility corridors that exit contaminated areas. Further soil vapor investigation may be conducted in areas of low to no contamination identified after the soil sampling program is completed. Limited groundwater data is available in the southeastern area of the Site, therefore four grab groundwater samples will be collected to evaluate that area. Grab water samples will also be collected from the A, B, and C water bearing zones in CPT borings located just west of Infinity Salvage. One groundwater grab sample will be collected from a boring located near the former laboratory (R25). During the course of the field program, the joint agencies will take split samples of any media at their discretion.

Subsurface sampling locations were selected based on requirements outlined in a number of documents including a USEPA letter dated January 11, 2008, a Joint Agency comment letter dated April 24, 2008, and a follow-up letter on May 23, 2008. Additional program development discussions occurred with the Joint Agencies between June 2008 and March 2011. Other sources used to select sampling locations include historical sampling data, historical Site operations, and a Site walk on June 17, 2008.

4.2 Sample Selection and Analytical Criteria

Generally, the Site has been divided into 30-foot by 30-foot grids (as suggested in the USEPA letter dated January 11, 2008) in the central and northern area where processing and storage of COCs occurred within permitted units. The non-permitted units, southern, eastern, and western areas of the Site have been generally divided into 90-foot by 90-foot grids. All of the permitted units and other areas of concern (such as SWMUs which are not within a permitted unit, historic drum storage areas, etc.) will be sampled within the 30-foot by 30-foot grid; however, portions of these areas may have a less dense sample distribution. Areas where historic data have not indicated contamination were present, or where there are no known source(s) of contamination, will generally be sampled on a 90-foot by 90-foot grid. If topographic low points are identified in the grid, samples will be collected at that point. Additionally if sumps are present in the grid, samples will be collected adjacent to the sump. Because the entire Site has been plotted in grids, the nomenclature for samples will be based on an alpha-numeric coordinate system (Figure 6).

All boring locations will be analyzed for VOCs at some depth, and a majority of the soil samples will be analyzed for VOCs at all depths (Table 1). Approximately 20 percent of the samples will be submitted for a more extensive suite of analyses to measure presence of metals, SVOCs, pesticides, PCBs, and TPH (gasoline, diesel, and motor oil ranges). Samples for the expanded analyses were selected from areas where contaminants other than VOCs are likely to be found (for example, the former pond areas). In addition, a smaller suite of analytes (VOCs, TPH, lead, chromium, and cadmium) will be analyzed on samples collected from areas associated with the former auto wrecking operations.

Most soil samples taken throughout the Site will initially be obtained from the shallowest first contact with soil (not gravel) below the concrete cover if they will be analyzed for the full suite of constituents and the auto wrecking yard subset (VOCs, TPH, lead, chromium, and cadmium). Where a concrete cover is not present, the full suite analysis and auto wrecking yard subset will be analyzed on soil samples taken from the 0 to 0.5 foot interval below ground surface (bgs).

All soil boring locations will be sampled at 2.5 to 3.0 feet bgs and at 5.5 to 6.0 feet bgs and analyzed for VOCs plus additional compounds as defined in Table 1. Deeper full suite analysis will be targeted to depths based on Site history and possible unit locations. It is anticipated that groundwater will be present at approximately 6.0 feet bgs. However, if groundwater is present at a shallower depth, the deepest sample will be collected from just above groundwater level.

Soil vapor samples will also be collected at the Site as part of the CSAP implementation. A soil vapor survey will be conducted to evaluate potential contamination along the utility corridors that exit contaminated areas (Figure 7). Further soil vapor investigation may be conducted in areas of low to no contamination identified after the soil sampling program is completed. Table 2 presents a summary of soil vapor sampling locations and analyses.

Limited groundwater data is available in the southeastern area of the Site; therefore five grab groundwater samples will be collected to evaluate that area (Figure 6). The groundwater samples will be tested for the compounds shown on Table 3.

Sampling procedures are discussed in detail in Section 5.0. Figures 6 and 7 present the proposed sampling locations, and Tables 1 through 3 summarize sample depths and analyses. The following table presents the proposed analyses and corresponding USEPA analytical methods (Table 4 identifies containers, preservatives, and holding times for the analyses).

Analyses	**USEPA Method**
VOCs in Groundwater	USEPA Method 8260B
VOCs in Soil	USEPA Method 5035A / 8260

Analyses	USEPA Method
VOCs in Soil Vapor	USEPA 8260B (mobile laboratory) USEPA Method TO-15 Modified (fixed laboratory)
Metals	USEPA Method 6010 (California Assessment Manual [CAM] 17)
SVOCs	USEPA Method 8270
Pesticides	USEPA Method 8081A
PCBs	USEPA Method 8082
TPHs as Gasoline, Diesel, and Motor Oil Ranges	USEPA Method 8015 Modified

During the field investigation a photoionization detector (PID) will be used to screen soil for the presence of contamination. In addition, visual or olfactoral observations will also be utilized. If contamination is detected by any of these means, additional step-out samples may be collected in the vicinity to delineate the lateral extent of contamination if deemed necessary after discussion with the Joint Agencies.

4.3 Areas of Interest

4.3.1 Former Pond Area

As part of the characterization for the Site closure, the dimensions of the former eastern and western ponds will be delineated. Historical photos appear to indicate that the ponds were originally wetland soil and vegetation that were filled in with imported rock, concrete blocks, gravel, and possibly nearby native material and debris. Therefore, the delineation will focus on identifying the horizontal and vertical boundaries of the former ponds, as well as on collection of subsurface samples to better characterize the fill material. Based on lithologic data from previous borings advanced in the ponds, it appears that both ponds contain fill to a depth of approximately 10 feet bgs. Below the fill is organic clay that appears to represent native material. Four test pits (TP-1 through TP-4) will be excavated to evaluate the former pond area (Figure 6). If the four test pits indicate that waste material encountered is highly variable, an additional test pit will be excavated. If the fifth test pit is determined not to be necessary, a soil boring will be drilled in the proposed test pit location. The test pits will be approximately 10 feet by 10 feet and should ideally extend to the base of the fill material.

Excavations will be conducted in a manner such that the subsurface stratigraphy can be logged and the fill/native soil interface can be located and sampled. Each fill layer encountered in the test pits will be characterized for chemical impacts and physical condition for use in corrective action planning. The test pits will be trenched to the bottom of fill material or groundwater, whichever is encountered first. During excavation, groundwater infiltration rates, water quality, and nuisance odor levels will be documented for future planning. Test pits will be logged as they are excavated in layers to obtain subsurface data. Samples will be collected in the test pits from each discrete layer to facilitate excavation planning and to define contaminant distribution within the layers. If no discrete layering is encountered, samples will be collected from depths of 0 to 0.5 feet bgs (i.e., the soil/concrete interface), 2.5 to 3.0 feet bgs, and 5.5 to 6.0 feet bgs. Soil samples will be tested for the full suite of analyses: metals, SVOCs, pesticides, PCBs, TPH (gasoline, diesel, and motor oil ranges), and VOCs. Discretionary samples may also be collected, including but not limited to samples from immediately above the water table, at the beginning of the native material, and from soil with strong odors or discoloration. Discretionary samples will be tested by one or more analyses based on field observations and discussions with the Joint Agency Staff.

If groundwater is encountered before reaching the native organic substrate, it may not be possible to delineate the vertical boundary of the ponds without resorting to extensive dewatering and/or shoring. If groundwater is encountered and the vertical extent of the pond cannot be delineated, or if the test pits cannot identify the fill/native material interface, then a soil boring will be advanced adjacent to the test pit and advanced until the interface is determined. The boring will be advanced using Geoprobe® technology. If the boring reaches refusal and cannot be advanced to the bottom of the former pond, then rotosonic or some other drilling method will be utilized.

If free product accumulates in the test pit, it will be sampled with a bailer and submitted for the full suite of analyses: metals, SVOCs, pesticides, PCBs, TPH (gasoline, diesel, and motor oil ranges), and VOCs. Groundwater samples (if present) will be collected from each test pit using a bailer and submitted for the full suite of analyses: metals, SVOCs, pesticides, PCBs, TPH (gasoline, diesel, and motor oil ranges), and VOCs. If identifiable pond sludge materials are encountered, adequate samples will be collected to facilitate complete characterization of the materials. At a minimum, one sample would be collected from each test pit. Each pond sludge sample will be tested for the full suite of analyses: metals, SVOCs, pesticides, PCBs, TPH (gasoline, diesel, and motor oil ranges), and VOCs. In addition, pond sludge samples may be tested for leachability using toxicity characteristic leaching procedure (TCLP) methods.

Horizontal delineation of the pond margins will be obtained using Geoprobe® or similar direct push technology (DPT) drilling. Geoprobe® will be advanced in lines that are perpendicular to the expected perimeter of the ponds (based on historical aerial photographs). Based on the lithology encountered in the borehole (native material or fill), Geoprobes® will either move farther away or closer to the pond. Approximately six lines of Geoprobes® will be advanced across the suspected perimeter to fully delineate the horizontal boundaries (Figure 6). Soil samples will be collected in Geoprobe® locations that coincide with required permitted unit sampling.

Based on the findings from the test pits and sample analyses, and Geoprobe® lines, recommendations will be developed that may include excavation of the pond, selective excavation, and/or targeted in-situ treatment. If the pond areas are found to not be conducive to excavation, then the area beneath the permitted units (Drum Crusher, South Drum Storage Building, and the Drum Sampling Area) will be sampled on the 30-foot by 30-foot grid with soil borings (see Section 4.3.2 for a discussion of sampling in permitted units). The area that is not beneath the permitted units will be characterized by collecting soil from four Geoprobe® locations (three on the eastern side and one on the southwest side of the former pond area).

4.3.2 Permitted Units

Eighteen permitted units at the Site will be investigated (Figure 3, Figure 6). Each of the permitted units will be sampled based on the 30-foot by 30-foot grid spacing, resulting in a total of 45 soil sampling locations. Sample locations will be analyzed for VOCs from 0 to 0.5 foot (i.e., the soil/concrete interface), 2.5 to 3 feet, and 5.5 to 6 feet bgs. Approximately 20 percent of the samples will be submitted for the larger suite of analyses. In addition, because the West Storage Building is located in the area of historic auto wrecking operations, samples collected from this permitted unit will be tested for TPH (gas, diesel, and motor oil ranges), and deeper samples will be tested for lead, cadmium, and chromium (see Section 4.3.4.3 for a discussion of sampling rationale in the auto wrecking yard).

Figure 6 indicates the proposed soil sample location at each permitted unit and identifies the locations where samples will be collected for the expanded suite of analytes. Table 1 presents soil boring identification, sampling depths, and analyses. Because the three northern-most units (a portion of the Drum Crusher, South Drum Storage Building, and the Drum Sampling Area) were constructed on top of the ponds, they will be investigated as part of the above-discussed former ponds area investigation.

4.3.3 Solid Waste Management Units

Many of the SWMUs are located within a permitted unit and will be investigated in conjunction with that permitted unit (discussed above). There are six SWMUs that are not within the permitted units at the Site. These areas will have at least one soil boring location advanced within the boundary of the SWMU. Based on the size and historical activity, additional borings may be advanced. Sections 4.3.3.1 through 4.3.3.6 discuss individual SWMUs; refer to Figure 6 for soil boring locations and to Table 1 for sample depths and analyses.

4.3.3.1 Drum Crushing Area (SWMU 1)

The drum crushing area is located in the northern portion of the Site (Figure 6). Historically, damaged drums were crushed in the area. The area is also located on the boundary of the former western pond area (DTSC, 1989). Three soil borings will be advanced within the vicinity and all soil boring depths will be sampled for VOCs. One sample was randomly selected to be analyzed for the large suite of analyses (Table 1).

4.3.3.2 Surge Tank Separator (SWMU 2)

The surge tank separator area is located in the northwestern portion of the Site. Process and sanitary system wastewaters were combined near the waste product unloading areas and pumped into the surge tank (DTSC, 1989). Two soil borings are proposed to be advanced within the boundaries of this SWMU (Figure 6). All sample depths will be analyzed for VOCs and one randomly selected sample will be analyzed for the larger suite of analyses (Table 1).

4.3.3.3 Septic Tank (SWMU 3)

A septic/tank leach field was identified as a SWMU in the RCRA facility assessment report (DTSC, 1989). During a recent interview with the former owner, it was indicated that there has never been a leach field and the buildings have always been connected directly to the public sanitary sewer system. What appeared to be sumps and pipes were located during a Site walk on June 17, 2008. Upon further investigation it was determined there was an underground wooden tank which contained up to four feet of standing liquid and had a pipe that was connected to the north end, which is now plugged. This tank was further investigated in early 2009. It was concluded that the tank is a former septic tank equipped with internal baffling. It was not determined whether the tank is still connected to an inlet line. The discharge line was unplugged and traced for approximately 300 feet west (as shown on Figure 7). The tank was pumped free of water and visibly monitored for leakage. Groundwater rapidly entered the tank, suggesting that tank integrity is compromised.

The liquid and sludge present in the tank was sampled and analyzed for the larger suite of constituents including: VOCs, metals, SVOCs, organochlorine pesticides, PCBs, and TPH (gasoline, diesel, and motor oil). The liquid contents were similar in chemistry to nearby groundwater monitoring wells, suggesting the tank is communicating with groundwater. Results from the sampling will be included in the Comprehensive Sampling Results Report to be prepared after the CSAP is implemented (see Section 9.0). The contents of the tank will be vacuumed out and properly disposed offsite during the implementation of the Final Remedy.

Two borings will be advanced adjacent to the tank (sample locations P23 and P25); one soil boring will be advanced in the vicinity of the interior sewer lines (R24); and one additional boring will be advanced in the vicinity of the former onsite laboratory (R25) (Figure 6). All sample depths will be analyzed for VOCs and three randomly selected samples will be analyzed for the full suite of analyses (Table 1). In addition, a deeper sample at location P25 will be tested for CAM metals in order to evaluate metal concentrations beneath the septic tank.

4.3.3.4 Runoff Sump Separator (SWMU 4)

The runoff sump separator is located in the northeastern portion of the Site, southeast of the former drum storage area. Because this is the lowest point of the facility, rainwater or liquid hazardous waste releases would flow to this area (DTSC, 1989). In addition, Figure 5 of the 1989 DTSC facility assessment report shows a dashed line that represents a concrete retaining wall adjacent to the runoff sump separator. This line can mistakenly be interpreted to represent a drain line from the separator. Field inspection confirms that there is no drain line from the separator. Therefore, there is only one proposed soil boring location for this area (P27 on Figure 6). All sample depths at this location will be submitted for the larger suite of analyses (Table 1).

4.3.3.5 West Storage Lot (SWMU 5)

The west storage lot is located in the southwestern corner of the Site. Surplus equipment, scrap metal, old drum pallets, etc. were all stored in this area (DTSC, 1989). Two proposed soil boring locations are to be advanced in the vicinity (Figure 6). Most soil samples will be analyzed for VOCs, and one randomly selected sample depth will be submitted for the larger suite of analyses (Table 1). In addition, since the borings are located in the area of historic auto wrecking operations, samples will be tested for TPH (gas, diesel, and motor oil), and lead, cadmium and chromium. Section 4.3.4.3 provides a discussion of sampling rationale in the historic auto wrecking yards.

4.3.3.6 Truck Parking Area (SWMU 6)

Located in the southern portion of the Site, the truck parking area was used for parking bulk waste tank trucks, flatbed trucks, or drum trucks (DTSC, 1989). Two proposed soil boring locations are to be advanced and sampled in this location (Figure 6). The soil samples collected in this area will be analyzed for VOCs. Due to the location of this SWMU in the area of historic auto wrecking operations, the samples will also be submitted for TPH (gas, diesel, and motor oil), and lead, cadmium and chromium testing (Table 1).

See Section 4.3.4.3 for a discussion of sampling rationale in the historic auto wrecking yards.

4.3.4 Other Areas of Interest

There are five areas of concern (AOCs) that have potential historical significance or contain contamination with no identifiable source. Refer to Figure 6 for sample locations and to Table 1 for sample identifiers, depths, and analyses in these areas.

4.3.4.1 Process Water Treatment (AOC 7)

The process water treatment location is in the southern portion of the Site along the southeastern Site perimeter. One boring will be advanced at this location and three soil samples will be collected (Figure 6). The samples will be analyzed for VOCs (with the exception of the sample collected at 0 to 0.5 feet bgs). Based on the location of this AOC in the historic auto wrecking operations area, the samples will also be tested for TPH (gas, diesel, and motor oil), and lead, cadmium and chromium (Table 1). Section 4.3.4.3 provides a discussion of sampling rationale in the historic auto wrecking yards.

4.3.4.2 Drum Storage Areas (AOCs 8 and 9)

There are two drum storage areas at the Site: the north drum storage area (AOC 8) and the south drum storage area (AOC9). At any given time, as many as 1,000 to 1,500 drums may have been present in these areas. The drums consisted of reclaimed product, waste, and empty drums (HLA, 1991). Samples from the 25 soil boring locations in this area will be tested for VOCs, and 14 randomly selected sample depths will be submitted for the larger suite of analyses. In addition, the five borings that are located in the area of historic auto wrecking operations (N6, O6, P6, Q6, and R6) will be tested for TPH (gas, diesel, and motor oil); and lead, cadmium and chromium (Figure 6, Table 1). See Section 4.3.4.3 for a discussion of sampling rationale in the historic auto wrecking yards.

4.3.4.3 Adjacent Auto Wrecking Yards and Historic Onsite Yards (AOC 10)

The properties to the south and west of the Site were part of former auto wrecking yards; during Site expansion, the Romic Facility acquired these adjacent properties, now located along the southern and western boundaries of the current facility. A total of 47 soil boring locations are proposed to be advanced to assess the impact of auto wrecking activities in this area (Figure 6, Table 1). Nineteen of the sampling locations associated with historical auto wrecking, however, are also located in other permitted units, SWMUs, or AOCs. A discussion of those samples is therefore included in the pertinent sections. These 19 samples have been shaded on Table 1 to facilitate identification.

One randomly selected sample from 24 of the 47 sampling locations in the historic auto wrecking yards are slated to have the full suite of analyses (Table 1). The remainder of the samples will be sampled for VOCs; TPH (gas, diesel, and motor oil); and lead, cadmium, and chromium. The rationale for the selection of lead, cadmium, and chromium (total) as indicator metals is based on their established relationship with automobile recycling and soil/groundwater impacts. Since more than 50 percent of soil sample locations in these areas will be tested for the CAM-17 list of metals, the overall number of CAM-17 metals analyses will exceed the target of 20 percent set by the Joint Agencies (2008). The combination of indicator metals data and CAM-17 metals data will adequately screen the former auto wrecking areas for metals impacts.

4.3.4.4 Area of Elevated VOCs in Groundwater (AOC 11)

Elevated VOCs in groundwater were detected near the southwestern property boundary when a well in the area was sampled in the 1990s. An ERD program was implemented in this area in 2001 to remediate the groundwater. Two soil borings are proposed in this area (Figure 6). Samples will be analyzed for VOCs, and one randomly selected sample will be analyzed for the larger suite of analyses (Table 1). In addition, since the borings are located in the area of historic auto wrecking operations, samples will be tested for TPH (gas, diesel, and motor oil), and lead, cadmium and chromium. Section 4.3.4.3 provides a discussion of sampling rationale in the historic auto wrecking yards.

4.3.4.5 Former Building Footprint Areas

Soil samples will be collected from beneath the footprints of the former office, laboratory, and maintenance buildings. Locations of samples are shown on Figure 6. Sample depths and proposed chemical analyses are listed in Table 1.

4.3.5 Utility Corridors

Utility corridors can act as preferential pathways for the migration of contaminants. To test whether buried utilities and presumably porous backfill materials at Romic are functioning as preferential pathways for migration of VOC vapors from impacted areas, soil vapor samples will be collected along the utility corridor(s) indentified during the utility mapping program (discussed in Section 5.2.3). Specifically, soil vapor samples will be collected at locations along the utility corridors considered beyond source areas characterized as impacted by VOCs and adjacent to where the utility corridors exit the Site property boundaries. Twenty-one samples will be collected at approximate 200-foot intervals as shown in Figure 7. Where individual utility pipes and conduits are in close proximity within one corridor, a centrally located sample will be used for the designated corridor location. Sample depths and analyses are shown on Table 2. Based on the results of initial soil vapor sampling, additional sampling may be conducted along utility lines. Figure 8 presents a decision tree that will be used to guide decisions on additional soil vapor sample collection in utility trench areas.

Vapor sampling will be conducted after the soil and groundwater sample steps are completed. If additional utility lines are identified during the course of the subsurface investigation, soil vapor samples will be collected from those utility lines that traverse out of contaminated areas. Soil vapor sampling methods are described in Section 5.2.4.

Soil vapor samples will not be collected at utility corridor locations that are anticipated to be excavated as part of the corrective action (based on screening criteria) or where VOC concentrations in groundwater exceed RBTCs, because the shallow contaminated groundwater could potentially elevate the soil vapor concentration. Also, soil vapor samples will only be collected in areas where groundwater is greater than five feet bgs. Depth to water data collected in December 2008 indicated depths to water in the central area of the Site (loosely bounded by Tank Farm Q on the west, the south side of the drum sampling area to the north, the central processing area to the east, and Tank farm K to the south) was less than five feet bgs. Depth to groundwater at the remainder of the Site was greater than five feet bgs. The depth to water changes seasonally so it is not known what, if any, areas during the investigation will have groundwater present at less than five feet bgs.

4.3.6 Waste Discharge Trough

A former waste discharge trough was identified on historical figures as being located between the central processing area and the former pond area. Its location has not been visible since the area was concreted. An approximate 15 foot long trench will be excavated perpendicular to the estimated location of the historical waste discharge trough. A second trench, located approximately 20 feet to the north of the initial trench will be excavated if the trough is not identified with the first excavation. If located, samples will be collected from beneath the trough alignment at least every 50-feet (from the central processing area to the former pond area) and analyzed for the full suite of analytes.

4.4 Groundwater

There is limited groundwater data available for the southeastern portion of the Site along the entrance. Therefore, four grab-groundwater samples will be collected from temporary wells set in the soil borings advanced into the A-zone water-bearing unit in this area (Figure 6). One additional grab-groundwater sample will be collected from boring R25 located near the former laboratory building and sewer line. The groundwater samples will be collected with a bailer and immediately placed in a laboratory supplied sampling container. Because they are grab samples, groundwater parameters will not be collected; however, visual condition of the samples will be recorded on the field logs. All groundwater grab samples will be analyzed for VOCs (Table 3). Three of the samples will also be tested for the full suite of analyses, and two will be tested for lead, cadmium, and chromium to evaluate the potential impact of auto wrecking operations (Table 3).

Additionally, three cone penetrometer tests (CPTs) will be conducted along the southeastern boundary of the Site with Infinity Salvage (Figure 6). Groundwater from these locations will be collected using HydroPunch technology from the A-, B-, and C-zone water bearing units. Each sample will tested for VOCs (Table 3).

4.5 Background Data for Metals

Because metals are naturally occurring compounds, concentrations vary with Site locations and soil types. It is essential to establish local and regional background concentrations of metals to provide a basis for comparison to Site-specific metals data. Comparison of background and Site metal datasets, as well as statistical analysis of Site data, are the intended methods for characterizing which metals in soil are present above background. When combined with RBTCs for metals (see Appendix B), the two analytical approaches will be used to establish metal concentrations that can be left on Site while remaining protective of human health and the environment. Bay Enterprises, in consultation with the Joint Agencies, will determine the specific approach to establish background metal concentrations once the investigation data are collected and assessed. As noted in Section 9.0, the investigation report will include a section describing the statistical analysis and determination of background conditions for use in screening metals data.

This investigation is designed to generate metals data for the CAM 17 suite of metals in at least 20 percent of the total number of sample locations. A subset of auto dismantling targeted metals (see Section 4.3.4.3) will provide additional metals data results. Existing metals data and background assessments may also be available from nearby agency regulated sites. As part of the background evaluation for the Site, data from nearby sites will be researched to determine whether the sites are chemically and geologically similar. If so determined, then the metals data from these sites will be used in a controlled study to expand the number of samples used for parts of the statistical analyses. Bay Enterprises will consult with the Joint Agencies in evaluating the potential applicability of nearby sites for this purpose. Regional studies and data may also be applicable to establishing background conditions for the Site.

The goal will be to compile a balanced data set of contaminated and non-contaminated metals data to support parametric and non-parametric statistical analyses to establish metal-specific background concentrations. A number of guidance documents exist to facilitate selection of appropriate methods to evaluate site metals data and to compare background data sets to site contamination data (e.g. USEPA 540-R-01-003: *Guidance for Comparing Background and Chemical Concentrations in Soil at CERCLA Sites,* September 2002). Once the Site, local, and regional data sets are compiled, the most appropriate analytical method or methods will be selected in consultation with the Joint Agencies.

5.0 Sampling Procedures

General field operations, practices, specific sample collection, and inventory procedures must be carefully planned and implemented to ensure that the data collected in an environmental study are of the highest quality. This section of the CSAP describes pre-field activities and sampling procedures that will be followed for all media so this goal may be achieved. Additionally, QA/QC procedures (Appendix A), field documentation forms (Appendix C), and standard operating procedures (SOPs) (Appendix D) will be used to help meet all DQOs for the investigation.

5.1 Field Preparation

5.1.1 Health and Safety

Prior to initiating field activities, a Site-specific Health and Safety Plan (HASP) will be prepared in accordance with the Occupational Safety and Health Administration "Hazardous Waste Operations and Emergency Response" guidelines (29 Code of Federal Regulations 1910.120) to address potential hazards. The work outlined in this CSAP is a phased approach which will require various field activities performed by numerous workers. Prior to the initiation of field work the HASP will be reviewed and signed by all field personnel.

5.1.2 Subsurface Utility Clearance

Underground Service Alert (USA) will be contacted at least 48 hours prior to any subsurface work. Additionally, an underground utility locator will be subcontracted prior to the initiation of field activities, to identify possible subsurface obstructions and utilities adjacent to proposed drilling or excavation locations.

Soil boring locations situated in areas covered in concrete will be cored by a concrete coring service or concrete breaker prior to drilling activities. Because subsurface investigation will be conducted after the facility has been decommissioned, there should be no live feeds to the Site, and therefore no safety considerations warranting hand-auger drilling methods.

5.1.3 Permitting

Prior to advancing soil borings, required permits will be obtained from the San Mateo County Environmental Health Department.

5.1.4 Archeological Screening

According to the USEPA, there are known Native American archaeological sites located in the general vicinity of the Site. Therefore, to comply with Section 106 of the National Historical Preservation Act (NHPA), a qualified professional archaeologist will prepare a field investigation discovery and contingency plan prior to the start of subsurface work. The archeologist will be onsite part-time during the first test pit excavation (refer to Sections 4.3.1 and 5.2.2) to evaluate the presence of features suggestive of Native American archaeological sites. If a unique resource is found, the archaeologist will recommend means of avoiding or mitigating impacts as called for in the contingency plan. All work will be conducted in accordance with the California Environmental Quality Act (CEQA) Sections 21083.2 and 21084.1. If test pits do not indicate the presence of important archaeological sites, additional subsurface work will not be conducted in the presence of an archaeologist. However, the archaeologist will be on-call in the event a potential artifact is uncovered at any time during the implementation of this CSAP.

5.2 Sample Collection Methods

The following section provides a description of the sample collection methods that will be used during implementation of the Site CSAP. Field documentation forms that will be used during the investigation are presented in Appendix C. Appendix D presents the SOPs for the following field investigation methods:

- Soil drilling and sample collection;
- Groundwater sampling using hydropunch;
- Soil vapor sampling; and
- CPT.

5.2.1 Direct Push Drilling

Direct push drilling methods, such as Geoprobe®, will be used to collect subsurface lithology samples and soil samples for laboratory analysis. Shallow grab groundwater samples will also be collected during direct push drilling activities. Direct push-drilling methods use hydraulic pressure and the weight of the drill rig to advance drill rods into the subsurface. This drilling method is invasive but can be performed quickly while generating relatively little waste.

Rods containing clear acetate liners approximately 2 inches in diameter and 4 feet long will be driven to the desired depth. The rods will be retracted, and the acetate liners will be removed for lithologic logging. Soil will be logged using the unified soil classification system (USCS). Soil samples will be collected using an EnCore™ sampler from the desired sampling depth (three EnCores™ per sample). After soil samples have been collected the soil borings will be sealed to grade (freefall) using neat cement grout. All soil borings will be completed under the supervision of a California Professional Geologist.

Grab groundwater samples will be collected by placing a temporary poly vinyl chloride (PVC) well casing and screen into the borehole once the target depth has been reached. The water column will be allowed to stabilize for at least 30 minutes prior to sample collection. Grab groundwater samples will be collected using a pre-cleaned bailer. Once the grab groundwater sample has been collected, the PVC will be removed and the borehole will be abandoned in the same manner as the soil borings.

Additional soil samples may be collected at the discretion of the field geologist, based on Site conditions and signs of contamination and/or PID measurements. If free-phase product is encountered during the Geoprobe® investigation, temporary PVC well casing will be put in the borehole to allow free product to accumulate, and a well cap will be used to prevent off-gassing of VOCs. A temporary well screen will be placed above and below the water table once the water table has equilibrated, and the well will be sampled for the full suite of sample analyses: VOCs, metals, SVOCs, pesticides, PCBs, and TPH (gas, diesel, and motor oil).

All soil and groundwater grab sample containers will be labeled and stored in an ice-filled cooler chilled to 4 degrees Celsius (°C). The samples will be shipped or couriered under proper chain-of-custody protocol to a California State-certified laboratory for analysis.

5.2.2 Test Pits

Because the nature and extent of the former pond area is not known, four test pits will be excavated within the perimeter of the ponds to evaluate the subsurface and assess the fill history of these features (Figure 6). A fifth optional test pit may be excavated if the material and the depths encountered in the four test pits are substantially different.

Prior to excavation, the surface area will be saw-cut to expose a 10-foot by 10-foot area of soil. Four test pits will then be excavated. Material from the test pits will be placed on bermed, visqueen sheeting positioned immediately adjacent to the excavation. The stockpiled material will be covered with visqueen immediately after the excavation is complete and during periods of inactivity. During each excavation, test pit side walls will be cleared of any loose rock or soil to prevent debris from falling into the excavation. No equipment or materials are to be located within two feet of an open excavation. All test pits will be barricaded when open to limit access. Because the test pits may be the first field activity conducted as part of the closure, excavated material will likely be placed back in the test pit, covered with visqueen, and barricaded to prevent access until the corrective action program commences.

Soil samples will be collected based on Site conditions, signs of contamination, and/or PID readings. Soil samples will be collected from the bucket of the excavator so that no personnel need enter the excavation. Soil samples will be collected in brass sleeves and EnCore™ samplers. Soil samples will be tested for the full suite of analyses: metals, SVOCs, pesticides, PCBs, TPH (gasoline, diesel, and motor oil ranges), and VOCs. . If free product accumulates in the test pit, it will be sampled with a bailer and submitted for the full suite of analyses: metals, SVOCs, pesticides, PCBs, TPH (gas, diesel, and motor oil), and VOCs.

Groundwater samples (if present) will be collected from each test pit using a bailer and submitted for the full suite of analyses: metals, SVOCs, pesticides, PCBs, TPH (gas, diesel, and motor oil), and VOCs. If identifiable pond sludge materials are encountered, adequate pond sludge samples will be collected to facilitate complete characterization of the materials. At a minimum, one pond sludge sample would be collected from each test pit. Each pond sludge sample will be tested for the full suite of analyses: metals, SVOCs, pesticides, PCBs, TPH (gas, diesel, and motor oil), and VOCs. In addition, pond sludge samples may be tested for leachability using TCLP methods.

All samples will be labeled and stored in an ice-filled cooler chilled to 4 °C. The samples will be shipped or couriered under proper chain-of-custody protocol to a California State-certified laboratory for analysis.

5.2.3 Underground Utility Mapping

An update to existing historical utility location maps was developed following a utility survey conducted in August and September 2008. A range of methods were utilized during the utility survey to locate underground lines including electromagnetic surveying, low frequency vibrators, and intrusive line probing. The resulting survey is presented in Figure 7, and is considered to be representative of current conditions. If additional utilities are identified during Site closure and related activities, their locations will be added to the master utility location map.

5.2.4 Soil Vapor Sampling

Soil vapor samples will be initially collected only along utility corridors shown in Figure 7. Additional soil vapor samples may subsequently be collected away from utility corridors based on the results of this investigation. These additional samples would be collected in areas where soil, groundwater, and utility vapor sampling indicate that no elevated soil contamination is present, in order to complete the closure process for those portions of the Site.

Soil vapor samples will be collected in accordance with the procedures outlined in the Los Angeles RWQCB *Interim Guidance for Active Soil Gas Investigation* (1997); the *Advisory - Active Soil Gas Investigations*, jointly issued by Los Angeles RWQCB and DTSC

(2003); and the *Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (DTSC, 2005).

All soil vapor samples will be collected from temporary implants installed in borings following the procedures presented below. Samples collected at each location will be tested for VOCs at either an onsite mobile laboratory or an offsite laboratory.

5.2.4.1 Soil Vapor Implant Installation and Sampling Methods

Temporary soil vapor sampling implants will be installed in borings drilled at each sampling location using hydraulically-powered direct-push drilling technology. Each boring will include a single sampling implant. The implants will be constructed as follows: Drill rods will be advanced to a total depth of approximately 5 feet bgs and then retracted, leaving an open boring. Using a Tremie pipe as necessary, inert disposable Nylaflow™ tubing with an outer diameter between 0.125 and 0.25 inches and an attached microfilter sampling tip will be installed in the boring at the target depth. Following installation of the sampling line, a one-foot thick annular sand-pack (grain size selected based upon the surrounding lithology to minimize disruption of air flow) will be installed. The sand-pack will be centered around the sampling tip. One foot of dry granular bentonite will then be added to the boring, followed by an additional 3 feet of hydrated granular bentonite up to the ground surface.

Each sampling line will be labeled and finished at the surface with an in-line clamp and two way valve. The in-line valve or clamp will be kept in place at all times while not sampling to prevent the backflow of ambient air into the sampling line between purges and prior to sampling. To allow subsurface conditions to equilibrate, no further procedures will be conducted for approximately 30 minutes, or in the case of augered borings, 48 hours. Soil vapor sampling will not be conducted during or immediately after any significant rain event (e.g., ½ inch or greater) or any onsite watering which may cause no-flow or low-flow conditions.

During sampling, a leak detection gas (1,1-difluorethane (1,1-DFA), as found in standard keyboard cleaner) will be used to saturate the air space inside an overturned bucket, which is then placed over the ground surface at the borehole and over the sample train to confirm that the sample train and tubing surface seal is tight and leak free. The leak test will be conducted in accordance with DTSC guidance documents, and will be conducted at each individual soil gas sampling location. The detection limit for analyses for the leak check compound will be at or below 10 micrograms per liter (µg/L), in accordance with DTSC guidance. If DTSC guidance is updated to incorporate new leak detection methods prior to implementation of the CSAP, an addendum will be developed prior to conducting soil vapor sampling in order to incorporate the new methods.

Following completion of the soil gas sampling, and after the laboratory has confirmed a successful analysis of the sample, sampling implants will be abandoned by removing the tubing from the boring, and abandoning the boring in-place. The hydrated bentonite seal will continue to swell, sealing the tubing void. Ultimate closure of the sealed borehole will be performed in accordance with San Mateo County requirements.

5.2.4.2 Purge Volume Tests

If soil vapor samples are collected for testing at an onsite mobile laboratory, purge volume testing will be performed to establish an optimal purge volume for a representative soil type. If soil vapor samples are collected for analysis at a fixed lab, then the default purge volume will be three times a single volume. To perform a purge volume test, the volume of each sampling train, including the annular space of the sand-pack, will be calculated to determine the purge volume. Following equilibration, a syringe will be used to purge each sampling train. The number of volumes of the sample line to be purged prior to sampling will be based upon the results of a purge volume test to be performed at the beginning of the sampling program.

The purge volume test will be conducted with the collection of the first sample, and will be completed as described in DTSC guidance documents, with the purge volume yielding the highest analytical results being used as the appropriate number of volumes purged during subsequent sampling. Samples will be collected for analysis following the purging of one, three, and seven volumes of vapor from the sampling train. Each of these samples will be analyzed in a mobile laboratory, and the sampling volume with the highest detected concentrations will be selected as the appropriate purge volume for the Site.

5.2.4.3 Mobile Laboratory Testing

For soil vapor sample collection and associated VOC analyses performed onsite, the work will be conducted by a California certified mobile laboratory using USEPA Method 8260B. A minimum of ten percent of the soil vapor samples will be confirmed at a fixed laboratory using USEPA Method TO-15 (see Section 5.2.4.4).

Samples will be collected in either an air-tight glass syringe or 250 milliliter (or 1-liter) Summa canister provided by the laboratory. The flow rate during purging and sampling will be moderated to between 100 and 200 milliliters per minute (mL/min) by the sampler to limit stripping of chemical compounds, to prevent ambient air from diluting the soil vapor samples, and to reduce the variability of sampling rates. Glass syringe samples will be injected into the gas chromatograph within 15 minutes of sample collection.

Summa canisters will be decontaminated by the laboratory and used to collect only a single sample; other sampling equipment that has the potential to come into contact with soil vapor (such as tubing) shall be used only one time and then contained for proper disposal.

5.2.4.4 Fixed Laboratory Testing

Samples collected for fixed laboratory testing will be collected in 1-liter Summa canisters provided by the laboratory. The flow rate during purging and sampling will be moderated to between 100 and 200 mL/min by the sampler to limit stripping of chemical compounds, to prevent ambient air from diluting the soil vapor samples, and to reduce the variability of sampling rates. Summa canisters will be transported to the offsite laboratory under proper chain-of-custody protocol. Samples will be tested for VOCs by USEPA Method TO-15.

5.2.5 Cone Penetrometer Testing

CPT and Hydropunch ™ sampling will be conducted along the Site boundary with the Infinity Salvage property (on the southeast) to evaluate the presence of VOCs in groundwater. The samples will be collected from the A-, B-, and C-zone water bearing units.

CPTs will be conducted using a piezocone connected by stainless steel rods to a hydraulic system that pushes the piezocone through the soil. The piezocone measures friction, tip resistance, and pore pressure, which are logged and used to evaluate soil types on a nearly continuous geologic log. The CPTs will be performed in accordance with American Society for Testing and Materials (ASTM) *Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils* (D 5778-07) (2007).

HydroPunch™ technology will be used to collect depth-specific groundwater samples from targeted permeable intervals based on the CPT results. A direct-push drill rig (e.g., Geoprobe or CPT) will be used to hydraulically advance 1¾- inch diameter, hollow push rods to the bottom of the desired sampling interval. The push rods will then be retracted, exposing a screen and allowing groundwater to infiltrate hydrostatically from the formation into the screen. A small-diameter bailer will be lowered through the push rods into the screen section for sample collection. Upon filling, the bailer will be retrieved and the groundwater will be decanted into the appropriate laboratory-supplied sample containers. Upon completion of sample collection, the equipment will be decontaminated as it is retrieved to the ground surface. Boreholes will be grouted with neat cement grout from the bottom up using the HydroPunch rods as tremie pipe.

Sample containers will be labeled and stored in an ice-filled cooler chilled to 4°C. The samples will be shipped or couriered to a California State-certified laboratory for analysis under proper chain-of-custody protocol.

5.2.6 Trenching

Trenching will be conducted utilizing a backhoe to evaluate the presence or absence of the waste discharge trough in the northeastern area of the Site. The concrete will be saw cut and a trench will be dug using a one-foot wide backhoe bucket. The trench will be approximately 5 feet deep and 15 feet long. If the waste discharge trough is not located with the initial trench, a second trench approximately 20 feet to the north of the first will be excavated in the same manner.

If the trough is located, soil samples will be collected beneath it at a spacing of every 50 feet (from the central processing area to the former pond area) and analyzed for the full suite of analytes: metals, SVOCs, pesticides, PCBs, TPH (gas, diesel, and motor oil), and VOCs.. Sample containers will be labeled and stored in an ice-filled cooler chilled to 4°C. The samples will be shipped or couriered to a California State-certified laboratory under proper chain-of-custody protocol.

6.0 Management of Investigation Derived Waste

Investigation derived waste (IDW) will be managed based on type of field work and quantity of IDW generated.

6.1 IDW Generated During the Former Pond Area Investigation

IDW generated during the excavation of the four or five test pits will be placed on visqueen during excavation and covered during periods of inactivity. Once all test pits have been logged and sampled, the excavated material will be placed back in the excavations and covered with visqueen to contain VOCs. The area will be barricaded to prevent access. The used stockpile visqueen will be placed in 55-gallon drums and immediately sealed. If results indicate the former pond area should be excavated in its entirety then the material from the excavated areas will be re-excavated and disposed at an offsite facility with the rest of the pond material. If results indicate the former pond area does not need to be excavated then the excavated areas will be compacted and sealed with a concrete patch that is similar to the existing slab. The 55-gallon drums that contain the used stockpile visqueen will be profiled and disposed offsite.

If excavation is the selected remedy for the former pond area, a Soil Management Plan (SMP) will be written prior to the start of excavation.

6.2 IDW Generated During the Geoprobe Investigation

Geoprobe® drilling generates limited quantities of IDW. Based on the number of borings that will be advanced, soil generated during the drilling activities will be stored in 55-gallon drums or a roll-off style soil bin. Because of the anticipated levels of VOCs in the soil, drums or the bin will only be open when soil is being placed in them. Once the soil is placed, the covers will immediately be sealed. The drums or bins will be located throughout the Site so the drillers do not have to transport contaminated soil across a large area.

Because the soil sampling program is so extensive, it will not be necessary to conduct separated IDW characterization. Laboratory results will be submitted to appropriate landfills for profiling and disposal purposes.

6.3 IDW Generated During Decontamination Activities

A decontamination pad will be constructed prior to beginning the field activities. The pad will be bermed and have plastic material placed in the pad and over the berms. All equipment will be decontaminated in the pad. Decontamination water will be pumped into 55-gallon drums or a rental poly tank. At the completion of the project, the water will be profiled and properly disposed of offsite.

6.4 Personal Protective Equipment

All personal protective equipment (PPE) will be contained in 55-gallon drums. At the completion of the project it will be profiled and properly disposed at a landfill.

7.0 Risk Based Target Concentrations (RBTCs)

The Site is known to contain several different contaminants in the groundwater, soil, and soil vapor at various concentrations and locations that will be defined through this investigation. While the USEPA has selected a Final Remedy for remediating soil and groundwater (and thus soil vapor indirectly) with specific cleanup objectives for groundwater, surface water, and soil vapor (e.g., constituent-specific maximum contaminant levels [MCLs] for groundwater), risk-based values needed to be developed for soil to establish cleanup objectives. The RBTCs presented in Table 5 and Appendix B were developed with input from the Joint Agencies to establish the soil cleanup objectives and to provide appropriate screening criteria for groundwater, soil, and soil vapor for use in implementing the Final Remedy as well as for use in guiding interim uses of the Site.

RBTCs represent concentrations of chemicals that can remain in environmental media (e.g., groundwater, soil vapor, or soil) and still be protective of human health for current and/or future land uses. Chemical concentrations detected in these media may be compared to the RBTCs in order to identify areas requiring further investigation, remediation or mitigation. RBTCs were calculated based on Site-specific exposure assumptions specific to future commercial/industrial and construction worker exposure scenarios. In addition, cumulative impacts from multiple contaminants are also addressed to reflect the multiple chemicals present in some areas of the Site.

As discussed in further detail in Appendix B, the methodology used to develop RBTCs for the Site is consistent with USEPA, CalEPA, and San Francisco RWQCB risk assessment guidance. RBTCs were developed for a list of preliminary COCs that includes all chemicals detected to date in Site soils plus chemicals detected in more than five percent of all groundwater samples collected since September 2000 at the Site. RBTCs were also developed for pesticides, PCBs and certain metals that were not analyzed for in soils collected previously at the Site. If new chemicals are detected during further Site investigations, RBTCs will be developed for these new chemicals using the same methodology as presented in Appendix B.

Laboratory testing data from the Site investigation will be compared to the RBTCs as part of the data evaluation to be presented in the Comprehensive Sampling Results Report (outlined in Section 8.0). Areas of the Site found to be impacted with contaminants at concentrations above the RBTCs will be targeted for remediation in accordance with the Final Remedy. Areas not found to be impacted by contaminants at concentrations above the RBTCs will be identified for possible closure following further discussions with the Joint Agencies.

For areas where elevated concentrations of TPH are identified in soils and groundwater at the Site, the Joint Agencies in consultation with Bay Enterprises, will determine the appropriate remedial action, if any, to mitigate the TPH. The following criteria will be considered in evaluating potential remedial actions for TPH soil contamination: human health impacts, TPH soil saturation levels, potential impacts to groundwater and organoleptic effects.

8.0 Comprehensive Sampling Results Report

Following completion of the implementation of the CSAP, a Comprehensive Sampling Results Report will be submitted. It is anticipated the report will be structured to present the following information; however, this list may change based on actual findings in the field:

- Introduction/Background
- Investigation Activities
    - Former Pond Area
    - Permitted Units
    - Non-Permitted Areas
    - Other Areas of Interest
- Investigation Findings
    - Former Pond Area
    - Permitted Units
    - Non-Permitted Areas
    - Other Areas of Interest
- Data Validation
- Screening of Data against Risk Based Target Concentrations
- Background Metals Statistical Analysis and Determination
- Conclusions
- Recommendations
- References

This report will form the basis for preparing the CMIP required to implement the remedies selected by the USEPA.

9.0 Post Remediation Confirmation Sampling

The USEPA has selected a corrective action remedy for the Site. USEPA's *Statement of Basis for Proposed Soil and Ground Water Remedy* was issued on September 14, 2007. USEPA's *Final Remedy Decision for Former Romic Environmental Technologies Corporation Facility, East Palo Alto, California and Response to Public Comments* was issued on July 28, 2008. The investigation activities described in this CSAP were designed to provide data to develop an implementation plan for USEPA's selected remedy. Following remediation of the Site, confirmation samples will be collected to confirm the effectiveness of the Final Remedy. The specific procedures for the confirmation sampling will be included in the CMIP.

10.0 References

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Tables

FINAL DRAFT
COMPREHENSIVE SITE-WIDE SAMPLING AND ANALYSES PLAN
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses (1)						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths(2)**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
DRUM CRUSHER HWMU	D21	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	D22	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	D23	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	E22	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
LIQUIFACTION AREA	K23	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
WEST STORAGE BUILDING 2	OP/3,4	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	OP/4,5	0-0.5'	X		X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	PQ/3,4	0-0.5'	X		X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	PQ/4,5	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	QR/3,4	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	QR/4,5	0-0.5'	X		X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
TANKFARM Q	MN/7,8	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	NO/7,8	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	NO/8,9	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	OP/7,8	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses [1]						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths[2]**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
TANKFARM Q (continued)	OP/8,9	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	PQ/7,8	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	PQ/8,9	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	QR/7,8	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	QR/8,9	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	RS/7,8	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
TANKFARM H	N17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
TANKFARM G	O17	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	P17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
TANKFARM MNO	N19	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	N20	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	N21	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
TANKFARM CLR	OP/19,20	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	OP/20,21	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses (1)						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths(2)**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
TANKFARM I AND J	Q17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	R17	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	S16	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	S17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
HIGH TEMP UNIT	S22	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
TANKFARM K	V 17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	V 18	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	V 19	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
TRUCK WASH	Y16	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	Y17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X	X		X	X	X	X
		5.5-6'	X	X		X	X	X	X
	Z/16,17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X	X		X	X	X	X
		5.5-6'	X	X		X	X	X	X
TANKFARM D	S20	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
TANKFARMS A AND B	Q19	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	R19	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	Q20	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	R20	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses (1)						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths(2)**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
DRUM CRUSHING AREA (SWMU #1)	G17	2.5-3'	X						
		5.5-6'	X						
	G18	2.5-3'	X						
		5.5-6'	X						
	H17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
SURGE TANK (SWMU #2)	L6	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	L7	2.5-3'	X						
		5.5-6'	X						
SEPTIC TANK (SWMU #3)	P23	2.5-3'	X	X		X	X	X	X
		5.5-6'	X						
	R24	2.5-3'	X						
		5.5-6'	X						
	R25	0.0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	P25	2.5-3'	X	X		X	X	X	X
		5.5-6'	X	X					
RUNOFF SUMP (SWMU #4)	P27	0-0.5'	X	X		X	X	X	X
		2.5-3'	X	X		X	X	X	X
		5.5-6'	X	X		X	X	X	X
WEST STORAGE LOT (SWMU #5)	Y2	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Y3	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
TRUCK PARKING AREA (SWMU #6)	X8	0-0.5'	X		X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	X9	0-0.5'	X		X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
PROCESS WATER TREATMENT (AOC 7)	Bb19	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses [1]						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths[2]**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
NORTH DRUM STORAGE AREA (AOC 8)	K19	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	K20	2.5-3'	X						
		5.5-6'	X						
	K21	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	L20	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	L23	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	M19	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	M22	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	M24	2.5-3'	X						
		5.5-6'	X						
	N23	2.5-3'	X						
		5.5-6'	X						
	N25	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
SOUTH DRUM STORAGE AREA (AOC 9)	N6	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	O6	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	P6	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Q6	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	R6	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Q10	2.5-3'	X						
		5.5-6'	X						
	Q16	2.5-3'	X						
		5.5-6'	X						
	R10	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	R11	2.5-3'	X						
		5.5-6'	X						
	T18	2.5-3'	X						
		5.5-6'	X						

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses [1]						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths[2]**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
SOUTH DRUM STORAGE AREA (AOC 9) (continued)	T19	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	U20	2.5-3'	X						
		5.5-6'	X						
	U21	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	V22	2.5-3'	X						
		5.5-6'	X						
	V23	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
ONSITE AUTO WRECKING YARDS (AOC 10)	P1	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	M2	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	S2	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	V2	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Bb2	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	M5	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	S5	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	V5	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Y5	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Bb5	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Bb8	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Y11	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Y14	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses (1)						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths(2)**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
ONSITE AUTO WRECKING YARDS (AOC 10) (continued)	Aa17	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Y23	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Bb23	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Ee23	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Ee26	2.5-3'	X	X		X	X	X	X
		5.5-6'	X		X	X			
	Hh23	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Kk23	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Kk26	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Nn23	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Nn26	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Z27	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Bb26	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Gg26	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	V29	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Aa25	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			

VOCS IN GROUNDWATER (AOC 11)	Aa12	0-0.5'			X	X			
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			
	Bb11	0-0.5'	X	X		X	X	X	X
		2.5-3'	X		X	X			
		5.5-6'	X		X	X			

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses (1)						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths(2)**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
FORMER BUILDING FOOTPRINT AREAS AND REMAINDER OF SITE	T8	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	V8	2.5-3'	X						
		5.5-6'	X						
	T11	0-0.5'	X						
		2.5-3'	X						
		5.5-6'	X						
	V11	0-0.5'	X	X		X	X	X	X
		2.5-3'	X	X		X	X	X	X
		5.5-6'	X	X		X	X	X	X
	P16	2.5-3'	X						
		5.5-6'	X						
	N18	2.5-3'	X						
		5.5-6'	X						
	S19	2.5-3'	X						
		5.5-6'	X						
	T21	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	O23	2.5-3'	X						
		5.5-6'	X						
	V26	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	S26	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	N26	2.5-3'	X						
		5.5-6'	X						
	K27	0-0.5'	X	X		X	X	X	X
		2.5-3'	X						
		5.5-6'	X						
	C24	2.5-3'	X						
		5.5-6'	X						
	C21	2.5-3'	X						
		5.5-6'	X						
	A21	2.5-3'	X						
		5.5-6'	X						
	W22	2.5-3'	X						
		5.5-6'	X						
	T24	2.5-3'	X						
		5.5-6'	X						

TABLE 1: SOIL SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

			Analyses [1]						
Area or Area of Concern (AOC)	**Sample ID (location)**	**Sample Depths[2]**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**

Notes:

Shaded sample indicates location in historical auto wrecking operations area.

(1) "VOCs" indicates volatile compounds by USEPA method 8260B.
"CAM 17 Metals" indicates analyses of 17 metals by USEPA method 6010B, and mercury by USEPA Method 7470A Modified.
"Metals (Pb, Cd, Cr) indicates lead, cadmium, and chromium by USEPA method 6010B.
"TPH" indicates total petroleum hydrocarbons as gasoline, diesel, and motor oil by modified USEPA method 8015.
"SVOCs" indicates semivolatile organic compounds by USEPA method 8270.
"Pesticides" indicates organochlorine pesticides by USEPA method 8081A.
"PCBs" indicates polychlorinated biphenyls by USEPA method 8082.

(2) "Sample Depths" indicates below ground surface. Most soil samples taken throughout the Site will initially be obtained from the shallowest first contact with soil (not gravel) below the concrete cover. Where a concrete cover is not present, analyses will be conducted on soil samples taken from the 0 to 0.5 foot interval below ground surface.

TABLE 2: SOIL VAPOR SAMPLING AND ANALYSIS SUMMARY

Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

		Analyses (1)
Sample ID (location)	**Sample Depths(2)**	**VOCs**
SG-01	5.0'	X
SG-02	5.0'	X
SG-03	5.0'	X
SG-04	5.0'	X
SG-05	5.0'	X
SG-06	5.0'	X
SG-07	5.0'	X
SG-08	5.0'	X
SG-09	5.0'	X
SG-10	5.0'	X
SG-11	5.0'	X
SG-12	5.0'	X
SG-13	5.0'	X
SG-14	5.0'	X
SG-15	5.0'	X
SG-16	5.0'	X
SG-17	5.0'	X
SG-18	5.0'	X
SG-19	5.0'	X
SG-20	5.0'	X
SG-21	5.0'	X

Notes:

(1) "VOCs" indicates volatile organic compounds by USEPA method TO-15 modified (if a fixed laboratory is used) or USEPA 8260B (if a mobile laboratory is used).

(2) "Sample Depths" indicates below ground surface (bgs)

TABLE 3: GROUNDWATER SAMPLING AND ANALYSIS SUMMARY
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

		Analyses (1)						
Sample ID (location)	**Sample Depths(2)**	**VOCs**	**CAM 17 Metals**	**Metals (Pb, Cd, Cr)**	**TPH**	**SVOCs**	**Pesticides**	**PCBs**
Ee26	15.0'	X	X		X	X	X	X
Kk23	15.0'	X		X				
R25	15.0'	X	X		X	X	X	X
Kk26	15.0'	X	X		X	X	X	X
Nn26	15.0'	X		X				
Aa27 (3)	15.0', 30.0', 60.0'	X						
Gg27 (3)	15.0', 30.0', 60.0'	X						
Mm27 (3)	15.0', 30.0', 60.0'	X						

Notes:

(1) "VOCs" indicates volatile compounds by USEPA method 8260B.
"CAM 17 Metals" indicates analyses of 17 metals by USEPA method 6010B, and mercury by USEPA Method 7470A Modified.
"Metals (Pb, Cd, Cr) indicates lead, cadmium, and chromium by USEPA method 6010B.
"TPH" indicates total petroleum hydrocarbons as gasoline, diesel, and motor oil by modified USEPA method 8015.
"SVOCs" indicates semivolatile organic compounds by USEPA method 8270.
"Pesticides" indicates organochlorine pesticides by USEPA method 8081A.
"PCBs" indicates polychlorinated biphenyls by USEPA method 8082.
(2) "Sample Depths" indicates below ground surface (bgs)
(3) Sample taken at same location as CPT.

TABLE 4: SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Analyte	Analytical Method	Container	Preservative	Holding Time	Minimum Sample Volume
Soil					
VOCs	EPA Method 5035A/8260	Encore or Similar	Cool , 4 ± 2ºC	7 days	5 g
SVOCs	EPAMethod 8270C	Acetate Sleeve	Cool , 4 ± 2ºC	14/40	30 g
Pesticides	EPA Method 8081A	Acetate Sleeve	Cool , 4 ± 2ºC	14/40	30 g
PCBs	EPA Method 8082	Acetate Sleeve	Cool , 4 ± 2ºC	14/40	30 g
Cam 17 Metals	EPA Method 6010B	Acetate Sleeve	Cool , 4 ± 2ºC	180 days	5 g
TPH-g	EPA Method 5035A/8015B	Encore or Similar	Cool , 4 ± 2ºC	7 days	5 g
TPH-d, TPH-mo	EPA Method 8015B	Acetate Sleeve	Cool , 4 ± 2ºC	14/40	50 g

Groundwater					
VOCs	EPA Method 8260B	3 x 40-ml Voa vials	HCl	14 days	40 ml
SVOCs	EPAMethod 8270	1-liter amber	none	7/40	1 L
Pesticides	EPA Method 8081/8082	1-liter amber	none	7/40	1 L
PCBs	EPA Method 8081/8082	1-liter amber	none	7/40	1 L
Cam 17 Metals	EPA Method 6010B	500ml poly	HNO_3	180 days	100 ml
TPH-g	EPA Method 8015B	3 x 40 ml VOA vials	HCl	14 days	40 ml
TPH-d, TPH-mo	EPA Method 8015B	1-liter amber	none	14/40	1 L

Soil Vapor					
VOCs	EPA Method TO-15	250mL or 1L summa	none	14 days	250mL or 1L
VOCs	EPA Method 8260B	Syringe	Cool, protect from UV light	ASAP	Determined on-site

Notes:

VOCs - volatile organic compounds
SVOCs - semivolatile orgainc compounds
TPH-g - total petroleum hydrocarbons as gasoline
TPH-d - total petroleum hydrocarbons as diesel
TPH-mo - total petroleum hydrocarbons as motor oil
14/40 - 14 days to extract/ 40 days to analyze after extraction
HNO3- nitric acid
g - gram
ml - milliliter
L - liter

TABLE 5: Minimum Risk-Based Target Concentrations
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Chemical	Environmental Media											
	Groundwater (mg/L)				Soil Gas (mg/m^3) [a]				Soil (mg/kg)			
	RBTC	**Water Solubility Limit**	**RBTC Scenario**		**RBTC**	**Vapor Pressure Limit**	**RBTC Scenario**		**RBTC**	**Saturation Limit**	**RBTC Scenario**	
Acetone	940000	1000000	indoor worker	NC	410000	1400000	indoor worker	NC	49000	130000	indoor worker	NC
Benzene	1.3	1800	indoor worker	C	4.7	410000	indoor worker	C	0.013	770	indoor worker	C
2-Butanone	120000	220000	indoor worker	NC	66000	520000	indoor worker	NC	5300	29000	indoor worker	NC
Carbon Disulfide	1400	2200	indoor worker	NC	9200	1300000	indoor worker	NC	4.5	460	indoor worker	NC
Chlorobenzene	250	500	indoor worker	NC	660	63000	indoor worker	NC	4.8	300	indoor worker	NC
Chloroethane	**24000**	6700	indoor worker	NC	130000	3100000	indoor worker	NC	77	1400	indoor worker	NC
Chloroform	0.5	8000	indoor worker	C	1.6	1200000	indoor worker	C	0.0029	1600	indoor worker	C
Chloromethane	190	5300	indoor worker	NC	1200	1900000	indoor worker	NC	0.73	970	indoor worker	NC
Cumene	**1700**	61	indoor worker	NC	5300	29000	indoor worker	NC	31	95	indoor worker	NC
1,2-Dichlorobenzene	**1200**	160	indoor worker	NC	2600	12000	indoor worker	NC	51	140	indoor worker	NC
1,4-Dichlorobenzene	1.5	81	indoor worker	C	3.3	8000	indoor worker	C	0.05	71	indoor worker	C
1,1-Dichloroethane	6.2	5000	indoor worker	C	23	1200000	indoor worker	C	0.028	1000	indoor worker	C
1,2-Dichloroethane	0.56	8600	indoor worker	C	1.4	420000	indoor worker	C	0.0088	1800	indoor worker	C
1,1-Dichloroethene	340	2400	indoor worker	NC	2600	2600000	indoor worker	NC	0.9	670	indoor worker	NC
cis-1,2-Dichloroethene	----	6400	----	----	----	1100000	----	----	**2300**	1400	outdoor worker	NC
trans-1,2-Dichloroethene	230	4500	indoor worker	NC	790	760000	indoor worker	NC	1.4	970	indoor worker	NC
Ethylbenzene	4.7	170	indoor worker	C	15	55000	indoor worker	C	0.075	180	indoor worker	C
2-Hexanone	490	17000	indoor worker	NC	390	66000	indoor worker	NC	15	2600	indoor worker	NC
Methyl tert-butyl ether	84	51000	indoor worker	C	140	1200000	indoor worker	C	1.2	7400	indoor worker	C
4-Methyl-2-pentanone	**52000**	19000	indoor worker	NC	39000	110000	indoor worker	NC	1600	2800	indoor worker	NC
Methylene Chloride	21	13000	indoor worker	C	78	1700000	indoor worker	C	0.14	2300	indoor worker	C
Styrene	**5400**	310	indoor worker	NC	13000	35000	indoor worker	NC	190	320	indoor worker	NC
1,1,2,2-Tetrachloroethane	0.55	2800	indoor worker	C	0.63	43000	indoor worker	C	0.021	880	indoor worker	C
Tetrachloroethene	1.5	210	indoor worker	C	6.2	150000	indoor worker	C	0.0048	75	indoor worker	C
Tetrahydrofuran	----	1000000	----	----	----	2900000	----	----	----	120000	----	----
Toluene	**20000**	530	indoor worker	NC	66000	140000	indoor worker	NC	220	320	indoor worker	NC
1,2,4-Trichlorobenzene	16	49	indoor worker	NC	26	2800	indoor worker	NC	2.4	140	indoor worker	NC
1,1,1-Trichloroethane	**14000**	1300	indoor worker	NC	66000	910000	indoor worker	NC	35	340	indoor worker	NC
1,1,2-Trichloroethane	1.2	4600	indoor worker	C	2.3	160000	indoor worker	C	0.026	1100	indoor worker	C
Trichloroethene	4.8	1300	indoor worker	C	18	520000	indoor worker	C	0.018	350	indoor worker	C
1,1,2-Trichloro-1,2,2-trifluoroethane	**8700**	170	indoor worker	NC	390000	3700000	indoor worker	NC	58	400	indoor worker	NC
1,2,4-Trimethylbenzene	35	57	indoor worker	NC	92	14000	indoor worker	NC	0.85	78	indoor worker	NC
1,3,5-Trimethylbenzene	----	48	----	----	----	17000	----	----	**11000**	65	outdoor worker	NC
Vinyl Chloride	0.81	8800	indoor worker	C	8.4	10000000	indoor worker	C	0.0025	2400	indoor worker	C
Xylenes (total)	**400**	110	indoor worker	NC	1300	23000	indoor worker	NC	8.9	96	indoor worker	NC

TABLE 5: Minimum Risk-Based Target Concentrations
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

	Environmental Media											
	Groundwater (mg/L)				Soil Gas (mg/m^3) [a]				Soil (mg/kg)			
Chemical	**RBTC**	**Water Solubility Limit**	**RBTC Scenario**		**RBTC**	**Vapor Pressure Limit**	**RBTC Scenario**		**RBTC**	**Saturation Limit**	**RBTC Scenario**	
Semi-Volatile Organic Compounds (SVOCs)												
Acenaphthylene	----	3.9	----	----	----	18	----	----	----	38	----	----
bis(2-Chloroethoxy)methane	----	----	----	----	----	----	----	----	2100	----	outdoor worker	NC
bis(2-Chloroethyl) ether	0.88	17000	indoor worker	C	----	12000	----	----	0.055	3200	indoor worker	C
bis(2-Ethylhexyl)phthalate	----	----	----	----	----	----	----	----	140	----	outdoor worker	C
Butylbenzylphthalate	----	----	----	----	----	----	----	----	1000	----	outdoor worker	C
4-Chloroaniline	----	----	----	----	----	----	----	----	9.6	----	outdoor worker	C
Dimethylphthalate	----	----	----	----	----	----	----	----	----	----	----	----
Di-n-butylphthalate	----	----	----	----	----	----	----	----	68000	----	outdoor worker	NC
Di-n-octylphthalate	----	----	----	----	----	----	----	----	----	----	----	----
Fluoranthene	----	----	----	----	----	----	----	----	24000	----	outdoor worker	NC
Hexachlorobutadiene	----	3.2	----	----	----	1100	----	----	25	----	outdoor worker	C
Hexachlorocyclopentadiene	----	1.8	----	----	----	2000	----	----	4100	----	outdoor worker	NC
Isophorone	----	----	----	----	----	----	----	----	2000	----	outdoor worker	C
2-Methylnaphthalene	----	25	----	----	----	520	----	----	**2400**	120	outdoor worker	NC
2-Methylphenol	----	----	----	----	----	----	----	----	34000	----	outdoor worker	NC
4-Methylphenol	----	----	----	----	----	----	----	----	3400	----	outdoor worker	NC
Naphthalene	0.88	31	indoor worker	C	1.1	560	indoor worker	C	0.35	100	indoor worker	C
Phenol	----	----	----	----	----	----	----	----	210000	----	outdoor worker	NC
Pesticides/Polychlorinated Biphenyls												
Total Polychlorinated Biphenyls	----	----	----	----	----	----	----	----	0.83	----	outdoor worker	C
Aroclor 1016	----	----	----	----	----	----	----	----	24	----	outdoor worker	C
Aroclor 1254	----	----	----	----	----	----	----	----	0.83	----	outdoor worker	C
Aldrin	----	0.017	----	----	----	----	----	----	0.11	----	outdoor worker	C
Chlordane	----	0.056	----	----	----	----	----	----	7.2	----	outdoor worker	C
4,4'-DDD	----	----	----	----	----	----	----	----	8	----	outdoor worker	C
4,4'-DDE	----	0.12	----	----	----	----	----	----	5.6	----	outdoor worker	C
4,4'-DDT	----	----	----	----	----	----	----	----	7.8	----	outdoor worker	C
Dieldrin	----	0.2	----	----	----	----	----	----	0.12	----	outdoor worker	C
Endosulfan I	----	----	----	----	----	----	----	----	4100	----	outdoor worker	NC
Endosulfan II	----	----	----	----	----	----	----	----	4100	----	outdoor worker	NC
Endosulfan sulfate	----	----	----	----	----	----	----	----	4100	----	outdoor worker	NC
Endrin	----	----	----	----	----	----	----	----	210	----	outdoor worker	NC
Endrin aldehyde	----	----	----	----	----	----	----	----	210	----	outdoor worker	NC
Heptachlor	----	0.18	----	----	----	----	----	----	0.43	----	outdoor worker	C

TABLE 5: Minimum Risk-Based Target Concentrations
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

	Environmental Media											
	Groundwater (mg/L)				Soil Gas (mg/m^3) [a]				Soil (mg/kg)			
Chemical	**RBTC**	**Water Solubility Limit**	**RBTC Scenario**		**RBTC**	**Vapor Pressure Limit**	**RBTC Scenario**		**RBTC**	**Saturation Limit**	**RBTC Scenario**	
Heptachlor epoxide	----	----	----	----	----	----	----	----	0.21	----	outdoor worker	C
alpha-Hexachlorocyclohexane	----	2	----	----	----	----	----	----	0.3	----	outdoor worker	C
beta-Hexachlorocyclohexane	----	----	----	----	----	----	----	----	1.1	----	outdoor worker	C
delta-Hexachlorocyclohexane	----	----	----	----	----	----	----	----	----	----	----	----
gamma-Hexachlorocyclohexane	----	7.3	----	----	----	----	----	----	2.3	----	outdoor worker	C
Methoxychlor	----	0.1	----	----	----	----	----	----	3400	----	outdoor worker	NC
Toxaphene	----	----	----	----	----	----	----	----	1.7	----	outdoor worker	C
Metals												
Antimony	----	----	----	----	----	----	----	----	450	----	outdoor worker	NC
Arsenic	----	----	----	----	----	----	----	----	1.8	----	outdoor worker	C
Barium	----	----	----	----	----	----	----	----	210000	----	outdoor worker	NC
Beryllium	----	----	----	----	----	----	----	----	2200	----	outdoor worker	NC
Cadmium	----	----	----	----	----	----	----	----	890	----	outdoor worker	NC
Chromium (total)	----	----	----	----	----	----	----	----	----	----	----	----
Chromium III	----	----	----	----	----	----	----	----	1700000 (b)	----	outdoor worker	NC
Chromium VI	----	----	----	----	----	----	----	----	120	----	outdoor worker	NC
Cobalt	----	----	----	----	----	----	----	----	340	----	outdoor worker	NC
Copper	----	----	----	----	----	----	----	----	45000	----	outdoor worker	NC
Lead	----	----	----	----	----	----	----	----	320	----	commercial/ industrial CHHSL (c)	----
Mercury	----	0.06	----	----	----	----	----	----	0.0043	5	indoor worker	NC
Molybdenum	----	----	----	----	----	----	----	----	5700	----	outdoor worker	NC
Nickel	----	----	----	----	----	----	----	----	22000	----	outdoor worker	NC
Selenium	----	----	----	----	----	----	----	----	5700	----	outdoor worker	NC
Silver	----	----	----	----	----	----	----	----	5700	----	outdoor worker	NC
Thallium	----	----	----	----	----	----	----	----	----	----	----	----
Tin	----	----	----	----	----	----	----	----	680000	----	outdoor worker	NC
Vanadium	----	----	----	----	----	----	----	----	5700	----	outdoor worker	NC
Zinc	----	----	----	----	----	----	----	----	340000	----	outdoor worker	NC

TABLE 5: Minimum Risk-Based Target Concentrations
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

	Environmental Media											
	Groundwater (mg/L)				Soil Gas (mg/m^3) [a]				Soil (mg/kg)			
Chemical	**RBTC**	**Water Solubility Limit**	**RBTC Scenario**		**RBTC**	**Vapor Pressure Limit**	**RBTC Scenario**		**RBTC**	**Saturation Limit**	**RBTC Scenario**	

Notes:

mg/L = milligram per Liter; mg/m^3 = milligram per cubic meter; mg/kg = milligram per kilogram

C = Cancer

NC = Noncancer

RBTC = Risk based target concentration

---- = RBTC was not calculated

[a] Calculated for soil gas at a depth of five feet below ground surface (bgs). None of the minimum soil gas RBTCs are greater than the vapor pressure limit.

[b] Minimum soil RBTC is greater than one million parts per million.

[c] 2009 commercial/industrial CHHSL is used as the screening level for lead.

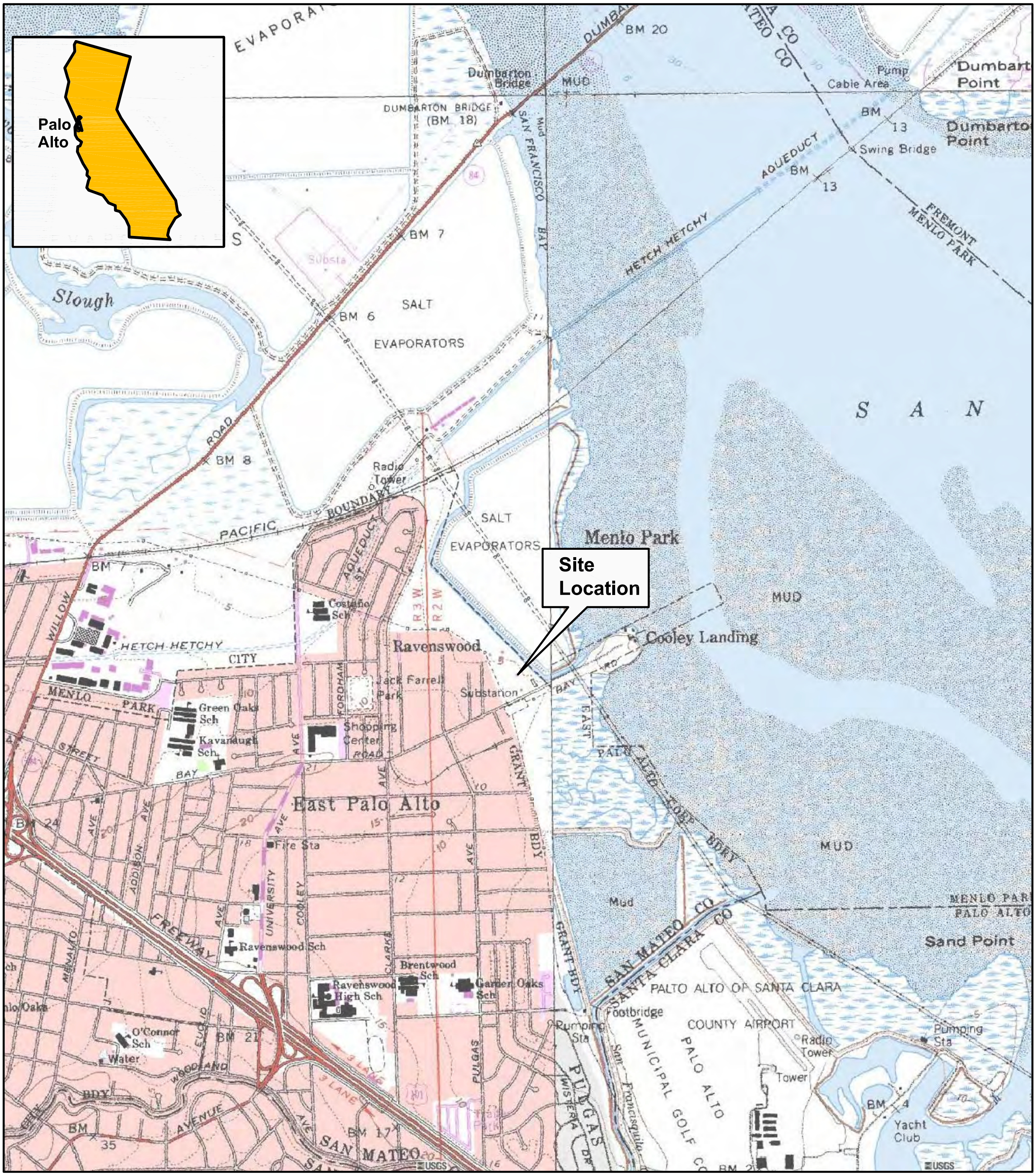
Bold values exceed either the water solubility limit, vapor pressure limit or soil saturation limit, for groundwater, soil gas or soil, respectively.

Sources:

California Environmental Protection Agency (Cal/EPA). 2009. *Revised California Human Health Screening Levels for Lead. Office of Environmental Health Hazard Assessment (OEHHA).* September.

Figures

FINAL DRAFT
COMPREHENSIVE SITE-WIDE SAMPLING AND ANALYSES PLAN
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California



Source: Microsoft Research Maps, USGS 7.5' Quadrangle, East Palo Alto, California, 1998

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SCALE IN FEET

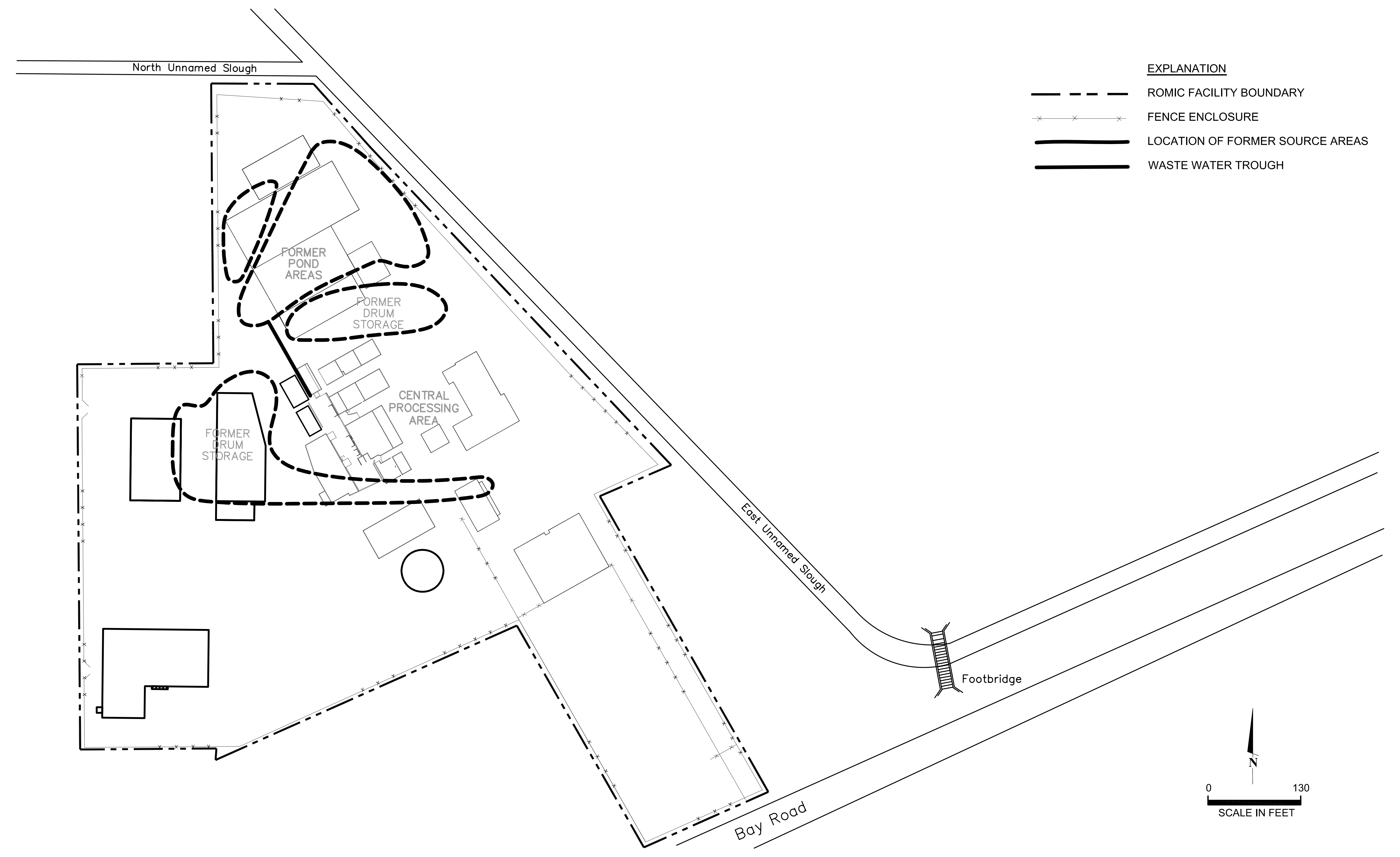
IRIS ENVIRONMENTAL
1438 Webster Street, Suite 302
Oakland, California 94612
Ph. (510) 834-4747 Fax: (510) 834-4199

Site Location Map
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Figure
1

Drafter: EC
Date: 03/22/11
Contract Number: 07-555A

I:\CAD\07\07-555-A\site location.dwg



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Site Facility Map
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

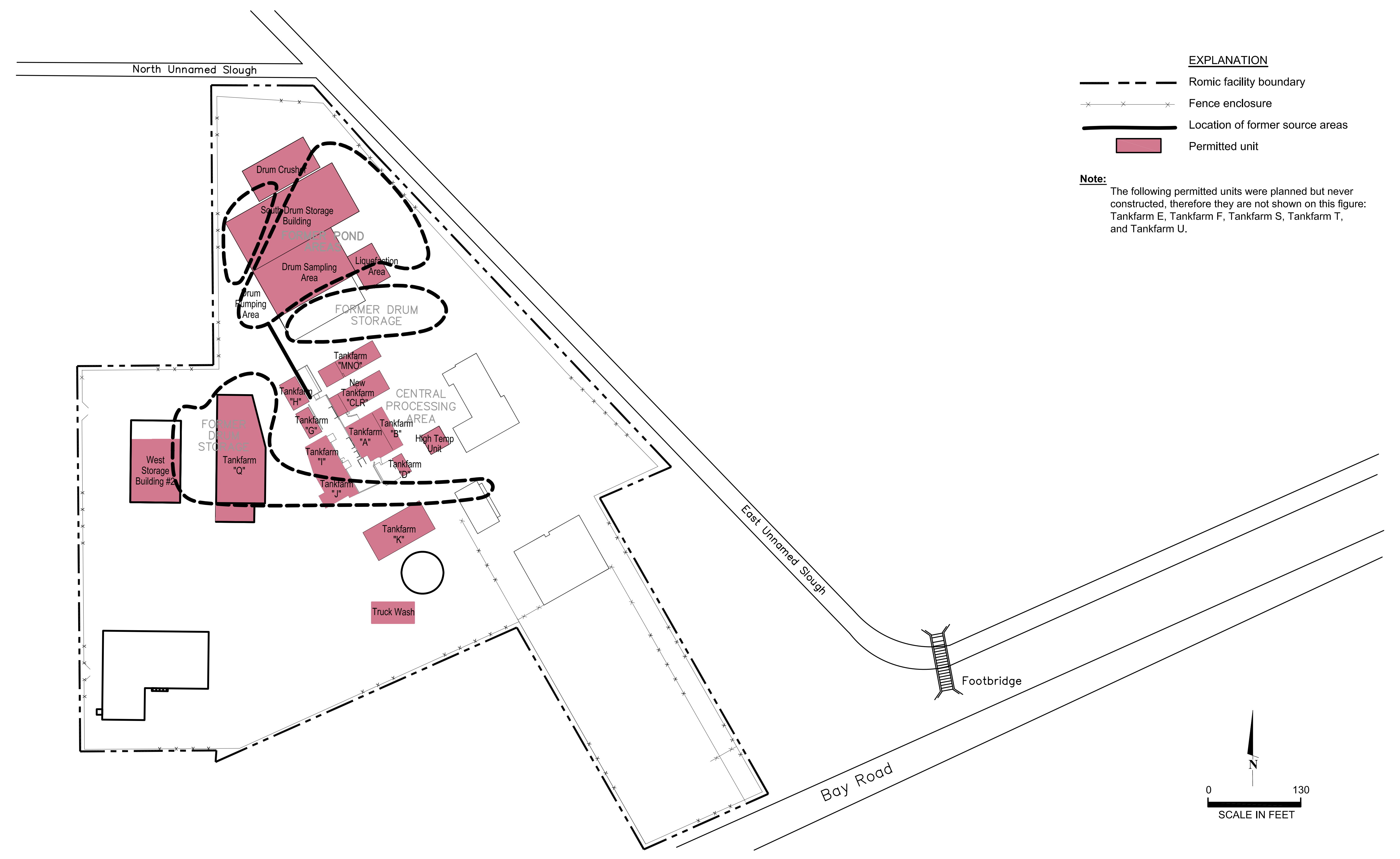
Figure
2

Drafter: EC

Date: 03/22/11

Contract Number: 07-555A

I:\CAD\07\07-555-A\site facility.dwg



Note:
The following permitted units were planned but never constructed, therefore they are not shown on this figure: Tankfarm E, Tankfarm F, Tankfarm S, Tankfarm T, and Tankfarm U.

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Locations of Permitted Units
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Figure
3

Drafter: EC
Date: 03/28/11
Contract Number: 07-555A

I:\CAD\07\07-555-A\location of permitted unit.dwg

RB-32

Depth	@3-3.5'	@6-6.5'
c-DCE	<0.005	<0.005
MEK	0.018	0.028
MIBK	<0.01	<0.01
Benzene	<0.005	0.0085
Ethylbenzene	0.038	0.027
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	0.038	0.044
TCE	<0.005	<0.005
VC	<0.005	<0.005
Total SVOCs	4	0.6

RB-30

Depth	@3-3.5'	@4.5-5'
c-DCE	<1.25	<0.005
MEK	<2.5	0.015
MIBK	<2.5	<0.01
Benzene	<1.25	<0.005
Ethylbenzene	3.2	0.058
MC	<2.5	<0.01
PCE	<1.25	<0.005
Toluene	5.9	0.036
TCE	<1.25	<0.005
VC	<1.25	0.034
Total SVOCs	16.6	

RB-20

Depth	@2-2.5'	@4.5-5'
c-DCE	<0.005	<0.005
MEK	0.018	0.028
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	0.29
MC	<0.01	<0.01
PCE	0.017	<0.005
Toluene	0.00556	0.12
TCE	0.01	<0.005
VC	<0.005	<0.005
Total SVOCs	ND	12

RB-31

Depth	@2-2.5'	@4.5-5'
c-DCE	<0.005	<0.025
MEK	0.016	9.7
MIBK	0.019	1
Benzene	0.015	<0.025
Ethylbenzene	0.59	0.8
MC	<0.01	<0.05
PCE	<0.005	<0.025
Toluene	1.2	3.7
TCE	<0.005	<0.025
VC	<0.005	<0.025
Total SVOCs	11	0.9

RB-34

Depth	@3-3.5'	@4.5-5'
c-DCE	<0.005	0.13
MEK	0.036	0.28
MIBK	0.025	0.067
Benzene	<0.005	0.027
Ethylbenzene	0.0069	0.69
MC	<0.01	<0.05
PCE	<0.005	<0.025
Toluene	0.047	1.1
TCE	<0.005	**0.055**
VC	<0.01	<0.05
Total SVOCs	0.4	0.5

RB-5

Depth	@5-5.5'
c-DCE	<0.5
MEK	724
MIBK	80.8
Benzene	0.6
Ethylbenzene	211
MC	**107**
PCE	**206**
Toluene	**805**
TCE	**72**
VC	<5
Total SVOCs	5,523

RB-21

Depth	@2.5-3'	@4.5-5'
c-DCE	<1.25	<1.25
MEK	130	410
MIBK	19	21
Benzene	<1.25	<1.25
Ethylbenzene	80	42
MC	**13**	<2.5
PCE	**73**	**19**
Toluene	280	390
TCE	**9.3**	**300**
VC	<1.25	<1.25
Total SVOCs	4,580	4,300

RB-33

Depth	@3-3.5'	@4.5-5'
c-DCE	0.011	<1.25
MEK	0.028	90
MIBK	<0.01	17
Benzene	<0.005	<1.25
Ethylbenzene	<0.005	18
MC	<0.01	<2.5
PCE	<0.005	**6.8**
Toluene	0.012	49
TCE	<0.005	**5.8**
VC	<0.005	<1.25
Total SVOCs	ND	5,905

RB-22

Depth	@3-3.5'	@4.5-5'
c-DCE	0.033	<0.005
MEK	0.018	<0.01
MIBK	0.02	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	0.034	<0.005
MC	1.7	<0.01
PCE	0.14	<0.005
Toluene	0.031	0.0054
TCE	0.039	<0.005
VC	<0.005	<0.005
Total SVOCs	ND	ND

RB-28

Depth	@3-3.5'	@4.5-5'
c-DCE	<0.005	<1.25
MEK	<0.01	3.2
MIBK	<0.1	<2.5
Benzene	<0.005	<1.25
Ethylbenzene	0.012	18
MC	<0.1	<2.5
PCE	<0.005	**87**
Toluene	0.015	13
TCE	<0.005	**79**
VC	<0.005	<1.25
Total SVOCs	4.3 @ 2.5-3'	

RB-29

Depth	@3-3.5'	@4.5-5'
c-DCE	8.8	7.8
MEK	47	<2.5
MIBK	<2.5	<2.5
Benzene	<1.25	<1.25
Ethylbenzene	4.8	10
MC	<2.5	<2.5
PCE	**4.6**	**4.1**
Toluene	6	8.1
TCE	<1.25	<1.25
VC	<1.25	<1.25
Total SVOCs	0.4 @ 2.5-3'	

RB-37

Depth	@2-2.5'	@4-4.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-36

Depth	@2-2.5'	@4-4.5'
c-DCE	0.008	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	**0.14**	**0.13**
VC	<0.01	<0.005

RB-40

Depth	@2.5-3'	@4.5-5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-41

Depth	@2-2.5'	@4-4.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-23

Depth	@1.5-2'	@7-7.5'
c-DCE	0.16	0.28
MEK	0.12	<0.01
MIBK	0.16	<0.01
Benzene	0.029	0.056
Ethylbenzene	0.13	<0.005
MC	<0.01	<0.01
PCE	<0.01	<0.01
Toluene	0.11	0.014
TCE	0.09	0.046
VC	<0.005	0.08
Total SVOCs	ND	

RB-24

Depth	@2-2.5'	@4.5-5'
c-DCE	<1.25	<0.005
MEK	17	<0.01
MIBK	<2.5	<0.01
Benzene	<1.25	<0.005
Ethylbenzene	37	0.0095
MC	<2.5	<0.01
PCE	**29**	<0.005
Toluene	54	0.03
TCE	**3.6**	0.0068
VC	<1.25	<0.005
Total SVOCs	3.9	

RB-25

Depth	@2-2.5'	@4.5-5'
c-DCE	0.3	<0.005
MEK	9	<0.01
MIBK	2	<0.01
Benzene	<0.025	0.012
Ethylbenzene	1.5	0.073
MC	<0.05	<0.01
PCE	**1.8**	**0.052**
Toluene	7.6	0.083
TCE	**0.3**	0.013
VC	<0.025	<0.005
Total SVOCs	10	

RB-26

Depth	@2-2.5'	@4.5-5'
c-DCE	15	6
MEK	10	4.3
MIBK	23	8.5
Benzene	1.4	<1.25
Ethylbenzene	39	50
MC	<2.5	<2.5
PCE	**9.3**	**1.1**
Toluene	92	91
TCE	**51**	**1.9**
VC	<1.25	<1.25
Total SVOCs	4.4	

RB-27

Depth	@1.5-2'	@4.5-5'
c-DCE	5.5	41
MEK	74	37
MIBK	59	79
Benzene	<1.25	2.4
Ethylbenzene	29	87
MC	<2.5	<2.5
PCE	**7.9**	**26**
Toluene	77	260
TCE	**49**	**130**
VC	<1.25	<1.25
Total SVOCs	2.4	

RB-42

Depth	@2-2.5'	@4-4.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-39

Depth	@3-3.5'	@5-5.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-38

Depth	@2-2.5'	@4-4.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-47

Depth	@3.5-4'	@5.5-6'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-45

Depth	@2-2.5'	@4-4.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-46

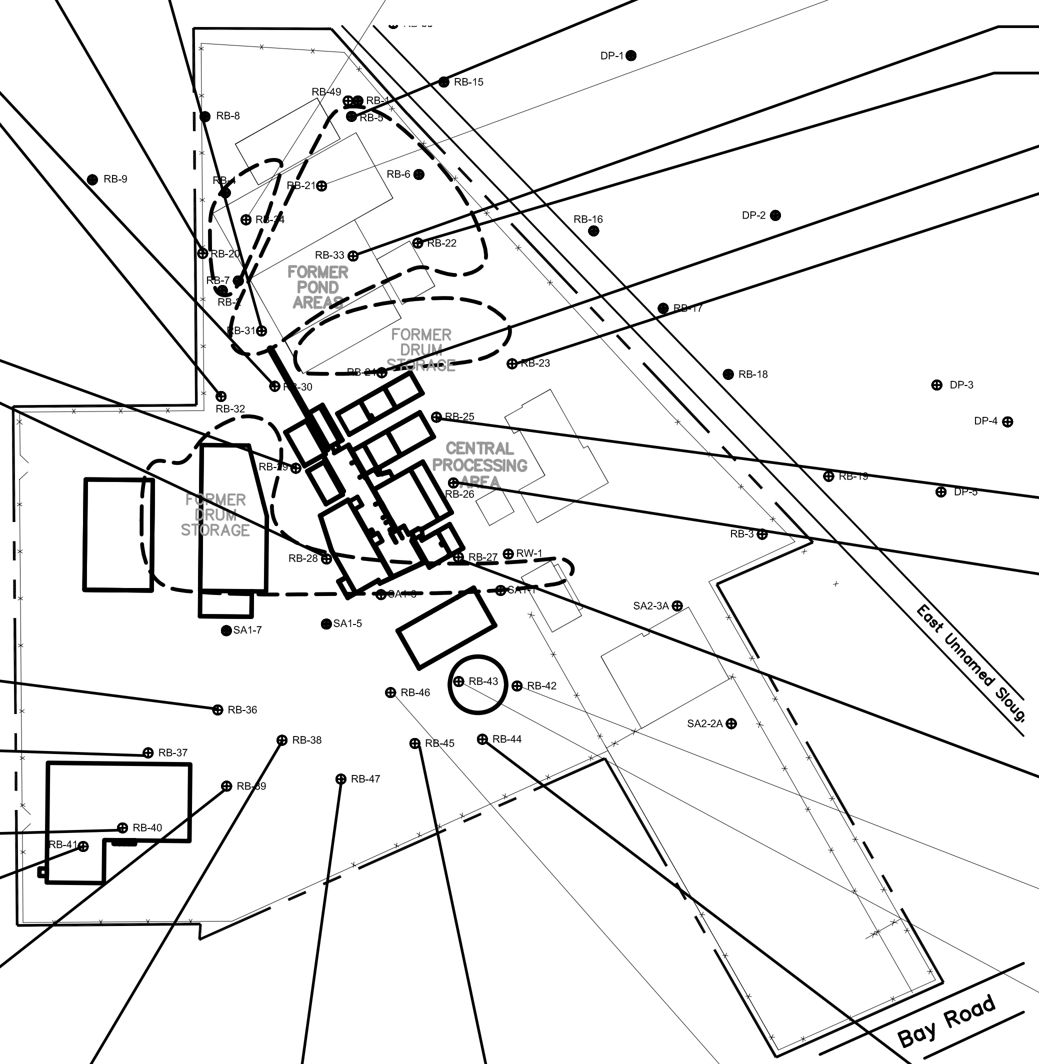
Depth	@2-2.5'	@4-4.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-44

Depth	@2-2.5'	@4-4.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005

RB-43

Depth	@2.5-3'	@4-4.5'
c-DCE	<0.005	<0.005
MEK	<0.01	<0.01
MIBK	<0.01	<0.01
Benzene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
MC	<0.01	<0.01
PCE	<0.005	<0.005
Toluene	<0.005	<0.005
TCE	<0.005	<0.005
VC	<0.005	<0.005



EXPLANATION

— — —	Romic facility boundary
—×—×—×—	Fence enclosure
RB-24 ⊕	Soil sample collected between grade and 8 feet bgs
RB-15 ●	Soil sample collected deeper than 8 feet bgs
c-DCE	cis–1,2–Dichloroethene
MEK	Methyl Ethyl Ketone (2–Buranone)
MIBK	4–Methyl 2–Pentanone
MC	Methylene Chloride
PCE	Tetrachloroethene
TCE	Trichloroethene
VC	Vinyl Chloride
NA	Not applicable
PRG	EPA Preliminary Remediation Goal
VOC	Volatile organic compound
SVOC	Semi–volatile organic compound
BGS	Below ground surface

Bold indicates result above PRG

Results in milligrams/kilogram

PRGs:

c-DCE	43
MEK	22,000
MIBK	NA
Benzene	0.64
Ethylbenzene	400
MC	9.1
PCE	0.48
Toluene	520
TCE	0.053
VC	0.079

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SCALE IN FEET

Basemap by ARCADIS

IRIS ENVIRONMENTAL
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VOCs and SVOCs - Historical Soil Sample Results (0-8.5' bgs)

Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Figure
4

Drafter: EC

Date: 03/22/11

Contract Number: 07-555A

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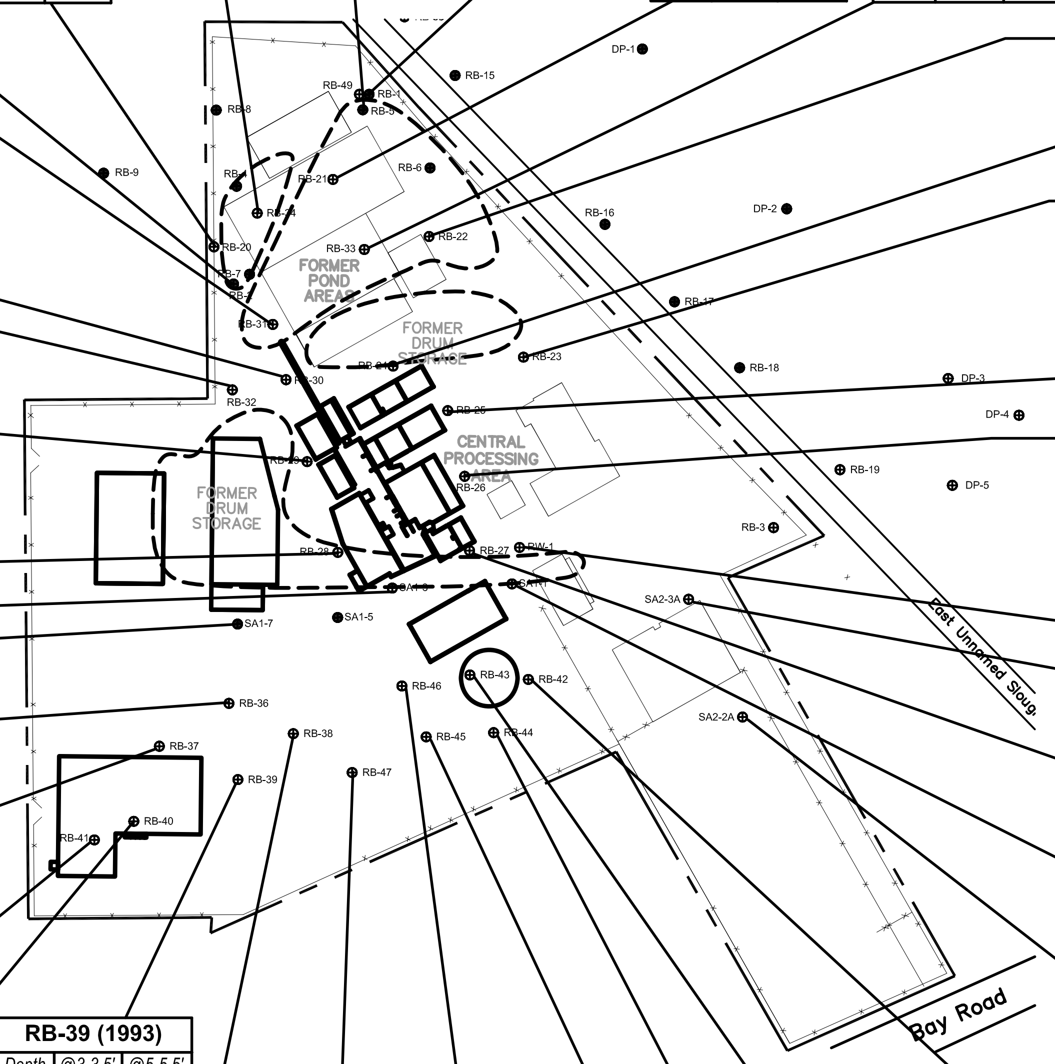

RB-2 (1990)

Depth	@8-8.5'
As	4
Cd	<10
Pb	20

RB-20 (1993)

Depth	@2-2.5'	@4.5-5'
As	**4**	**3**
Cd	<1	4
Cr	34	56
Cu	29	171
Pb	<20	96

RB-34 (1993)

Depth	@3-3.5'	@4.5-5'
As	**5**	3
Cd	<1	<1
Cr	54	38
Cu	43	34
Pb	21	30

RB-5 (1993)

Depth	@5-5.5'
As	**10**
Cd	**73**
Cr	**425**
Cu	300
Pb	**1,530**

RB-1 (1990)

Depth	@8-8.5'
As	**4**
Cd	<10
Pb	20

RB-21 (1993)

Depth	@2.5-3'	@4.5-5'
As	**5**	**27**
Cd	25	25
Cr	**373**	**550**
Cu	179	196
Pb	**1,410**	**2,070**

RB-33 (1993)

Depth	@3-3.5'	@4.5-5'
As	**10**	**6**
Cd	<1	20
Cr	33	**242**
Cu	27	157
Pb	52	**837**

RB-22 (1993)

Depth	@3-3.5'	@4.5-5'
As	**3**	**3**
Cd	<1	<1
Cr	36	31
Cu	30	22
Pb	<20	<20

RB-31 (1993)

Depth	@2-2.5'	@4.5-5'
As	**4**	**4**
Cd	1	1
Cr	57	54
Cu	50	39
Pb	89	<20

RB-30 (1993)

Depth	@3-3.5'
As	**4**
Cd	4
Cr	**1,360**
Cu	430
Pb	**256**

RB-24 (1993)

Depth	@2-2.5'
As	<1
Cd	1
Cr	74
Cu	64
Pb	100

RB-23 (1993)

Depth	@1.5-2'
As	**2**
Cd	<1
Cr	29
Cu	19
Pb	<20

RB-32 (1993)

Depth	@3-3.5'	@6-6.5'
As	**2**	**1**
Cd	4	9
Cr	75	39
Cu	72	26
Pb	**236**	44

RB-29 (1993)

Depth	@2.5-3'
As	**3**
Cd	<1
Cr	32
Cu	22
Pb	<20

RB-28 (1993)

Depth	@2-2.5'
As	<1
Cd	<1
Cr	109
Cu	88
Pb	<20

RB-25 (1993)

Depth	@2-2.5'
As	<1
Cd	1
Cr	100
Cu	57
Pb	101

RB-26 (1993)

Depth	@2-2.5'
As	**3**
Cd	<1
Cr	32
Cu	19
Pb	<20

RW-1 (1990)

Depth	@2.5-3'	@7.5-8'
As	**2**	**2**
Cd	<10	<10
Cr	30	30
Cu	20	20
Pb	<10	<10

SA1-3 (1990)

Depth	@1.5-2'
As	**15**
Cd	<5
Cr	33
Cu	19
Pb	<30

SA1-7 (1990)

Depth	@1.5-2'
As	1
Cd	<5
Cr	73
Cu	59
Pb	160

RB-36 (1993)

Depth	@2-2.5'	@4-4.5'
Cr	108	102
Pb	45	19

SA2-3A (1990)

Depth	@1.5-2'
As	**3**
Cd	<5
Cr	**900**
Cu	**13,000**
Pb	140

RB-27 (1993)

Depth	@1.5-2'
As	**3**
Cd	<1
Cr	30
Cu	21
Pb	<20

RB-37 (1993)

Depth	@2-2.5'	@4-4.5'
Cr	170	35
Pb	26	<20

RB-41 (1993)

Depth	@2-2.5'	@4-4.5'
Cr	43	31
Pb	<20	<20

RB-40 (1993)

Depth	@2.5-3'	@4.5-5'
Cr	36	31
Pb	<20	<20

RB-39 (1993)

Depth	@3-3.5'	@5-5.5'
Cr	29	28
Pb	<20	<20

RB-38 (1993)

Depth	@2-2.5'	@4-4.5'
Cr	69	34
Pb	68	<20

RB-46 (1993)

Depth	@2-2.5'	@4-4.5'
Cr	42	34
Pb	70	<20

RB-47 (1993)

Depth	@3.5-4'	@5.5-6'
Cr	268	47
Pb	47	<20

RB-45 (1993)

Depth	@2-2.5'	@4-4.5'
Cr	77	43
Pb	54	<20

RB-44 (1993)

Depth	@2-2.5'	@4-4.5'
Cr	37	205
Pb	25	<20

RB-43 (1993)

Depth	@2.5-3'	@4-4.5'
Cr	33	76
Pb	<20	<20

RB-42 (1993)

Depth	@2-2.5'	@4-4.5'
Cr	50	30
Pb	42	<20

SA2-2A (1990)

Depth	@1.5-2'
As	2
Cd	<5
Cr	94
Cu	250
Pb	150

SA1-1 (1990)

Depth	@1.5-2'
As	**100**
Cd	5
Cr	35
Cu	29
Pb	70

EXPLANATION

— — —	Romic facility boundary
—×—×—	Fence enclosure
RB-24 ⊕	Soil sample collected between grade and 8 feet bgs
RB-15 ●	Soil sample collected deeper than 8 feet bgs
As	Arsenic
Cd	Cadmium
Cr	Chromium
Cu	Copper
Pb	Lead
BGS	Below ground surface
PRG	EPA Preliminary Remediation Goal

Bold indicates result above PRG
Results in milligrams/kilogram

PRGs:

As	0.39
Cd	37
Cr	210
Cu	3,100
Pb	150

N

0 200
SCALE IN FEET

Basemap by ARCADIS

IRIS ENVIRONMENTAL
1438 Webster Street, Suite 302
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Metals - Historical Soil Sample Results (0-8.5' bgs)
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Figure
5

Drafter: EC
Date: 03/22/11
Contract Number: 07-555A

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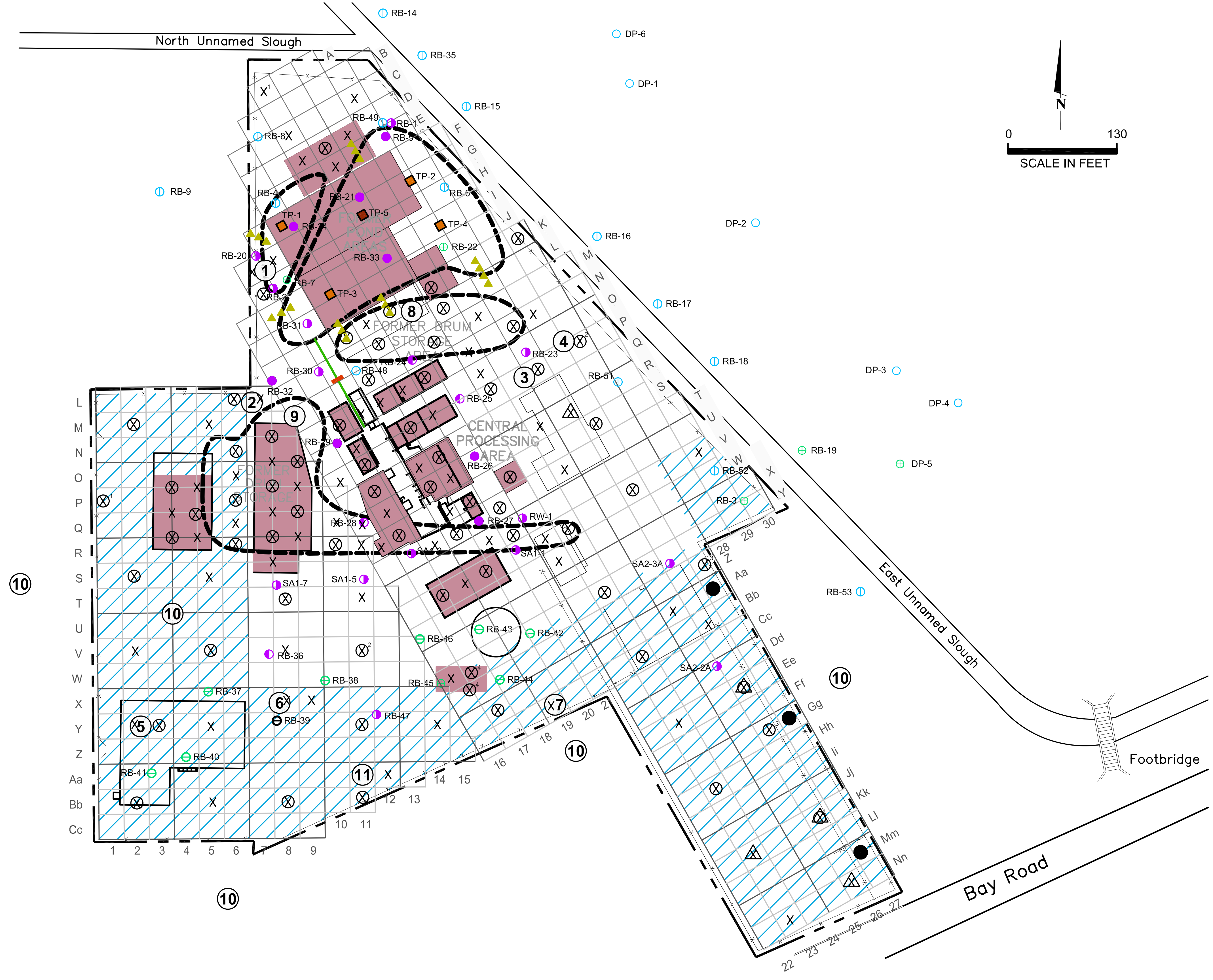

EXPLANATION

▬ ▬ Romic facility boundary

—×— Fence enclosure

▨ Permitted unit

◑ Soil sample (0-8' bgs) exceeds PRG for metals

◐ Soil sample (0-8' bgs) exceeds PRG for VOCs

● Soil sample (0-8' bgs) exceeds PRG for VOCs and metals

⊕ Soil boring location (0-8' bgs) samples did not exceed metals or VOC PRGs

⊖ Soil sample did not contain VOCs or metals above PRGs

⦶ Soil sample not collected 0-8' bgs

○ Soil sample data not available

X Proposed soil sample location

⊗ Proposed soil sample location with one depth analyzed for full suite (refer to Table 1 for depth)

△ Proposed soil and A-zone grab groundwater sample location

X¹ Sample will be collected from lowest point in the area (determined doing a site walk on June 17, 2008)

X² Sample will be collected beneath sump and analyzed for full suite of analyses

X³ Location of former building likely associated with auto wrecking operations

X⁴ Samples collected from beneath each sump

■ Proposed test pit location (10 x10)

■ Location of optional test pit

▲ Proposed Geoprobe location for delineation of pond perimeter

● Cone penetrometer test

— Approximate location of waste discharge trough

— Approximate location of proposed trench

▨ Area of historic auto wrecking operations

VOCs Volatile organic compounds

BGS Below ground surface

Solid Waste Management Units:

① Drum crushing area
② Surge tank separator
③ Septic tank
④ Runoff sump separator
⑤ West storage lot
⑥ Truck parking area

Other Areas of Concern:

⑦ Area of elevated VOCs in process water treatment
⑧ Former drum storage area (north)
⑨ Former drum storage area (south)
⑩ Offsite auto wrecking yard
⑪ Elevated concentrations of VOCs in groundwater

Source: Basemap supplied by ARCADIS

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Proposed Sample Locations
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Figure
6

Drafter: EC
Date: 03/28/11
Contract Number: 07-555A

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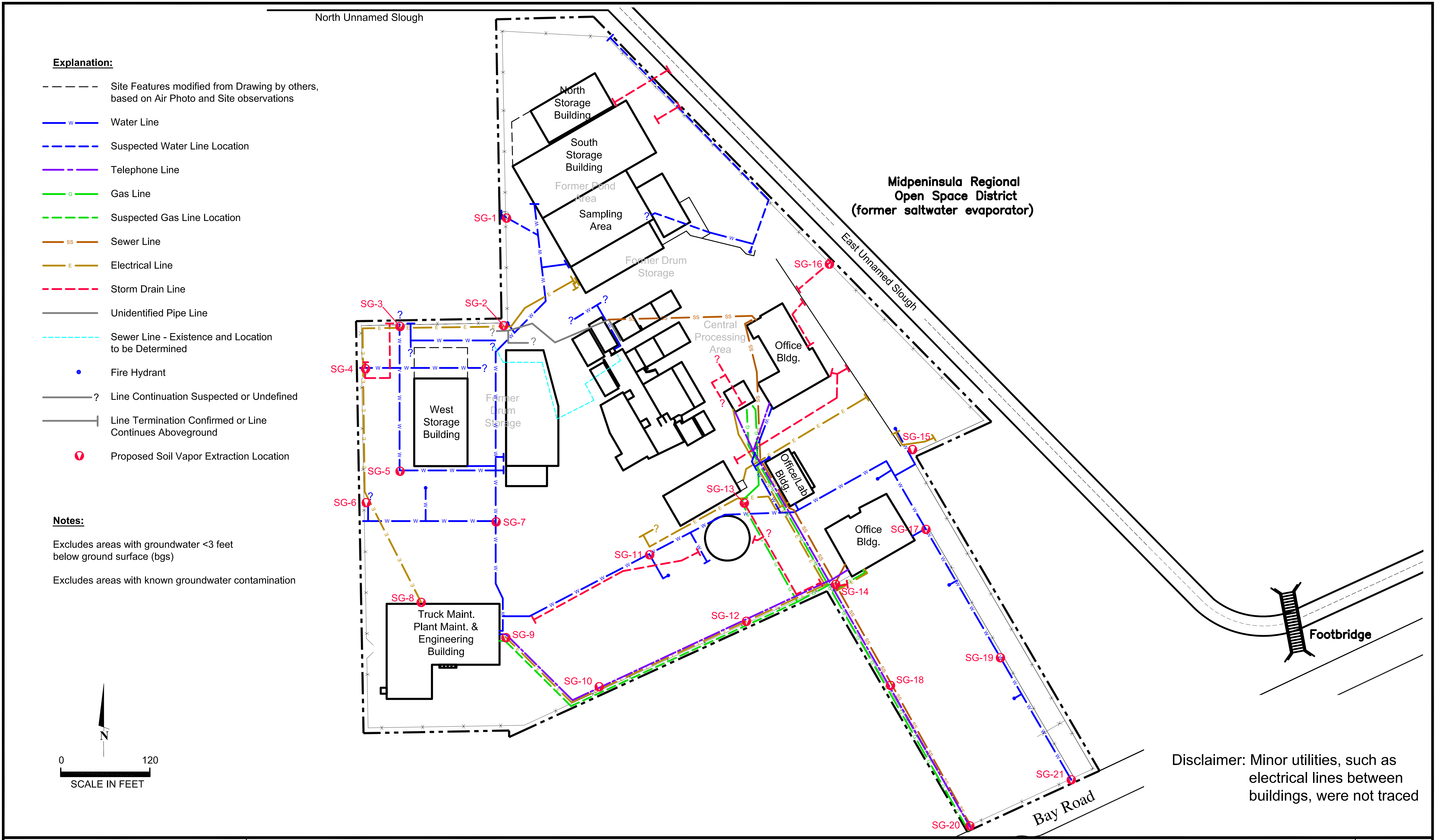

Notes:

Excludes areas with groundwater <3 feet below ground surface (bgs)

Excludes areas with known groundwater contamination

Disclaimer: Minor utilities, such as electrical lines between buildings, were not traced

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Proposed Soil Vapor Sample Locations Along Utility Corridors
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
Palo Alto, California

Figure
7

Drafter: EC

Date: 03/22/11

Contract Number: 07-555A

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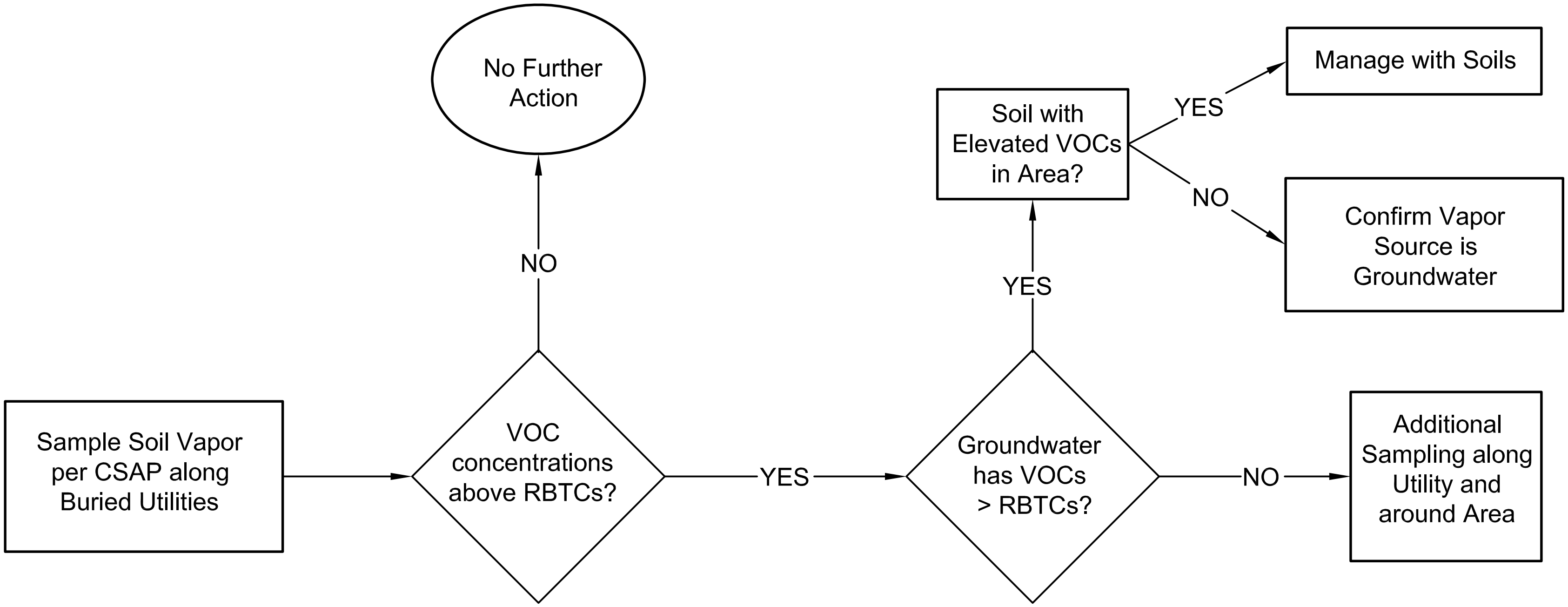

EXPLANATION:

RBTCs	Risk Based Threshold Concentrations
VOCs	Volatile Organic Compound

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Utility Trench Soil Vapor Sampling Decision Tree
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
Palo Alto, California

Figure
8

Drafter: EC
Date: 03/22/11
Contract Number: 07-555A

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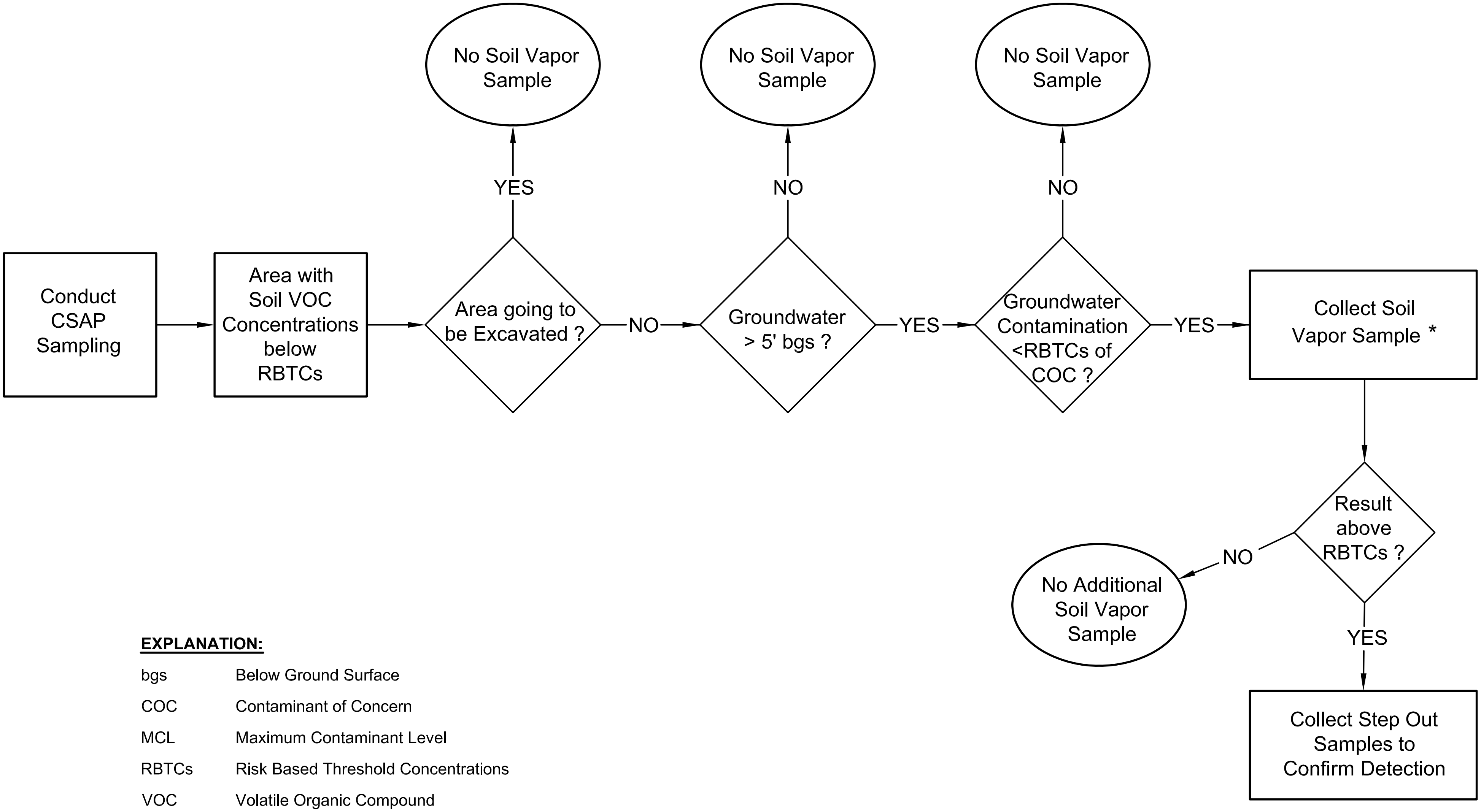

EXPLANATION:

bgs	Below Ground Surface
COC	Contaminant of Concern
MCL	Maximum Contaminant Level
RBTCs	Risk Based Threshold Concentrations
VOC	Volatile Organic Compound
*	Location and Quantity to be determined

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Non-Utility Trench Areas Soil Vapor Sampling Decision Tree
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
Palo Alto, California

Figure
9

Drafter: EC
Date: 03/22/11
Contract Number: 07-555A

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Appendices

FINAL DRAFT
COMPREHENSIVE SITE-WIDE SAMPLING AND ANALYSES PLAN
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Appendix A

Quality Assurance/Quality Control

Appendix A

Quality Assurance/Quality Control (QA/QC)

The quality assurance (QA) objectives of this Site-Wide Sampling and Analysis Plan are to outline procedures for the collection and assessment of data that are within acceptable ranges of precision, accuracy, representativeness, completeness, and comparability to meet the project data quality objectives (DQOs). The DQOs associated with environmental data are a function of the sampling plan rationale and procedures used to collect the samples, as well as the analytical methods and instrumentation used. However, uncertainty cannot be eliminated entirely from environmental data. Environmental measurements will be conducted throughout the course of the project to produce data that are scientifically valid, are of known and acceptable quality, that meet established project objectives, and that are legally defensible. Additionally in order to support the investigation it is necessary to provide proper documentation. Field documentation forms are presented in Appendix C. Standard operating procedures (SOPs) for field investigation activities are included in Appendix D.

Analytical Data Quality Objectives

Analytical data will be obtained using published standard methods such as SW–846. Analytical DQOs will be assessed through measures of parameters. These parameters are precision, accuracy, completeness, comparability, and representativeness.

Precision

Precision is a measure of reproducibility of analytical results. It can be defined as the degree of mutual agreement among individual measurements obtained under similar conditions. Total precision is a function of the variability associated with both sampling and analysis. Precision will be evaluated as the relative percent difference (RPD) between field duplicate sample results or between the matrix spike (MS) and matrix spike duplicate (MSD) results. Field duplicates will comprise 10 percent of the sampling effort. MS/MSD samples will be field-designated at a 5-percent frequency.

Precision is calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. Precision values will be compared to the approved control limits for specified analytes.

Accuracy

Accuracy is the degree of agreement between a measured value and the “true” or expected value. It represents an estimate of total error from a single measurement, including both, systematic error or bias, and random error that may reflect variability due to imprecision. Accuracy is evaluated in terms of percent recoveries determined from results of MS/MSD and laboratory control sample (LCS) analyses. Surrogate recoveries from samples analyzed for organic parameters are also used to assess accuracy.

Accuracy is calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. Accuracy values will be compared to the approved control limits for specified analytes.

Representativeness

Representativeness is the degree to which sample data accurately reflect the characteristics of a population of samples. Factors that can affect representativeness include site homogeneity, sample homogeneity at a single point, and available information around which the sampling program is designed. Using multiple methods to measure an analyte can also result in non-representativeness of sample data.

Representativeness shall be achieved through a well-designed sampling program and by using standardized sampling strategies and techniques and analytical procedures. Decisions regarding sample/well/boring locations and numbers and the statistical sampling design are documented in the CSAP.

The representativeness criterion is best satisfied in the laboratory by making certain that all subsamples taken from a given sample are representative of the sample as a whole. This would include sample homogenizing prior to and during aliquotting procedures. Samples requiring volatiles analysis should not undergo any premixing or homogenization. Representativeness can be assessed by a review of the precision obtained from the field and/or laboratory duplicate samples.

Completeness

Completeness is the amount of valid measurements compared to the total amount generated. It will be determined for each method, matrix, and analyte combination. The completeness goals of each project are optimized to meet the DQOs. The goals for this program are 90 percent for soil samples.

For completeness requirements, valid data are defined as usable data that meet the data quality objectives for the project (i.e., all results not qualified with a rejected “R” flag). The number of usable results determines the completeness of the data set. Iris Environmental shall review the validated data for usability and calculate completeness based on the usable data. It is the responsibility of Iris Environmental to review the appropriateness of the validation qualifiers based on DQOs presented in the Quality Assurance Project Plan (QAPP).

Comparability

Comparability is the confidence with which one data set can be compared to another. It is achieved by maintaining standard techniques and procedures for collecting and analyzing samples. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability.

Sample data should be comparable for similar samples and sample conditions. Comparability is unknown unless precision and bias are provided. When this information is available, the data sets can be compared with confidence.

The laboratory shall make the necessary provisions to ensure the comparability of all data. These procedures include, but are not limited to, the use of standard approved methodologies, the use of standard units and report format, the use of calculations as referenced in the methodology for quantitation, and the use of standard measures of accuracy and precision for QC samples.

Laboratory Quality Control Procedures

Laboratory QC checks indicate the state of control that prevailed at the time of sample analysis. QC checks that involve field samples, such as matrix and surrogate spikes and field duplicates, also provide an indication of the presence of matrix effects. Field-originated blanks provide a way to monitor for potential contamination to which field samples are subjected. The QAPP specifies requirements for method blanks, LCSs, surrogate spikes, and MS/MSDs that must be followed by laboratories participating in the data collection effort.

A laboratory QC batch is defined as a method blank, LCS, MS/MSD, or a sample duplicate depending upon the method, and 20 or fewer environmental samples of similar matrix that are extracted or analyzed together. For gas chromatography/mass spectrometry volatile analyses, a method blank, LCS, and MS/MSD must be analyzed in each 12 hour tune period. The number of environmental samples allowed in the laboratory QC batch is defined by the remaining time in the method prescribed 12 hour tune period divided by the analytical run time. Each preparation or analytical batch should be identified in such a way as to be able to associate environmental samples with the appropriate laboratory QC samples.

Method Blank

Blanks are used to monitor each preparation or analytical batch for interference and/or contamination from glassware, reagents, and other potential contaminant sources within the laboratory. A method blank is analyte-free matrix (laboratory reagent water for aqueous samples or Ottawa sand for soil samples) to which all reagents are added in the same amount or proportions of are added to samples. It is processed through the entire sample preparation and analytical procedures along with the samples in the batch. There should be at least one method blank per preparation or analytical batch. If a target analyte is found at a concentration that exceeds the reporting limit, corrective action must be performed to identify and eliminate the contamination source. All associated samples must be re-prepared and/or reanalyzed after the contamination source has been eliminated. No analytical data may be corrected for the concentration found in the blank.

Laboratory Control Sample

The LCS will consist of analyte-free matrix (laboratory reagent water for aqueous samples or Ottawa sand for soil samples) spiked with known amounts of analytes that come from a source different than that used for calibration standards. Target analytes specified in the QAPP will be spiked into the LCS. The spike levels should be less than or equal to the mid-point of the calibration range. If LCS results are outside the specified control limits, corrective action must be taken, including sample re-preparation and/or reanalysis, if appropriate. If more than one LCS is analyzed in a preparation or analytical batch, the results of all the LCSs must be reported. Any LCS recovery outside of QC limits affects the accuracy for the entire batch and requires corrective action.

Surrogates

Surrogates are organic analytes that behave similarly as the analytes of interest but are not expected to occur naturally in the samples. They are spiked into the standards and into the samples and QC samples prior to sample preparation. Recoveries of surrogates are used as an indicator of accuracy, method performance, and extraction efficiency. If surrogate recoveries are outside the specified control limits, corrective action must be taken, including sample re-preparation and/or reanalysis, if appropriate.

Matrix Spike/Matrix Spike Duplicate

A sample matrix fortified with known quantities of specific compounds is called an MS. It is subjected to the same preparation and analytical procedures as the native sample. Target analytes specified in the QAPP are spiked into the sample. MS recoveries are used to evaluate the effect of the sample matrix on the recovery of the analytes of interest. An MSD is a second fortified sample matrix. The RPD between the results of the duplicate MSs measures the precision of sample results. Only project-specific samples designated on the chain-of-custody form will be spiked. The spike levels will be less than or equal to the mid-point of the calibration range.

Equipment Blank

Equipment blanks, also sometimes referred to as rinsate blanks, are used to assess the effectiveness of the sampling equipment decontamination procedure. They are obtained immediately following sampling equipment decontamination by rinsing the decontaminated sampling equipment with deionized or ASTM Type II water. The rinse water is collected in sample bottles, preserved, handled, and analyzed in the same manner as the samples. Equipment rinsate blanks will be collected at a 5-percent frequency for each decontaminated equipment type or one per day for each decontaminated equipment type, whichever is more frequent.

Trip Blank

Trip blanks are used to monitor for contamination during sample shipping and handling and for cross-contamination through VOC migration among the collected samples. They are prepared in the laboratory by pouring laboratory-deionized water into a VOC sample container. They are then sealed, transported to the field, stay sealed while VOC samples are taken, and transported back to the laboratory in the same cooler as the VOC samples. One trip blank should accompany each VOC sample cooler.

Field Duplicates

A field duplicate is an independent sample collected as close as possible to the original sample from the same source under identical conditions; the field duplicate is used to evaluate sampling precision. The duplicates are collected simultaneously or in immediate succession and are treated in exactly the same manner during storage, shipment, and analysis. Field duplicates will be collected at a minimum frequency of 10 percent or one per sampling event, whichever is more frequent, for each matrix and for each type of analysis. The sampling locations for field samples will be recorded in the field logbook.

The field duplicates will be identified in a manner so that the laboratory does not recognize them as such.

Sample Collection and Quality Control

The quality of data collected in an environmental study is critically dependent upon the quality and thoroughness of field sampling activities. Because of the sensitivity of analytical methods and the levels of detection specified for contaminant analysis, the sampling process is vital to the integrity of data ultimately generated. Therefore, general field operations, practices, specific sample collection, and inventory procedures must be carefully planned and implemented. The following subsections discuss the implementation of these practices and procedures. In addition, field documentation forms used to support the investigation are presented in Appendix C. Standard operating procedures (SOPs) for field investigation activities are included in Appendix D.

Sample Identification

On-site measurements will be recorded on field investigation daily logs or data forms with identifying information (project number, station numbers, station location, date, time, and samplers), field observations, and remarks. All documentation will be maintained as project records by the project manager (PM).

Each sample must be identified by a unique code that identifies the sample station type, sample point, and sequential number. Each sample will be securely labeled with a plastic-coated self-adhesive label at the sampling site. These labels must be of a type that retains waterproof ink markings when wet. All labels will be completed in legibly printed lettering. Field QA/QC samples will be submitted blind to the laboratory.

Field Investigation Daily Report

Field personnel are responsible for the use and maintenance of field investigation daily reports when conducting project-related fieldwork. Field investigation daily reports provide a means for recording all data collection activities performed at a site. Entries must be as factual, detailed, and descriptive as possible so that a particular situation can be reconstructed without relying on the collector's memory. Field investigation daily reports will possess or be completed with consecutively numbered pages.

The first page of the daily report will contain the following information:

Project name and contract number;

Date;

Full name(s) of field staff onsite;

Subcontractors onsite (if any);

Equipment used onsite;

Visitors to the site (if any).

Entries in the daily report may contain a variety of information. At a minimum, entries must include the following information at the beginning of each day:

Start time;

Weather;

Level of personal protection being used on site.

In addition, the field logbook should include the following information as a minimum:

Detailed description of the station location;

Information on field QC samples (i.e., duplicates);

Observations about site and samples (odors, appearance, etc.);

Information about any miscellaneous events or circumstances that may affect the integrity of the samples (such as low-flying aircraft nearby, fossil-fueled motors in use nearby, painting activities upwind of sampling sites, etc.);

Calibration information for field equipment; and

Any other forms used during sampling.

All entries will be made in indelible black or blue ink; no erasures will be permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark and initialed by the originator. Entries will be organized into easily understandable tables if possible. Field investigation daily reports will be reviewed and approved by the PM.

Chain of Custody Procedures

Proper chain-of-custody and sample tracking methods will be used during sample collection. These methods include maintaining documentation necessary to trace sample possession, and the proper completion of standardized chain-of-custody forms used to accompany samples shipped to the analytical laboratory.

Field personnel (samplers) have custody of the physical evidence collected from the environment (samples). Samplers are responsible for documentation and tracking tasks when collecting samples designated for laboratory analysis or archiving. The samplers are responsible for the care and custody of the collected samples, and the proper and complete preparation of all sample labels and chain-of-custody forms related to the samples, until the samples are transferred or dispatched properly.

During an investigation, custody is maintained if an environmental sample is:

In one's actual physical possession or view;

In one's physical possession and has not been tampered with (i.e., under lock or official seal);

Retained in a secure area with restricted access; or

Placed in a container and secured with an official seal such that the sample cannot be accessed without breaking the seal.

A chain-of-custody form will be used as the sample custody and analyses specification document for all samples from the time of collection until laboratory analysis.

Equipment Calibration

An organic vapor monitor (OVM) photoionization detector will be used to monitor ambient air conditions, as described in the Health & Safety Plan (HSP). The OVM will be calibrated daily using calibration gas consisting of 100 parts per million (ppm) isobutylene, and the result of the calibration will be recorded on the field investigation daily reports.

Dust meters such as the MIE PDM-3 or PDR-1000 models to be used at the site will be factory calibrated and field zeroed according to the manufacturer’s instructions.

Data Quality Management

Data Handling Systems

This section describes the generation, review, and routing of field sampling and laboratory analysis data, and discusses the monitoring and controls established to track field and laboratory data through the following events:

- Field form completion;
- Field review and correction; and
- Storage and retrieval.

Data collection procedures and instructions included in this section and Appendix D provide the guidance necessary to complete the field forms and analytical sampling paperwork (Appendix C) involved with data collection activities.

Field Review and Correction

After field data and analytical sampling paperwork is completed, substantial effort must be made to ensure that the information recorded is accurate, complete, and legible. Data review and correction protocols have been established for both field- and office-specific data collection and processing. Technical personnel will document and review their own work, and are accountable for its correctness. The intent of the review is to ensure that all forms are complete, legible, and possess the required data elements.

Specific review considerations will be made for sample shipment paperwork.

Sample Shipment Paperwork

Before analytical samples are shipped from the field to the designated laboratory, chain-of-custody paperwork will undergo thorough QC checks. First, a check will be performed by field personnel after all chain-of-custody forms and labels have been completed. The reviewer will ensure that the following measures have been taken:

- All forms must be completed using a ballpoint pen. All sample labels must be completed with an indelible marker. Block lettering is strongly recommended.

- If an error is made on any form, the error should be struck with a single line and the correct value written close to the old value with the correction initialed and dated. The incorrect value should not be written over or obliterated in any way.

- If any sample shipment or paperwork error occurs, it is to be documented in the field investigation daily reports.

Analytical Data Review

Analytical data will be reviewed for the following (as applicable): holding times, surrogate recoveries, method blank analysis, and MS/MSD recoveries (expressed as accuracy, precision, and relative percent difference). These are as described in the following sections.

Data Reporting

Field measurements and observations will be recorded on standard data collection forms shown in Appendix C. Laboratory measurements will be recorded in standard formats that identify site location, sample identification, date, parameter, parameter value, and detection limit. Both laboratory and appropriate field data will be combined and summarized in final tables and graphs that are appropriate to the type of data, and convey information to support the findings, conclusions, and recommendations of the data collection program. In all cases, data will be clearly tabulated and presented in a consistent manner to facilitate data comparison.

Laboratory Reporting Limits

Laboratory reporting limits for media specific analytes are listed in Tables A1 through A3. All of the reporting limits are below the media cleanup objectives and RBTCs so the data produced in the investigation will be sufficient to meet the objectives of the CSAP and data quality objectives.

TABLE A1. RBTCs AND LABORATORY REPORTING LIMITS FOR SOIL

Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Compound Name	RBTC (mg/kg)	Reporting Limit [(1)] (mg/kg)
VOCs		
Acetone	49000	0.1
Benzene	0.013	0.005
2-Butanone	5300	NA
Carbon Disulfide	4.5	NA
Chlorobenzene	4.8	0.005
Chloroethane	77	0.005
Chloroform	0.0029	0.005
Chloromethane	0.73	NA
Cumene	31	NA
1,2-Dichlorobenzene	51	NA
1,4-Dichlorobenzene	0.05	NA
1,1-Dichloroethane	0.028	0.005
1,2-Dichloroethane	0.0088	0.005
1,1-Dichloroethene	0.9	NA
cis-1,2-Dichloroethene	11000	NA
trans-1,2-Dichloroethene	1.4	NA
Ethylbenzene	0.075	0.005
2-Hexanone	15	0.04
Methyl tert-butyl ether	1.2	NA
4-Methyl-2-pentanone	1600	0.04
Methylene Chloride	0.14	0.025
Styrene	190	0.005
1,1,2,2-Tetrachloroethane	0.021	0.005
Tetrachloroethene	0.0048	NA
Tetrahydrofuran	----	NA
Toluene	220	0.005
1,2,4-Trichlorobenzene	2.4	0.005
1,1,1-Trichloroethane	35	0.005
1,1,2-Trichloroethane	0.026	0.005
Trichloroethene	0.018	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	58	NA
1,2,4-Trimethylbenzene	0.85	0.005
1,3,5-Trimethylbenzene	11000	0.005
Vinyl Chloride	0.0025	0.005
Xylenes (total)	8.9	NA
Semi-Volatile Organic Compounds (SVOCs)		
Acenaphthylene	----	0.17
bis(2-Chloroethoxy)methane	2100	0.17
bis(2-Chloroethyl) ether	0.055	NA
bis(2-Ethylhexyl)phthalate	140	0.17
Butylbenzylphthalate	1000	NA
4-Chloroaniline	9.6	0.17
Dimethylphthalate	----	NA
Di-n-butylphthalate	68000	NA
Di-n-octylphthalate	----	NA

TABLE A1. RBTCs AND LABORATORY REPORTING LIMITS FOR SOIL

Former Romic Environmental Technologies Corporation Facility

2081 Bay Road

East Palo Alto, California

Compound Name	RBTC (mg/kg)	Reporting Limit [1] (mg/kg)
Fluoranthene	24000	0.17
Hexachlorobutadiene	25	0.17
Hexachlorocyclopentadiene	4100	0.17
Isophorone	2000	0.17
2-Methylnaphthalene	2400	0.17
2-Methylphenol	34000	0.17
4-Methylphenol	3400	NA
Naphthalene	0.35	0.17
Phenol	210000	0.67
Pesticides/Polychlorinated Biphenyls		
Total Polychlorinated Biphenyls	0.83	NA
Aroclor 1016	24	0.033
Aroclor 1254	0.83	0.033
Aldrin	0.11	0.0083
Chlordane	7.2	0.033
4,4'-DDD	8	0.0083
4,4'-DDE	5.6	0.0083
4,4'-DDT	7.8	0.0083
Dieldrin	0.12	0.0083
Endosulfan I	4100	NA
Endosulfan II	4100	NA
Endosulfan sulfate	4100	0.0083
Endrin	210	0.0083
Endrin aldehyde	210	0.0083
Heptachlor	0.43	0.0083
Heptachlor epoxide	0.21	0.0083
alpha-Hexachlorocyclohexane	0.3	NA
beta-Hexachlorocyclohexane	1.1	NA
delta-Hexachlorocyclohexane	----	NA
gamma-Hexachlorocyclohexane	2.3	NA
Methoxychlor	3400	0.0083
Toxaphene	1.7	0.033
Metals		
Antimony	450	2
Arsenic	1.8	2
Barium	210000	1
Beryllium	2200	1
Cadmium	890	1
Chromium (total)	----	NA
Chromium III	1700000 (2)	NA
Chromium VI	120	NA
Cobalt	340	1
Copper	45000	1
Lead (3,4)	320	NA
Mercury	0.0043	0.5
Molybdenum	5700	1

TABLE A1. RBTCs AND LABORATORY REPORTING LIMITS FOR SOIL
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Compound Name	RBTC (mg/kg)	Reporting Limit (1) (mg/kg)
Nickel	22000	1
Selenium	5700	2
Silver	5700	1
Thallium	----	2
Tin	680000	50
Vanadium	5700	1
Zinc	340000	2
Total Petroleum Hydrocarbons (TPH)		
TPH-Diesel	TBD	10
TPH-Gasoline	TBD	0.1
TPH-Residual (Oil and Grease)	TBD	NA

Notes

mg/kg = milligram per kilogram
RBTC = Risk-based target concentration, see Appendix B of CSAP.
TBD = TPH RBTCs will be determined after sampling is completed.
---- = RBTC was not calculated
NA = not available
(1) Reporting limit values from Accutest Laboratories, March 2011.
(2) Minimum soil RBTC is greater than one million parts per million.
(3) 2009 commercial/industrial CHHSL is used as the screening level for lead.
(4) California Environmental Protection Agency (Cal/EPA). 2009. *Revised California Human Health Screening Levels for Lead. Office of Environmental Health Hazard Assessment (OEHHA).* September.

TABLE A2. RBTCs, CLEANUP OBJECTIVES, AND LABORATORY REPORTING LIMITS FOR GROUNDWATER

Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Compound Name	RBTC	Cleanup Objective (1,2)	Reporting Limit (3)
	(mg/L)	(mg/L)	(mg/L)
VOCs			
Acetone	940000	NA	0.02
Benzene	1.3	0.001	0.001
2-Butanone	120000	NA	NA
Carbon Disulfide	1400	NA	NA
Chlorobenzene	250	0.05	0.001
Chloroethane	24000	0.012	0.001
Chloroform	0.5	0.07	0.001
Chloromethane	190	NA	NA
Cumene	1700	NA	NA
1,2-Dichlorobenzene	1200	0.01	NA
1,4-Dichlorobenzene	1.5	NA	NA
1,1-Dichloroethane	6.2	0.005	0.001
1,2-Dichloroethane	0.56	0.0005	0.001
1,1-Dichloroethene	340	0.006	NA
cis-1,2-Dichloroethene	----	0.006	NA
trans-1,2-Dichloroethene	230	0.01	NA
Ethylbenzene	4.7	0.03	0.001
2-Hexanone	490	NA	0.02
Methyl tert-butyl ether	84	NA	NA
4-Methyl-2-pentanone	52000	NA	0.02
Methylene Chloride	21	0.005	0.02
Styrene	5400	NA	0.001
1,1,2,2-Tetrachloroethane	0.55	NA	0.001
Tetrachloroethene	1.5	NA	NA
Tetrahydrofuran (4)	----	NA	NA
Toluene	20000	0.04	0.001
1,2,4-Trichlorobenzene	16	NA	0.005
1,1,1-Trichloroethane	14000	0.2	0.001
1,1,2-Trichloroethane	1.2	NA	0.001
Trichloroethene	4.8	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	8700	NA	NA
1,2,4-Trimethylbenzene (4)	35	NA	NA
1,3,5-Trimethylbenzene (4)	----	NA	NA
Vinyl Chloride	0.81	0.0005	0.001
Xylenes (total)	400	0.02	NA
Semi-Volatile Organic Compounds (SVOCs)			
Acenaphthylene	----	NA	0.015
bis(2-Chloroethoxy)methane	----	NA	0.015
bis(2-Chloroethyl) ether	0.88	NA	NA
bis(2-Ethylhexyl)phthalate	----	NA	0.01
Butylbenzylphthalate	----	NA	NA
4-Chloroaniline	----	NA	0.01
Dimethylphthalate	----	NA	NA
Di-n-butylphthalate	----	NA	NA

TABLE A2. RBTCs, CLEANUP OBJECTIVES, AND LABORATORY REPORTING LIMITS FOR GROUNDWATER
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Compound Name	RBTC	Cleanup Objective (1,2)	Reporting Limit (3)
	(mg/L)	(mg/L)	(mg/L)
Di-n-octylphthalate	----	NA	NA
Fluoranthene	----	NA	0.01
Hexachlorobutadiene	----	NA	0.02
Hexachlorocyclopentadiene	----	NA	0.01
Isophorone	----	NA	0.015
2-Methylnaphthalene	----	NA	0.01
2-Methylphenol	----	NA	0.01
4-Methylphenol	----	NA	NA
Naphthalene	0.88	NA	0.01
Phenol	----	NA	0.01
Pesticides/Polychlorinated Biphenyls			
Total Polychlorinated Biphenyls	----	NA	NA
Aroclor 1016	----	NA	0.0001
Aroclor 1254	----	NA	0.0001
Aldrin	----	NA	0.000025
Chlordane	----	NA	0.0002
4,4'-DDD	----	NA	0.000025
4,4'-DDE	----	NA	0.000025
4,4'-DDT	----	NA	0.000025
Dieldrin	----	NA	0.000025
Endosulfan I	----	NA	NA
Endosulfan II	----	NA	NA
Endosulfan sulfate	----	NA	0.000025
Endrin	----	NA	0.000025
Endrin aldehyde	----	NA	0.000025
Heptachlor	----	NA	0.000025
Heptachlor epoxide	----	NA	0.000025
alpha-Hexachlorocyclohexane	----	NA	NA
beta-Hexachlorocyclohexane	----	NA	NA
delta-Hexachlorocyclohexane	----	NA	NA
gamma-Hexachlorocyclohexane	----	NA	NA
Methoxychlor	----	NA	0.000025
Toxaphene	----	NA	0.0002
Metals			
Antimony	----	NA	0.03
Arsenic	----	NA	0.03
Barium	----	NA	0.1
Beryllium	----	NA	0.005
Cadmium	----	NA	0.002
Chromium (total)	----	NA	NA
Chromium III	----	NA	NA
Chromium VI	----	NA	NA
Cobalt	----	NA	0.005
Copper	----	NA	0.005
Lead (5)	----	NA	NA

TABLE A2. RBTCs, CLEANUP OBJECTIVES, AND LABORATORY REPORTING LIMITS FOR GROUNDWATER

Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Compound Name	RBTC	Cleanup Objective (1,2)	Reporting Limit (3)
	(mg/L)	(mg/L)	(mg/L)
Mercury	----	NA	0.0002
Molybdenum	----	NA	0.005
Nickel	----	NA	0.005
Selenium	----	NA	0.03
Silver	----	NA	0.005
Thallium	----	NA	0.03
Tin	----	NA	0.05
Vanadium	----	NA	0.005
Zinc	----	NA	0.01
Total Petroleum Hydrocarbons (TPH)			
TPH-Diesel	TBD	NA	0.1
TPH-Gasoline	TBD	NA	0.05
TPH-Residual (Oil and Grease)	TBD	NA	NA

Notes

mg/L = milligram per Liter
RBTC = Risk-based target concentration, see Appendix B of CSAP.
TBD = TPH RBTCs will be determined after sampling is completed.
---- = RBTC was not calculated
NA = not available

(1) From "USEPA Final Remedy Decision for Former Romic Environmental Technologies Corporation Facility, East Palo Alto, July 2008" and "Response to Public Comments on September 2007 Statement of Basis".
(2) "Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, California Regional Water Quality Control Board, San Francisco Bay, Interim Final, February 2005" (Environmental Screening
(3) Reporting limit values from Accutest Laboratories, March 2011.
(4) Groundwater Cleanup Objective from USEPA Preliminary Remediation Goals (PRGs)- October 2004.
(5) California Environmental Protection Agency (Cal/EPA). 2009. *Revised California Human Health Screening Levels for Lead. Office of Environmental Health Hazard Assessment (OEHHA).* September.

TABLE A3. RBTCs, CLEANUP OBJECTIVES, AND LABORATORY REPORTING LIMITS FOR SOIL VAPOR
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Compound Name	RBTC (1)	Indoor Air Vapor Intrusion Objective (2,3)	Reporting Limit (4)
	(mg/m^3)	(mg/m^3)	(mg/m^3)
VOCs			
Acetone	410000	NA	0.0048
Benzene	4.7	0.00025	0.1
2-Butanone	66000	NA	NA
Carbon Disulfide	9200	NA	0.0016
Chlorobenzene	660	0.062	0.0023
Chloroethane	130000	0.0023	0.1
Chloroform	1.6	0.000083	0.1
Chloromethane	1200	NA	0.0042
Cumene	5300	NA	0.0025
1,2-Dichlorobenzene	2600	0.21	0.003
1,4-Dichlorobenzene	3.3	NA	0.003
1,1-Dichloroethane	23	0.52	0.1
1,2-Dichloroethane	1.4	0.000074	0.1
1,1-Dichloroethene	2600	0.21	0.1
cis-1,2-Dichloroethene	----	0.037	0.1
trans-1,2-Dichloroethene	790	0.073	0.1
Ethylbenzene	15	1.1	0.1
2-Hexanone	390	NA	0.0083
Methyl tert-butyl ether	140	NA	0.0018
4-Methyl-2-pentanone	39000	NA	0.0021
Methylene Chloride	78	0.0041	0.1
Styrene	13000	NA	0.0022
1,1,2,2-Tetrachloroethane	0.63	NA	0.1
Tetrachloroethene	6.2	NA	0.1
Tetrahydrofuran	----	0.00099	0.0015
Toluene	66000	0.4	0.2
1,2,4-Trichlorobenzene	26	NA	0.015
1,1,1-Trichloroethane	66000	2.3	0.1
1,1,2-Trichloroethane	2.3	NA	0.1
Trichloroethene	18	NA	0.1
1,1,2-Trichloro-1,2,2-trifluoroethane	390000	NA	NA
1,2,4-Trimethylbenzene	92	0.0062	0.0025
1,3,5-Trimethylbenzene	----	0.0062	0.0025
Vinyl Chloride	8.4	0.00011	0.1
Xylenes (total)	1300	0.11	0.3
Semi-Volatile Organic Compounds (SVOCs)			
Acenaphthylene	----	NA	NA
bis(2-Chloroethoxy)methane	----	NA	NA
bis(2-Chloroethyl) ether	----	NA	NA
bis(2-Ethylhexyl)phthalate	----	NA	NA
Butylbenzylphthalate	----	NA	NA
4-Chloroaniline	----	NA	NA
Dimethylphthalate	----	NA	NA

TABLE A3. RBTCs, CLEANUP OBJECTIVES, AND LABORATORY REPORTING LIMITS FOR SOIL VAPOR
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Compound Name	RBTC [1]	Indoor Air Vapor Intrusion Objective [2,3]	Reporting Limit [4]
	(mg/m^3)	(mg/m^3)	(mg/m^3)
Di-n-butylphthalate	----	NA	NA
Di-n-octylphthalate	----	NA	NA
Fluoranthene	----	NA	NA
Hexachlorobutadiene	----	NA	0.022
Hexachlorocyclopentadiene	----	NA	NA
Isophorone	----	NA	NA
2-Methylnaphthalene	----	NA	NA
2-Methylphenol	----	NA	NA
4-Methylphenol	----	NA	NA
Naphthalene	1.1	NA	NA
Phenol	----	NA	NA
Pesticides/Polychlorinated Biphenyls			
Total Polychlorinated Biphenyls	----	NA	NA
Aroclor 1016	----	NA	NA
Aroclor 1254	----	NA	NA
Aldrin	----	NA	NA
Chlordane	----	NA	NA
4,4'-DDD	----	NA	NA
4,4'-DDE	----	NA	NA
4,4'-DDT	----	NA	NA
Dieldrin	----	NA	NA
Endosulfan I	----	NA	NA
Endosulfan II	----	NA	NA
Endosulfan sulfate	----	NA	NA
Endrin	----	NA	NA
Endrin aldehyde	----	NA	NA
Heptachlor	----	NA	NA
Heptachlor epoxide	----	NA	NA
alpha-Hexachlorocyclohexane	----	NA	NA
beta-Hexachlorocyclohexane	----	NA	NA
delta-Hexachlorocyclohexane	----	NA	NA
gamma-Hexachlorocyclohexane	----	NA	NA
Methoxychlor	----	NA	NA
Toxaphene	----	NA	NA
Metals			
Antimony	----	NA	NA
Arsenic	----	NA	NA
Barium	----	NA	NA
Beryllium	----	NA	NA
Cadmium	----	NA	NA
Chromium (total)	----	NA	NA
Chromium III	----	NA	NA
Chromium VI	----	NA	NA
Cobalt	----	NA	NA

TABLE A3. RBTCs, CLEANUP OBJECTIVES, AND LABORATORY REPORTING LIMITS FOR SOIL VAPOR
Former Romic Environmental Technologies Corporation Facility
2081 Bay Road
East Palo Alto, California

Compound Name	RBTC (1)	Indoor Air Vapor Intrusion Objective (2,3)	Reporting Limit (4)
	(mg/m^3)	(mg/m^3)	(mg/m^3)
Copper	----	NA	NA
Lead (5)	----	NA	NA
Mercury	----	NA	NA
Molybdenum	----	NA	NA
Nickel	----	NA	NA
Selenium	----	NA	NA
Silver	----	NA	NA
Thallium	----	NA	NA
Tin	----	NA	NA
Vanadium	----	NA	NA
Zinc	----	NA	NA
Total Petroleum Hydrocarbons (TPH)			
TPH-Diesel	TBD	NA	NA
TPH-Gasoline	TBD	NA	NA
TPH-Residual (Oil and Grease)	TBD	NA	NA

Notes

mg/m^3 = milligram per cubic meter
RBTC = Risk-based target concentration, see Appendix B of CSAP.
TBD = TPH RBTCs will be determined after sampling is completed.
---- = RBTC was not calculated
NA = not available

(1) Calculated for soil gas at a depth of five feet below ground surface (bgs). None of the minimum soil gas RBTCs are greater than the vapor pressure limit.

(2) From "USEPA Final Remedy Decision for Former Romic Environmental Technologies Corporation Facility, East Palo Alto, July 2008" and "Response to Public Comments on September 2007 Statement of Basis".

NOTE: OBJECTIVES ARE FOR INDOOR AIR SAMPLING, AND THUS NOT DIRECTLY COMPARABLE TO REPORTING LIMITS FOR SAMPLES COLLECTED IN SOIL.

(3) USEPA Preliminary Remediation Goals (PRGs)- October 2004.

(4) Reporting limit values from Air Toxics, Ltd and TEG Northern California, March 2011.

(5) California Environmental Protection Agency (Cal/EPA). 2009. *Revised California Human Health Screening Levels for Lead. Office of Environmental Health Hazard Assessment (OEHHA).* September.

Appendix B

Development of Risk Based Target Concentrations

DEVELOPMENT OF RISK-BASED TARGET CONCENTRATIONS

FORMER ROMIC ENVIRONMENTAL TECHNOLOGIES SITE
EAST PALO ALTO, CALIFORNIA

Prepared for:

Bay Enterprises
East Palo Alto, California

Prepared by:

ENVIRON International Corporation
Emeryville, California

March 29, 2011

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FIGURES

Figure 1 Conceptual Site Model (CSM)

ATTACHMENTS

1 Regional Water Quality Control Board – San Francisco Bay Region Environmental Screening Levels (ESLs) for Shallow Soil Gas for Vapor Intrusion Concerns

ACRONYMS

ASTM	American Society for Testing and Materials
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAG	Carcinogen Assessment Group
CalEPA	California Environmental Protection Agency
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
DTSC	Department of Toxic Substances Control
EPC	Exposure Point Concentration
ΔH	Enthalphy of Vaporization
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
IRIS	Integrated Risk Information System
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
OSWER	Office of Solid Waste and Emergency Response
PAH	Polyaromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PEF	Particulate Emission Factor
PRG	Preliminary Remediation Goal
PPRTV	Provisional Peer Reviewed Toxicity Values
RBTC	Risk-Based Target Concentration
RfC	Reference Concentration
RfD	Reference Dose
RME	Reasonable Maximum Exposure
RWQCB-SF	Regional Water Quality Control Board - San Francisco Bay Region
SVOC	Semi-Volatile Organic Compound
T_b	Boiling Point
T_c	Critical Temperature
TF	Transfer Factor
UCL	Upper Confidence Limit
VF	Volatilization Factor
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

<u>Units</u>

atm	atmosphere
cm	centimeter
g	gram
kg	kilogram
L	liter

ACRONYMS (continued)

m	meter
mg	milligram
µg	microgram
mol	mole
s	second

1.0 DEVELOPMENT OF RISK-BASED TARGET CONCENTRATIONS

Risk-based target concentrations (RBTCs) represent concentrations of chemicals that can remain in environmental media (e.g., groundwater, soil gas, or soil) and still be protective of human health for current and/or future land uses. Chemical concentrations detected in these media may be compared to the RBTCs in order to identify areas within a site requiring further investigation, remediation or mitigation.

The development of RBTCs for the protection of human health requires the same kinds of information and calculations used to develop risk estimates for a traditional risk assessment. One can estimate the potential risk associated with a measured concentration of a chemical in a given media (e.g., groundwater, soil gas or soil) or, alternatively one can calculate the concentration (i.e., RBTC) in that same media which would result in an acceptable cancer risk level or noncancer hazard index (HI). Average concentrations (i.e., 95 percent upper confidence limit (UCL) on the mean concentration) at or below the RBTCs would support the conclusion that the human health risks within an exposure area (e.g., commercial lot) are within acceptable limits.

The methodology used to develop RBTCs for the former Romic East Palo Alto Site ("Site") is consistent with the following United States Environmental Protection Agency (USEPA) risk assessment guidance:

- *Risk Assessment Guidance for Superfund. Volume I – Human Health Evaluation Manual (Part A)* (USEPA 1989a),

- *Risk Assessment Guidance for Superfund. Volume I – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)* (USEPA 1991a),

- *Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"* (USEPA 1991b),

- *Supplemental Guidance for Developing Soil Screening Levels for Superfund* (USEPA 2002),

- *Risk Assessment Guidance for Superfund. Volume I – Human Health Evaluation Manual (Part F,Supplemental Guidance for Inhalation Risk Assessment)* (USEPA 2009), and

- USEPA Region 9 Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites (USEPA November 2010).

In addition, other State agency guidance has been considered as follows:

- *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (CalEPA 1992),

- *Preliminary Endangerment Assessment Guidance Manual* (CalEPA 1994),

- *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Propertie*s (CalEPA 2005a, and
- *Screening for Environmental Concerns At Sites With Contaminated Soil and Groundwater* (RWQCB-SF 2008).

The following sections discuss the various components required for developing RBTCs in detail. Section 1.1 identifies the chemicals for which RBTCs were developed. Section 1.2 discusses the human populations that may potentially be exposed to chemicals in media at the Site and the pathways through which exposure may occur. Section 1.3 presents the exposure assumptions. Section 1.4 presents the fate and transport modeling used to predict the concentration of volatile chemicals and particulates in air. The toxicity of the chemicals evaluated is discussed in Section 1.5. Section 1.6 explains the methodology for calculation of RBTCs and presents the media and chemical-specific RBTCs. Uncertainties that may result from the various assumptions made in the development of the RBTCs are discussed in Section 1.7.

1.1 PRELIMINARY CHEMICALS OF POTENTIAL CONCERN

In this section, chemicals of preliminary potential concern (COPC) at the Site are identified. Groundwater, soil gas and soil RBTCs have been developed for this list of preliminary COPC. If new chemicals are detected during further Site investigations, RBTCs will be developed for these chemicals using the same methodology as presented in this report.

The preliminary COPC list includes all chemicals detected to date in Site soils. From past investigations, a total of 30 volatile organic compounds (VOCs), 19 semi-volatile organic compounds (SVOCs), and 14 metals) were detected in soil. Total petroleum hydrocarbons, which were also detected in soil, are being addressed separately and are not included in this report.

The preliminary COPC list also includes chemicals detected in more than five percent of all groundwater samples collected since September 2000 at the Site, according to the groundwater database received from ARCADIS (dated March 14, 2008). Based on the groundwater database, five VOCs that were not detected in soil were added to the COPC list: chloroethane, cumene, methyl tert butyl ether (MTBE), 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

Because additional sampling is planned at the Site, and these samples will be analyzed for pesticides, polychlorinated biphenyls (PCBs) and certain metals that were not analyzed in soils collected previously at the Site, soil RBTCs for these chemicals were also developed. The additional chemicals for which soil RBTCs were developed include: 19 pesticides; PCBs and Aroclors; and the metals, beryllium, molybdenum, selenium, and thallium.

The list of preliminary COPC for which RBTCs were developed is shown in Table 1.

1.2 POTENTIAL POPULATIONS AND EXPOSURE PATHWAYS

In order to develop RBTCs, the first step is to identify potentially exposed populations. Once they have been identified, the complete exposure pathways by which individuals in each of these potentially exposed populations may contact chemicals present in the environmental media at a site are determined. An exposure pathway is defined as "the course a chemical or pollutant takes from the source to the organism exposed" (USEPA 1988). An exposure route is "the way a chemical or pollutant enters an organism after contact" (USEPA 1988). A complete exposure pathway requires the following four key elements:

- Chemical source,
- Migration route (i.e., environmental transport),
- An exposure point for contact (e.g., groundwater, soil, air), and
- Human exposure route (e.g., ingestion, dermal contact, inhalation).

An exposure pathway is not complete unless all four elements are present.

A conceptual site model (CSM) for potential exposure pathways is used to show the relationship between a chemical source, exposure pathway, and potential receptors at a site. The CSM identifies all potential or suspected chemical sources, potentially impacted media, and potential receptors. It also identifies the potential human exposure routes for contacting impacted media. These source-pathway-receptor relationships provide the basis for the quantitative exposure assessment. In fact, only those complete source-pathway-receptor relationships are included in the quantitative risk evaluation. The CSM for the Site is shown on Figure 1.

The rationale for the selection of potentially exposed populations is presented in Section 1.2.1, and for the relevant (i.e., complete) exposure pathways in Section 1.2.2.

1.2.1 Potentially Exposed Populations

The proposed land use for the Site is commercial/industrial. Based on this proposed future land use, populations that could potentially be exposed to chemicals remaining in groundwater, soil gas or soil include long-term commercial / industrial workers who may primarily work indoors (indoor commercial/industrial worker) or outdoors (outdoor commercial/industrial worker). Additional populations could include short-term construction/maintenance workers during redevelopment or other short-term maintenance activities.

1.2.2 Relevant Exposure Pathways

Based on the CSM, the potential exposure media would include groundwater, soil gas, and soil. Each of these media is discussed separately below.

1.2.2.1 Groundwater

The depth to groundwater at the Site ranges from approximately 3 to 8 feet below ground surface (bgs). Once the Site has been graded for future development, it is assumed that the average future depth-to-groundwater will be 8 feet bgs. Groundwater beneath the Site is not used as a municipal water source and it is not expected to be in the future. Since groundwater at the Site will not be used as a source of drinking water or irrigation water, this exposure pathway is not evaluated in this report.

Two potentially complete exposure routes exist for groundwater. The first is exposure to VOCs via the inhalation of chemicals that have migrated from groundwater through the soil column into indoor or ambient air. This exposure pathway will be quantified in this report. Only inhalation of VOCs in indoor air was modeled for the indoor commercial/industrial worker population, since outdoor concentrations of VOCs will be lower than indoor air concentrations due to higher mixing in the ambient environment. Inhalation of VOCs in ambient air was modeled for the outdoor commercial/industrial worker and construction/maintenance worker (under a trenching scenario).

The second potential exposure route is direct contact with groundwater. As direct contact with groundwater is expected to be limited (infrequent digging activities), and only under controlled scenarios (worker protection), RBTCs were not developed for this exposure pathway.

1.2.2.2 Soil Gas

On-site indoor commercial/industrial workers could potentially be exposed to compounds migrating from soil gas into indoor air via the inhalation pathway. Therefore, migration from soil gas to indoor air has been included in the calculation of the RBTCs for the indoor commercial/industrial worker. Similar to groundwater, inhalation of VOCs migrating from soil gas to ambient air has been modeled and included in the RBTC for the outdoor commercial/industrial worker and construction worker (under a trenching scenario).

1.2.2.3 Soil

Future on-site indoor commercial/industrial workers, outdoor commercial/industrial workers and construction/ maintenance workers could be exposed directly to chemicals remaining in surface soils. Potential routes of exposure would include incidental ingestion, dermal contact, and inhalation of windblown particulates. Inhalation of VOCs migrating from soil to ambient or indoor air has also been evaluated.

1.3 EXPOSURE ASSESSMENT

The purpose of the exposure assessment is to determine the degree of contact a person has with a chemical. In order to be protective of current and future populations, the exposure assessment relies on an upper-bound estimate of the theoretical intake for each of the potentially exposed human populations via each of the exposure routes. Estimates of human intake are a function of exposure parameters such as duration, frequency, and contact rates. This section provides the equations and assumptions used to develop the intake factors used in the calculation of the RBTCs.

1.3.1 Estimation of Intake

USEPA defines exposure as “the contact with a chemical or physical agent” and defines the magnitude of exposure as “the amount of an agent available at human exchange boundaries (i.e., lungs, gut, skin) during a specified time” (USEPA 1989a). This section presents the equations used to estimate chemical exposures or intakes. These estimates of intake will be combined with toxicity values (Section 1.5) to estimate RBTCs for each population of potential concern (Section 1.6).

The inhalation pathway was evaluated according to the USEPA Supplemental Guidance for Inhalation Risk Assessment (USEPA 2009). For the inhalation pathway, the intake factor is calculated using the following equation:

$$IF = \frac{CF \times (TF \text{ or } PEF) \times ET \times EF \times ED}{AT}$$

Where:

IF = Intake Factor (kg/m^3)

CF = Conversion Factor (days/hour)

TF = Transfer Factor for volatile chemicals, (mg/m^3)/(mg per liter [mg/L]) for groundwater or (mg/m^3)/(mg/m^3) for soil gas,

PEF = Particulate Emission Factor for windblown dust, (mg/m^3)/(mg/mg)

ET = Exposure Time (hours/day)

EF = Exposure Frequency (days/year)

ED = Exposure Duration (years)

AT = Averaging Time; period over which exposure is averaged (days)

For the incidental ingestion and dermal contact pathways, intake factors are calculated using the following generalized equation:

$$IF = \frac{CR \times EF \times ED}{BW \times AT}$$

Where:

IF = Intake Factor of a environmental medium (kilogram [kg] soil/kg body weight-day),
CR = Contact Rate; the amount of medium contacted per unit time (e.g., milligram [mg] soil/day),
EF = Exposure Frequency (days/year),
ED = Exposure Duration (years),
BW = Body Weight (kg), and
AT = Averaging Time; period over which exposure is averaged (days).

In the above equation, the transfer factor, or TF, is the ratio of the concentration in air to the concentration in the source medium (e.g., groundwater or soil gas). The attenuation factor, α, is the ratio of the concentration in air to the concentration in the soil gas source. Therefore, for soil gas, the attenuation factor is equal to the TF. For groundwater, the source vapor concentration is estimated by multiplying groundwater concentration and the dimensionless Henry’s Law constant at a defined temperature.

Tables 2 and 3 present the route-specific equations used in this report to derive the groundwater, soil gas and soil RBTCs. The equations for exposure via inhalation of vapors and soil particulates are presented in Table 2, and incidental ingestion of and dermal contact with soil in Table 3. Exposure assumptions used to estimate intake factors for the potential populations of concern are summarized in Table 4 and discussed below.

1.3.2 Exposure Assumptions

Assumptions for route-specific exposure parameters used to estimate intakes can be separated into the following three categories:

- Assumptions regarding human physiology (e.g., body weight and breathing rate),
- Assumptions specific to the potentially exposed population (e.g., years in which an individual works at the same location), and
- Assumptions specific to the given route of exposure (e.g., amount of soil contacted each day).

For the development of the RBTCs, exposure assumptions corresponding to a reasonable maximum exposure (RME) scenario were developed. Intake assumptions for the RME scenario represent “the highest exposure that is reasonably expected to occur at the site” (USEPA 1989a). According to the USEPA, the intent of the RME scenario is “to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures” (USEPA 1989a). The RME is estimated by combining “upper-bound and mid-range exposure factors so that the results represent an exposure scenario that is both protective and reasonable; not the worst possible case” (USEPA 1989a).

Where available and appropriate, exposure parameter values recommended by the USEPA (USEPA 1989a, 1991a, 2002, 2010) and CalEPA (CalEPA 1992, 1994, 2005a) were used. For some exposure parameters, neither USEPA nor CalEPA have recommended values. In such cases, best professional judgment was used by ENVIRON to select parameter values corresponding to the individual pathways and is so noted. The three categories of exposure assumptions are further discussed below.

1.3.2.1 Human Physiological Assumptions

For estimating potential exposures to indoor commercial/industrial workers, outdoor commercial/industrial workers and construction/maintenance workers, the physiological assumptions for a male adult were used as recommended by USEPA (1991a, 2002, 2010) and CalEPA (1992). The physiological assumptions used in this report include an adult body weight of 70 kg.

1.3.2.2 Population-Specific Assumptions

Assumptions regarding population-specific exposure frequency, exposure duration, and exposure averaging time are used to determine the pathway-specific chemical intakes for the potentially exposed populations. Exposure frequency and exposure duration determine the total time of exposure for each population. The standard assumptions regarding exposure duration and exposure frequency for indoor commercial/industrial workers and outdoor commercial/industrial workers used in this analysis are those recommended by the USEPA (1989, 1991a, 2002, 2010) and CalEPA (1992).

Commercial/industrial workers are assumed to be exposed for eight hours/day for all pathways (USEPA 1991b, 2010). For indoor and outdoor commercial/industrial workers, exposure frequencies of 225 and 250 days/year are assumed, respectively (USEPA 2002). For the construction/maintenance worker, an exposure frequency of 60 days/year is assumed. This corresponds to an exposure of five days/week for 12 weeks/year (or approximately three months). This assumption is based on professional judgment taking into account the small size of the Site (<15 acres). This is likely a very conservative assumption for an excavation/trenching scenario. An exposure duration of one year is assumed for the construction worker involved in short-term work, while 25 years is assumed for the indoor and outdoor commercial/industrial workers (USEPA 2002, 2010).

It should be noted that the averaging time selected for estimating chemical intake for a particular exposed population depends on the type of effect being assessed. In accordance with regulatory guidance, intakes for carcinogens are calculated by averaging the dose received over a lifetime (i.e., 70 years or 25,550 days). As indicated in regulatory guidance for noncarcinogens, the averaging time used is the period of exposure expressed in days. The basis for the use of different averaging times for carcinogens and noncarcinogens is related to the currently held scientific opinion that the mechanisms of action for the two categories of chemicals are different (see section 1.5).

1.3.2.3 Route-Specific Assumptions

Potential routes of exposure include incidental ingestion of soil, dermal contact with soil, inhalation of windblown particulates, and inhalation of chemicals that volatilize to indoor or ambient air. The route-specific assumptions used to characterize the intake for each population and exposure pathway are presented below.

For indoor and outdoor commercial/industrial workers, the recommended soil ingestion rates are 50 mg/day and 100 mg/day, respectively (USEPA 2002). For a short-term construction worker, the recommended incidental soil ingestion rate is 330 mg/day (USEPA 2002), and this ingestion rate was assumed for the construction/maintenance worker.

Exposure via dermal contact may result from the deposition of soil particles onto skin and the subsequent absorption of chemicals present in the deposited soil through the skin. For outdoor commercial/industrial workers and construction/maintenance workers, the total surface area exposed to soil contact was assumed to consist of the face, hands, and forearms (USEPA 2002, 2010). The total exposed surface area of these body parts is 3,300 square centimeters (cm^2). A dermal adherence factor of 0.2 mg/cm^2 and 0.3 mg/cm^2 was assumed for the outdoor commercial/industrial worker and the construction/maintenance worker, respectively (USEPA 2002). Consistent with USEPA guidance (2002), the indoor worker is assumed to have little or no direct contact with outdoor soils and potential for ingestion of soil is assumed to occur only through ingestion of soil tracked in from the outside.

The fraction of a chemical present in soil adhered to the skin that is absorbed into the body is a function of the physical and chemical properties of the chemical. Chemical-specific dermal absorption fractions from soil were assigned to each COPC, consistent with USEPA (2004b), and are presented in Table 5.

1.3.3 Quantification of Exposure

Intake factors are presented in Table 6 for each pathway for both carcinogenic and noncarcinogenic effects. The values presented in the tables were calculated using the equations given in Tables 2 and 3, without including the chemical specific factors. For exposures via inhalation of vapors, each value in Table 6 multiplied times the TF represents the intake factor for that chemical. For exposures via dermal absorption, each value in Table 6 multiplied times the chemical-specific dermal absorption factor (Table 5) represents the intake factor for that chemical. TFs are discussed in Section 1.4 below.

1.4 FATE AND TRANSPORT MODELING

This section describes the approach used to estimate intermedia TFs needed to evaluate potential exposure through the inhalation route. Chemicals detected in groundwater and soil can potentially migrate in a vapor phase through the unsaturated zone to indoor or ambient air. This migration will be quantified for the purposes of this report through an intermedia TF.

For the development of the RBTCs, the following TFs are required:

- Groundwater to indoor air,
- Groundwater to outdoor ambient air,
- Groundwater to construction trench ambient air,
- Soil gas to indoor air,
- Soil gas to outdoor ambient air,
- Soil gas to construction trench ambient air,
- Soil to indoor air,
- Soil to outdoor ambient air, and
- Soil to construction trench ambient air.

At the request of the oversight agencies for this project, a default screening TF (or attenuation factor) was used for the evaluation of soil gas into indoor air. The attenuation factor of 3000 was recommended by the agencies based on inherent uncertainties in the Johnson and Ettinger model for vapor migration. For soil gas into ambient air and for groundwater, intermedia TFs were estimated using the screening-level model of vapor migration described by Johnson and Ettinger (1991). Specifically, Version 3.1 of the spreadsheet implementation developed by the USEPA was used (USEPA 2004a). The Johnson and Ettinger model was originally developed to predict vapor migration into buildings. However, as described below, it is easily adapted to predict vapor migration into ambient and trench air.

The Johnson and Ettinger model and its variants couple the following fate and transport processes:

- Source zone partitioning to determine source vapor concentration,
- Transport across the vadose zone by diffusion,
- Transport by diffusion and advection across the soil surface and, if present, a surface barrier such as asphalt or building foundation, and
- Dispersion in indoor or ambient air.

The first process in the above list, source zone partitioning, determines the vapor concentration of the chemical at the source. The last three processes, when considered together, describe the attenuation of the source soil vapor concentration as it migrates to indoor or ambient air. In the context of the Johnson and Ettinger model, the combined effect of these three attenuation processes is typically referred to as α, the soil vapor attenuation coefficient. In the model, α is a value equal to or less than one. Intermedia TFs, as used in this report, include the effect of source zone partitioning as well as the three attenuation processes. Therefore, the TF is simply the product of the appropriate partition coefficient and the vapor attenuation coefficient. No partitioning is required for a soil gas source, so soil gas TFs have a partition coefficient of one.

ENVIRON used the Jury Model (USEPA 2002) to estimate soil-to-ambient air transfer factors. The model is based on the Jury et al. (1984) analytical solution for the vapor flux from the soil surface of a chemical that is present in soil from the soil surface down to an infinite depth. This conservative model is based on the following assumptions: transport by vapor phase diffusion, instantaneous linear equilibrium adsorption, uniform soil properties, linear equilibrium liquid-vapor partitioning (Henry’s Law), no water evaporation or leaching, no stagnant air layer at the soil surface, and no chemical reactions, biodegradation, or photolysis. Soil to indoor air transfer factors were calculated by combining the default screening TF for soil gas to indoor air (as discussed above) with the equilibrium partitioning from soil to soil gas.

The calculation of TFs is based on parameters describing the properties of the chemicals evaluated, the vadose zone, the surface barrier, and the air dispersion zone. The physical-chemical properties are shown in Table 7. Based on guidance from USEPA (1991a), only chemicals that easily volatilize are included in the evaluation of indoor and ambient air. These include chemicals with a Henry’s Law constant of greater than 1×10^{-5} atmosphere-cubic meter per mole (atm-m^3/mol) and a molecular weight of less than 200 grams/mole (g/mol) (USEPA 2004a; Yaws and Yang 1992). For certain chemicals (2-hexanone, tetrahydrofuran, and acenaphthylene), the boiling point (T_b), critical temperature (T_c) and/or the enthalpy of vaporization (ΔH) were not located. For these chemicals, the Henry's law was not corrected for temperature in the model.

Vadose zone soil parameters, which are used to calculate the effective diffusion coefficients, are shown in Table 8. These parameter values were estimated based on soil boring logs from the geologic investigations conducted on the Site. For the groundwater and soil gas models, sandy clay was assumed to be present from the ground surface to the water table[1]. Default values given by USEPA (2004b) were used for bulk density and porosity of sandy clay soil. Water-filled porosity was defined as the average of the default values of saturated water content and the residual water content based on the soil type.

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[1] The RBTCs calculated in this report, reflect the site-specific soil parameters. As noted in the main text, soil gas samples collected from non-native fill surrounding utilities/pipelines will be evaluated separately using standard agency default screening levels.

With the exception of the migration from soil gas to indoor air, all TFs were calculated using the physical-chemical properties and vadose zone parameters given in Tables 7 and 8. Although the soil parameters remain the same, calculation of TFs for each receptor population is based on different assumptions regarding the following:

- Depth to chemical source (groundwater or soil gas),
- Surface cover (building foundation or no cover), and
- Air dispersion zone dimensions and mixing rates.

The different assumptions for each receptor population are described in the following sections.

1.4.1 Migration from Groundwater to Indoor Air

The receptor population for this scenario is an indoor commercial/industrial worker inside a one-story concrete slab-on-grade building. The depth-to-groundwater for this scenario is estimated to be 8 feet bgs, the assumed future average at the Site.

In addition to depth-to-groundwater, the parameters needed to estimate migration and mixing of indoor air are those describing the foundation and those describing the dimensions of the building. All parameter values for indoor air modeling are shown in Table 8. The air exchange rate chosen is the American Society for Testing and Materials (ASTM) commercial default value of 1.0 air changes per hour (CalEPA 2005). The building is assumed to be 10 meters (32.8 feet) wide by 10 meters long (USEPA 2004a), and the mixing height was assumed to be 10 feet (CalEPA 2005).

The estimated groundwater-to-air TFs and attenuation factors are presented in Table 9.

1.4.2 Migration from Groundwater to Ambient Air

Migration from groundwater to ambient air is estimated using a conceptual model similar to the indoor air model but with two main differences. First, there is assumed to be no barrier to vapor flux at the ground surface (i.e., no building foundation). Second, dilution of vapors migrating into outdoor ambient air is assumed to be mixed over a breathing zone adjacent to the ground surface. All parameter values for ambient air are shown in Table 8.

An outdoor air dispersion factor (Q/C) from USEPA (1996) was used to describe vapor dispersion in outdoor ambient air. The Q/C terms were derived by averaging the results from a more complex dispersion model for a ground-level area source. The model was run for a number of different size area sources, as well as for a number of different U.S. locations. The Q/C term selected (45.82 gram [g]/m^2-s [second] per kg/m^3) was from the model run for a 30-acre area source in San Francisco. This size and location are the closest to the Site.

The estimated groundwater-to-air TFs and attenuation factors are presented in Table 9.

1.4.3 Migration from Groundwater to Construction Trench Ambient Air

The receptor population exposed to trench ambient air is assumed to be a construction/ maintenance worker during redevelopment or other short-term maintenance activities. For a construction/maintenance worker located in a five-foot deep trench, the receptor would be five feet closer to groundwater. Migration of chemical vapors from groundwater to the trench ambient air is handled the same as the outdoor ambient air scenario, except that the depth-to-groundwater is assumed to be 3 feet for the trench model. The parameter values used for modeling the trench are shown in Table 8.

At the request of the oversight agencies for this project, the outdoor dispersion factor assumed in the trench model is based off a box model. The inputs for this model are presented in Table 8 and include the dimensions of the assumed trench along with 1/10th of the local average windspeed.

The estimated groundwater-to-air TFs and attenuation factors are presented in Table 9.

1.4.4 Migration from Soil Gas to Indoor Air

At the request of the oversight agencies for this project, a generic attenuation factor of 3000 (equivalent to a transfer factor of 3.33 x 10^{-4} (mg/m^3)/(mg/m^3) was applied to all COPCs for the evaluation of commercial worker exposure to indoor air and development of RBTCs for soil gas at five feet bgs.

For the screening of preferential pathways through presumably porous utility backfill materials (e.g., sewer pipe trench backfill), VOCs detected in soil gas will be compared to the RWQCB-SF Environmental Screening Levels (ESLs) under an industrial land use scenario. The applicable ESL table is included in Attachment I.

1.4.5 Migration from Soil Gas to Ambient Air

For the soil gas to ambient air, the depth-to-source was assumed to be at five feet bgs representing the depth of soil gas probes used to evaluate in-situ soil gas concentrations. Beside the depth-to-source, all other modeling parameters used were the same as for the groundwater to indoor and ambient air scenarios. See Table 8.

An outdoor air dispersion factor (Q/C) from USEPA (1996) was used to describe vapor dispersion in outdoor ambient air. The Q/C terms were derived by averaging the results from a more complex dispersion model for a ground-level area source. The model was run for a number of different size area sources, as well as for a number of different U.S. locations. The Q/C term selected (45.82 gram [g]/m^2-s [second] per kg/m^3) was from the model run for a 30-acre area source in San Francisco. This size and location are the closest to the Site.

The estimated soil gas-to-air TFs are presented in Table 10a.

1.4.6 Migration from Soil Gas to Construction Trench Ambient Air

Migration of chemical vapors from soil gas to the trench ambient air is handled the same as the outdoor ambient air scenario, except for the outdoor dispersion factor. At the request of the oversight agencies for this project, the outdoor dispersion factor assumed in the trench model is based off a box model. The inputs for this model include the dimensions of the assumed trench along with 1/10th of the local average windspeed. The parameter values used for modeling the trench are shown in Table 8.

The estimated soil gas-to-air TFs and attenuation factors are presented in Table 10a.

1.4.7 Migration from Soil to Indoor Air

At the request of the oversight agencies for this project, a generic soil gas attenuation factor of 3000 (equivalent to a transfer factor of 3.33×10^{-4} (mg/m^3)/(mg/m^3) was combined with a soil-to-soil gas partition coefficient for all COPCs for the evaluation of commercial worker exposure to indoor air and development of RBTCs for.

1.4.8 Migration from Soil to Ambient Air

As discussed in the introduction to Section 1.4, the Jury Model is used to estimate soil-to-air transfer factors, as recommended by USEPA (2002). Parameters used in the Jury Model are listed in Table 8. The same soil parameters for sandy clay soil and Q/C factor was used in the Jury Model as for the Johnson and Ettinger model. The default soil organic carbon fraction of 0.002 (USEPA 2004a) was also applied.

The estimated soil-to-ambient air transfer factors are presented in Table 10b.

1.4.9 Migration from Soil to Construction Trench Ambient Air

Migration of chemical vapors from soil to the trench ambient air is handled the same as the outdoor ambient air scenario, except for the outdoor dispersion factor. At the request of the oversight agencies for this project, the outdoor dispersion factor assumed in the trench model is based off a box model. The inputs for this model include the dimensions of the assumed trench along with 1/10th of the local average windspeed. The parameter values used for modeling the trench are shown in Table 8.

The estimated soil-to-air TFs and attenuation factors are presented in Table 10b.

1.4.10 Windblown Dust

It is assumed that outdoor commercial/industrial workers may be exposed to airborne particulates on a daily basis under regular Site conditions. Based on USEPA screening guidelines (USEPA 2002), a particulate emission factor (PEF) of 1.316×10^9 m^3/kg was used to estimate airborne concentrations of a chemical from corresponding soil concentrations for all chemicals. This PEF reflects an airborne concentration of dust of approximately 0.76 micrograms [µg]/m^3. For construction/maintenance workers, a PEF of 1.44×10^6 m^3/kg is used (RWQCB-SF 2007). This PEF reflects an airborne concentration of dust of approximately 700 µg/m^3.

As part of the estimation of the potential exposure via inhalation of windblown dust, it is assumed that the inhaled dust has the same chemical composition as the surface soil at the Site. This is thought to be a conservative assumption because not all of the dust in the air in the area will have originated from the area.

1.5 TOXICITY ASSESSMENT

The hierarchy of sources used for the toxicity factors is consistent with USEPA's recommended human health toxicity value hierarchy (2010). This hierarchy is as follows:

1. USEPA’s Integrated Risk Information System (IRIS)
2. The Provisional Peer Reviewed Toxicity Values (PPRTVs) derived by USEPA's Superfund Health Risk Technical Support Center (STSC) for the USEPA Superfund program
3. The Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels (MRLs)
4. The CalEPA Office of Environmental Health Hazard Assessment's (OEHHA’s) Chronic Reference Exposure Levels (RELS) from December 18, 2008 and the Cancer Potency Values from July 21, 2009
5. The USEPA Superfund program's Health Effects Assessment Summary

Cancer and noncancer toxicity values used in the development of the RBTCs are summarized in Table 11. Where available, the table also presents the chemical category presented in Table 2 of the USEPA (2009) guidance *“Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment.”* Consistent with USEPA guidance (2010), the RBTCs incorporate gastrointestinal absorption and do not assume route to route extrapolation.

Specific dermal route CSFs and RfDs have not yet been developed for any chemicals. Consistent with USEPA and CalEPA guidance, potential health effects associated with dermal exposure are calculated using the oral toxicity factors.

RBTCs were not developed for lead. Instead, lead detected at the Site may be compared to the Cal/EPA (2009) California Human Health Screening Level (CHHSL) of 320 mg/kg for lead in commercial/industrial soil.

1.6 CALCULATION OF RISK-BASED TARGET CONCENTRATIONS

Section 1.6.1 presents the methodology used to calculate the RBTCs. RBTCs for groundwater, soil gas and soil are presented in Section 1.6.2, and summarized in Tables 12 through 15.

1.6.1 Methodology

For carcinogenic chemicals, the equation used to calculate soil RBTCs due to exposure via the ingestion, dermal contact, and inhalation exposure pathways is as follows:

$$RBTC_{Carcinogen} = \frac{\text{Target Cancer Risk}}{[(CSF_{Inhal} \text{ x } IF_{Inhal}) + (CSF_{oral}(IF_{oral} + IF_{dermal})]}$$

Where:

CSF_{inhal} = Inhalation Cancer Slope Factor (mg chemical/kg body weight-day)$^{-1}$,
IF_{inhal} = Intake Factor for inhalation of particulates (kg soil/kg body weight-day),
CSF_{oral} = Oral Cancer Slope Factor (mg chemical/kg body weight-day)$^{-1}$,
IF_{oral} = Intake Factor for soil ingestion, (kg soil/kg body weight-day), and
IF_{dermal} = Intake Factor for dermal contact, (kg soil/kg body weight-day).

The equation used to calculate groundwater and soil gas RBTCs corresponding to potential exposure from the inhalation pathway is as follows:

$$RBTC_{Carcinogen} = \frac{\text{Target Cancer Risk}}{(URF_{Inhal} \text{ x } IF_{Inhal})}$$

Where:

URF_{inhal} = Inhalation Unit Risk Factor, (µg chemical/m^3)$^{-1}$, and
IF_{inhal} = Route-specific intake factor for inhalation of vapors (m^3 air/kg-day).

For noncarcinogens, the equation used to calculate soil RBTCs due to exposure via the ingestion, dermal contact, and inhalation exposure pathways is as follows:

$$RBTC_{Noncarcinogen} = \frac{\text{Target Hazard Index}}{\left[\frac{(IF_{Inhal})}{RfD_{Inhal}} + \frac{(IF_{oral} + IF_{dermal})}{RfD_{oral}}\right]}$$

Where:

IF_{Inhal} = Intake Factor for inhalation of particulates (kg soil/kg body weight-day),
RfD_{Inhal} = Inhalation Reference Dose (mg chemical/kg body weight-day),
IF_{oral} = Intake Factor for soil ingestion, (kg soil/kg body weight-day),
RfD_{oral} = Oral Reference Dose (mg chemical/kg body weight-day), and
IF_{dermal} = Intake Factor for dermal contact, (kg soil/kg body weight-day).

The equation used to calculate groundwater and soil gas RBTCs due to potential exposure via the inhalation pathway is as follows:

$$\mathrm{RBTC}_{\mathrm{Noncarcinogen}} = \frac{\text{Target Hazard Index}}{\left[\dfrac{\mathrm{IF}_{\mathrm{Inhal}}}{\mathrm{RfD}_{\mathrm{Inhal}}}\right]}$$

Where:

$\mathrm{IF}_{\mathrm{Inhal}}$ = Route-specific intake factor for inhalation of vapors (m^3 air/kg-body weight-day), and

$\mathrm{RfD}_{\mathrm{Inhal}}$ = Inhalation Reference Dose (mg chemical/kg body weight-day).

Route-specific intake factors (i.e., oral, inhalation, or dermal contact) were calculated based on the assumptions and equations presented in Section 1.3. CSFs and RfDs used in the calculations were presented in Section 1.5. The calculated intake factors for carcinogens and noncarcinogens are presented in Table 6.

The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] §300) is commonly cited as the basis for target risk and hazard levels. According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one in a million (1×10^{-6}) to one hundred in a million (1×10^{-4}), and noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., HI greater than one). As a risk management policy, the CalEPA generally considers 1×10^{-6} to be a point of departure for purposes of making risk management decisions, with most approved remediation achieving incremental risk levels of 10 in one million (1×10^{-5}) or lower.

For this report, the calculated RBTCs correspond to a cancer risk of 1×10^{-6}. For noncancer health hazards, a target HI of one is identified. Individual chemical exposures that yield HIs of less than one are not expected to result in adverse, noncancer health effects (USEPA 1989a).

1.6.2 Target Concentrations

Groundwater RBTCs were calculated for all chemicals identified in Table 1 that are considered to be volatile for the indoor commercial/industrial worker, outdoor commercial/industrial worker and construction/maintenance worker scenarios. Soil gas RBTCs were calculated for all VOCs listed in Table 1. The groundwater and soil gas RBTCs for each population are summarized in Tables 12 and 13, respectively.

Soil RBTCs were calculated for all chemicals identified in Table 1 for the indoor commercial/industrial worker, outdoor commercial/industrial worker and construction/maintenance worker scenarios. The soil RBTC for each population is summarized in Table 14.

Table 15 shows the minimum groundwater, soil gas, and soil RBTCs for all chemicals for the indoor and outdoor workers. The receptor with the lowest RBTC for each chemical in each medium is also noted in Table 15. As noted earlier in this report, RBTCs for any additional chemicals identified at the Site during future investigations will be developed using the same methodology as presented here.

As shown on Table 14, in some cases, the lowest RBTC is for the construction/maintenance worker. This is due to a very conservative soil ingestion rate (330 mg/day) and high dust concentration (700 $\mu g/m^3$) assumed for the calculation of the construction worker RBTC. The calculation of the RBTC assumes no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and eight hours exposure per day. As this is not representative of typical worker conditions during construction on large redevelopment properties, the most appropriate RBTCs for the Site would be those for the commercial/industrial workers. The construction worker RBTCs can be used in identifying the appropriate personal protection equipment needed for site-specific construction/maintenance activities.

1.7 UNCERTAINTIES

The process of developing RBTCs or estimating risk has inherent uncertainties associated with the calculations and assumptions used. The approach used in this report has been health protective whenever possible and tends to overestimate exposures, resulting in RBTCs that are likely to be lower (or risk estimates that are likely to be higher) than what may be required to be protective of human health. A discussion of the key uncertainties used in the development of the RBTCs is presented below.

1.7.1 Exposure Assessment

Numerous assumptions must be made in order to estimate human exposure to chemicals. These assumptions include parameters such as daily breathing rates, soil ingestion rates, skin surface area exposed to soil, human activity patterns, and many others. Most of the exposure assumptions used in this report are recommended by USEPA and CalEPA, and are often the upper 90th or 95th percentile values. The use of 90th or 95th percentile values, when available, is recommended by the USEPA in order to estimate the “Reasonable Maximum Exposure” that may occur at a site. However, the combination of several upper-bound estimates used as exposure parameters may substantially overestimate chemical intake. The RBTCs calculated in this report are, therefore, likely to be lower (and the risk estimates higher) than what may be required to be protective of human health.

1.7.2 Fate and Transport Modeling

At the request of the oversight agencies for this project, a default screening TF (or attenuation factor) was used for the evaluation of soil gas into indoor air. For soil gas into ambient air and for groundwater, intermedia TFs were estimated using the Johnson and Ettinger model and the uncertainties associated with the model are discussed below. Using the conservative default TF for soil gas into indoor air, rather than chemical-specific modeled values, has the effect of reducing the minimum soil gas RBTCs by approximately 40 to 60 percent for most of the evaluated chemicals.

In general, two types of uncertainty exist when modeling flow and transport processes: model uncertainty and parameter uncertainty. Model uncertainty relates to the simplifying assumptions and approximations present in any model of a physical system. In this report, the model being used is USEPA's implementation of the Johnson and Ettinger vapor intrusion model (USEPA 2004a), which models the chemical concentration in indoor air at a potential receptor from the concentration in groundwater or soil gas. For this report, the model has also been adapted to model chemical concentrations in outdoor air. Parameter uncertainty includes uncertainty in the model input parameters due to measurement errors and incomplete knowledge of surface and subsurface conditions. Both model and parameter uncertainty produce uncertainty in the model results, which in this analysis are indoor and ambient air concentrations present near potential receptors. As indicated below, the model and parameter uncertainty associated with this evaluation correspond to conservative (i.e., health protective) assumptions that result in RBTCs that are likely to be significantly more protective than may be required to be protective of human health.

The Johnson and Ettinger model is based on several simplifying assumptions that lead to model uncertainty. First, the model assumes vertical homogeneity in soil characteristics within the vadose zone. Depending on the actual variability in the vadose zone, this assumption may result in either an overestimate or an underestimate of the true air concentrations and the resulting risk. Second, the model does not account for the horizontal transport of chemicals within the vadose zone and assumes an infinite source of contamination. If the contamination is instead highly localized (i.e., a contaminated area is surrounded by a clean area), horizontal transport will tend to dilute the localized contamination and decrease the flux of chemicals to the atmosphere. In this case, the actual concentrations will be lower than those presented in this evaluation and, therefore, the actual risks will be overestimated. Third, the model assumes no chemical reactions, biodegradation, or leaching occurs. All these processes could result in lower exposures than those assumed in this evaluation, and thus these assumptions are protective of human health.

Parameter uncertainty is present because the input parameters to the model are not known with certainty. The model input parameters used in this evaluation were largely based on conservative default values that will be health protective under most circumstances. One of the conservative assumptions used in the modeling include assuming a constant groundwater and soil gas source concentration through time. Relaxing this assumption would result in a lower flux and higher RBTCs (or lower risk estimates). In addition, the shallowest expected future depth-to-groundwater was used for calculating vapor transport from groundwater.

The uncertainties in the calculated indoor air concentrations are mostly associated with the assumed parameters and structure of a commercial building. First and most importantly, the attenuation through the slab of a commercial structure is difficult to characterize since actual attenuation through a building slab is difficult to measure. Factors that influence it include the degree of cracking of the slab, the permeability of the soil underlying the slab, the degree of building underpressurization, and building construction. Buildings that are constructed with air space between the soil and the occupied space (such as those with open basements) would have greater attenuation of chemical migration into the building because the air space serves to passively vent vapors from the soil. The model used in this assessment did not assume open basements.

Uncertainty associated with mixing height can occur if ventilation within the indoor space is good. For this model, a commercial mixing height of 10 feet was chosen. The effect of a change in mixing height is a simple linear extrapolation on the corresponding TF. If the mixing height were doubled, the TFs would be reduced by a factor of two and increase the RBTCs by a factor of two.

Sensitivity in air exchange rate is also easily calculated, in that a doubled exchange rate reduces the TFs by two resulting in increased RBTCs by a factor of two. The air exchange rate can be different depending on whether ventilation in the building is aided by windows or doors being open or closed. The values used in this assessment are within that range at 1.0/hour for commercial. However, if the air exchange rates in commercial buildings are greater, the RBTCs would be higher and the risk estimates lower than presented here. Similarly, if commercial buildings have lower air exchange rates, the RBTCs would be lower and the risk estimates higher than those presented in this assessment.

There is also uncertainty in the outdoor air dispersion factor (Q/C) used to describe vapor dispersion in outdoor ambient air. Doubling the Q/C term would halve the TFs and increase the RBTCs by a factor of two. The Q/C term used was for a 30-acre source area (the largest area source run in the model) and for a site located in San Francisco (the closest location to the Site). In addition to uncertainties in the model used to develop the Q/C factors, there are uncertainties with the Q/C term chosen. In reality, the size of the area source may be significantly smaller than 30 acres. Running the model using a source area smaller than 30 acres would somewhat decrease the Q/C term and somewhat increase the RBTCs. In addition, the average wind speeds input into the model for the San Francisco location is likely different than average wind speeds for East Palo Alto. The difference in average wind speeds between San Francisco and East Palo Alto would only slightly change the Q/C term (and therefore, only slightly change the RBTCs).

1.7.3 Toxicity Assessment

Available scientific information is insufficient to provide a thorough understanding of all the toxic properties of each of the chemicals to which humans may be exposed. Therefore, it is often necessary to infer these properties by extrapolating them from data obtained from animal testing. Although reliance on experimental animal data has been widely used in general risk assessment practices, chemical absorption, metabolism, excretion, and toxic responses may differ between humans and the species for which experimental toxicity data are available. Uncertainties in using animal data to predict potential effects in humans are introduced when routes of exposure in animal studies differ from human exposure routes, when the exposures in animal studies are short-term or subchronic, and when effects seen at relatively high exposure levels in animal studies are used to predict effects at the much lower exposure levels found in the environment. Uncertainties in the toxicological assessments for carcinogens and noncarcinogens are discussed below.

1.7.3.1 Carcinogens

The use of animal data presents an uncertainty in predicting carcinogenicity in humans. While many substances are carcinogenic in one or more animal species, only a small number of substances are known to be human carcinogens. Due to inter-species physiological differences, it is possible that not all animal carcinogens are human carcinogens, and that not all human carcinogens are animal carcinogens. To prevent the underestimation of carcinogenic risk, regulatory agencies generally assume that humans are at least as sensitive to carcinogens as the most sensitive animal species.

The development of CSFs for carcinogens is predicated on the assumption generally made by regulatory agencies that no threshold exists for carcinogens (i.e., that there is some risk of cancer at all exposure levels above zero). The no-threshold hypothesis for carcinogens, however, may not be valid for all substances.

1.7.3.2 Noncarcinogens

In order to adjust for uncertainties that arise from the use of animal data, regulatory agencies often base the RfD and RfC for noncarcinogenic effects on the most sensitive animal species (i.e., the species that experiences adverse effects at the lowest dose). These doses are then adjusted via the use of safety or uncertainty factors. The adjustment compensates for the lack of knowledge regarding interspecies extrapolation, and guards against the possibility of humans being more sensitive than the most sensitive experimental animal species tested. The use of uncertainty factors is considered to be protective of health. In addition, when route-specific toxicity data were lacking, RfDs were extrapolated from one route to another (i.e., oral to inhalation and inhalation to oral). Due to the absence of contrary data, equal absorption rates were assumed for both routes.

1.7.4 Uncertainties in Risk

The USEPA (1989b) notes that the conservative assumptions used in risk assessments are intended to assure that the estimated risks do not underestimate the actual risks posed by a site and that the estimated risks do not necessarily represent actual risks experienced by population at or near a site. By using standardized conservative assumptions in a risk assessment, USEPA further states that:

> *"These values are upperbound estimates of excess cancer risk potentially arising from lifetime exposure to the chemical in question. A number of assumptions have been made in the derivation of these values, many of which are likely to over-estimate exposure and toxicity. The actual incidence of cancer is likely to be lower than these estimates and may be zero."*

The RBTCs developed in this report are based primarily on a series of conservative assumptions. The use of conservative assumptions tends to produce upper-bound estimates of risk. Although it is difficult to quantify the uncertainties associated with all the assumptions used in this report, the use of conservative assumptions is likely to result in a substantial overestimate of exposure, and hence, risk.

2.0 COMPARISON OF RISK-BASED TARGET CONCENTRATIONS TO MEASURED CONCENTRATIONS

In order to assess whether chemical concentrations in groundwater, soil gas and soil at the Site are within acceptable risk ranges, based on proposed future land uses, detected concentrations will be compared to the RBTCs developed in Section 1.

According to USEPA, the exposure concentration term in the intake equation used to calculate risk is the arithmetic average of the concentration that is contacted over the exposure period (USEPA 1989a). Although this concentration does not reflect the maximum concentration that could be contacted at any one time, it is regarded as a reasonable estimate of the concentration likely to be contacted over time, since assuming long-term contact with the maximum concentration is not reasonable. Because of the uncertainty associated with any estimate of exposure concentration, USEPA recommends that the 95 percent UCL on the arithmetic average be used for this variable (USEPA 1989a). The 95UCL provides reasonable confidence that the true site average will not be underestimated (USEPA 2007 a, b). Therefore, even if any one sample concentration exceeds its RBTC, the average may not.

When sufficient data is available, exposure point concentration (EPCs) will be estimated as the 95UCL of the population mean. The statistical methods used in the calculation of EPCs will be the same as or similar to those implemented in the recently released Version 4.0 of ProUCL (USEPA 2007a,b). EPCs will then be compared to RBTCs to evaluate whether chemical concentrations measured at the Site will pose unacceptable health risks to human receptors.

EPCs below the RBTCs (or naturally occurring background levels) would support the conclusion that risks posed by residual chemicals in groundwater, soil gas or soil at the Site are within acceptable limits. The presence of exposure concentrations above or at the high end of this risk range may warrant additional risk management measures. In addition, RBTCs will also be used to calculate non-cancer hazard indices and cumulative risk to a receptor in order to ensure that cumulative exposure to multiple chemicals will not result in risks above an acceptable level.

For each receptor, the cancer risk for a single chemical in a single media is estimated as follows:

$$CR = \frac{EPC}{RBTC_c} \times 10^{-6}$$

Where:

CR	=	Cancer Risk; the incremental probability of an individual developing cancer as a result of exposure to a particular cumulative dose of a potential carcinogen (unitless)
EPC	=	Exposure point concentration of chemical, and
$RBTC_c$	=	Risk-based target concentration level for chemical based on cancer endpoint.

The total cancer risk represents the sum of the cancer risks associated with individual chemicals estimated as follows.

$$CR_T = \sum_{i=1}^{n} CR_i$$

The hazard quotient (HQ) for a single chemical is estimated as follows:

$$HQ = \frac{EPC}{RBTCnc}$$

Where:

HQ = Hazard Quotient for chemical (unitless),
EPC = Exposure point concentration of chemical, and
$\mathrm{RBTC}_{\mathrm{nc}}$ = Risk-based target concentration for chemical based on the noncancer endpoint.

The hazard index (HI) is then estimated by summing the chemical-specific HQ as follows:

$$HI = \sum_{i=1}^{n} HQ_i$$

The cancer risk estimates are compared to a "target risk range" to aid in the interpretation of the risk assessment results.

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TABLES

TABLE 1
Preliminary Chemicals of Potential Concern (COPCs)
Former Romic Environmental Technologies Site
East Palo Alto, California

			Environmental Media		
Chemical	**CAS #**	**Any Media**	**Groundwater**	**Soil Gas**	**Soil**
Volatile Organic Compounds (VOCs)					
Acetone	67-64-1	X	X	X	X
Benzene	71-43-2	X	X	X	X
2-Butanone	78-93-3	X	X	X	X
Carbon Disulfide	75-15-0	X	X	X	X
Chlorobenzene	108-90-7	X	X	X	X
Chloroethane	75-00-3	X	X	X	X
Chloroform	67-66-3	X	X	X	X
Chloromethane	74-87-3	X	X	X	X
Cumene	98-82-8	X	X	X	X
1,2-Dichlorobenzene	95-50-1	X	X	X	X
1,4-Dichlorobenzene	106-46-7	X	X	X	X
1,1-Dichloroethane	75-34-3	X	X	X	X
1,2-Dichloroethane	107-06-2	X	X	X	X
1,1-Dichloroethene	75-35-4	X	X	X	X
cis-1,2-Dichloroethene	156-59-2	X	X	X	X
trans-1,2-Dichloroethene	156-60-5	X	X	X	X
Ethylbenzene	100-41-4	X	X	X	X
2-Hexanone	591-78-6	X	X	X	X
Methyl tert-butyl ether	1634-04-4	X	X	X	X
4-Methyl-2-pentanone	108-10-1	X	X	X	X
Methylene Chloride	75-09-2	X	X	X	X
Styrene	100-42-5	X	X	X	X
1,1,2,2-Tetrachloroethane	79-34-5	X	X	X	X
Tetrachloroethene	127-18-4	X	X	X	X
Tetrahydrofuran	109-99-9	X	X	X	X
Toluene	108-88-3	X	X	X	X
1,2,4-Trichlorobenzene	120-82-1	X	X	X	X
1,1,1-Trichloroethane	71-55-6	X	X	X	X
1,1,2-Trichloroethane	79-00-5	X	X	X	X
Trichloroethene	79-01-6	X	X	X	X
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	X	X	X	X
1,2,4-Trimethylbenzene	95-63-6	X	X	X	X
1,3,5-Trimethylbenzene	108-67-8	X	X	X	X
Vinyl Chloride	75-01-4	X	X	X	X
Xylenes (total)	1330-20-7	X	X	X	X
Semi-Volatile Organic Compounds (SVOCs)					
Acenaphthylene	208-96-8	X	X		X
bis(2-Chloroethoxy)methane	111-91-1	X			X
bis(2-Chloroethyl) ether	111-44-4	X	X		X
bis(2-Ethylhexyl)phthalate	117-81-7	X			X
Butylbenzylphthalate	85-68-7	X			X
4-Chloroaniline	106-47-8	X			X
Dimethylphthalate	131-11-3	X			X
Di-n-butylphthalate	84-74-2	X			X
Di-n-octylphthalate	117-84-0	X			X
Fluoranthene	206-44-0	X			X

TABLE 1
Preliminary Chemicals of Potential Concern (COPCs)
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	CAS #	Any Media	Environmental Media		
			Groundwater	Soil Gas	Soil
Hexachlorobutadiene	87-68-3	X			X
Hexachlorocyclopentadiene	77-47-4	X			X
Isophorone	78-59-1	X			X
2-Methylnaphthalene	91-57-6	X	X		X
2-Methylphenol	95-48-7	X			X
4-Methylphenol	106-44-5	X			X
Naphthalene	91-20-3	X	X	X	X
Phenol	108-95-2	X			X
Pesticides/Polychlorinated Biphenyls					
Total Polychlorinated Biphenyls	1336-36-3	X			X
Aroclor 1016	12674-11-2	X			X
Aroclor 1254	11097-69-1	X			X
Aldrin	309-00-2	X			X
Chlordane	57-74-9	X			X
4,4'-DDD	72-54-8	X			X
4,4'-DDE	72-55-9	X			X
4,4'-DDT	50-29-3	X			X
Dieldrin	60-57-1	X			X
Endosulfan I	959-98-8	X			X
Endosulfan II	33213-65-9	X			X
Endosulfan sulfate	1031-07-8	X			X
Endrin	72-20-8	X			X
Endrin aldehyde	7421-93-4	X			X
Heptachlor	76-44-8	X			X
Heptachlor epoxide	1024-57-3	X			X
alpha-Hexachlorocyclohexane	319-84-6	X			X
beta-Hexachlorocyclohexane	319-85-7	X			X
delta-Hexachlorocyclohexane	319-86-8	X			X
gamma-Hexachlorocyclohexane	58-89-9	X			X
Methoxychlor	72-43-5	X			X
Toxaphene	8001-35-2	X			X
Metals					
Antimony	7440-36-0	X			X
Arsenic	7440-38-2	X			X
Barium	7440-39-3	X			X
Beryllium	7440-41-7	X			X
Cadmium	7440-43-9	X			X
Chromium (total)	7440-47-3	X			X
Chromium III	16065-83-1	X			X
Chromium VI	18540-29-9	X			X
Cobalt	7440-48-4	X			X
Copper	7440-50-8	X			X
Lead	7439-92-1	X			X
Mercury	7439-97-6	X			X
Molybdenum	7439-98-7	X			X
Nickel	7440-02-0	X			X
Selenium	7782-49-2	X			X

TABLE 1
Preliminary Chemicals of Potential Concern (COPCs)
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	CAS #	Any Media	Environmental Media		
			Groundwater	Soil Gas	Soil
Silver	7440-22-4	X			X
Thallium	7440-28-0	X			X
Tin	7440-31-5	X			X
Vanadium	7440-62-2	X			X
Zinc	7440-66-6	X			X

Note:
CAS # = Chemical Abstract Service Number

TABLE 2
Intake Equations for Exposure via Inhalation of Vapors and Soil Particulates
Former Romic Environmental Technologies Site
East Palo Alto, California

VAPOR INHALATION INTAKE FACTOR,

$$IF = \frac{ET \times EF \times ED}{CF \times AT}$$

IF = Inhalation Intake Factor, unitless
ET = Exposure Time, hours/day
EF = Exposure Frequency, days/year
ED = Exposure Duration, years
ED = Exposure Duration, years
CF = Conversion Factor, 24 hours/day
AT = Averaging Time, days

PARTICULATE INHALATION INTAKE FACTOR,

$$IF = \frac{ET \times PEF \times EF \times ED}{CF \times AT}$$

IF = Inhalation Intake Factor, (milligram [mg]/m3)/(mg/kg)
ET = Exposure Time, hours/day
PEF = Transfer Coefficient (dust), $(mg/m^3)/(mg/kg)$
EF = Exposure Frequency, days/year
ED = Exposure Duration, years
CF = Conversion Factor, 24 hours/day
AT = Averaging Time, days

TABLE 3
Intake Equations for Exposure via Incidental Ingestion and Dermal Contact from Soil
Former Romic Environmental Technologies Site
East Palo Alto, California

SOIL INGESTION INTAKE FACTOR

$$IF = \frac{IR \times CF \times EF \times ED}{BW \times AT}$$

IF = Ingestion Intake Factor, kilograms (kg) soil/kg body weight-day
IR = Ingestion Rate, milligrams (mg)/day
CF = Conversion Factor, kg/mg
EF = Exposure Frequency, days/year
ED = Exposure Duration, years
BW = Body weight, kg
AT = Averaging Time, days

SOIL DERMAL INTAKE FACTOR

$$IF = \frac{SA \times AF \times ABS \times CF \times EF \times ED}{BW \times AT}$$

IF = Dermal Intake Factor, kilogram (kg) soil/kg body weight-day
SA = Surface Area of Exposed Skin, square centimeters (cm^2)/day
AF = Soil-to-Skin Adherence Factor, milligrams (mg)/cm^2
ABS = Absorption Factor (unitless)[a]
CF = Conversion Factor, kg/mg
EF = Exposure Frequency, days/year
ED = Exposure Duration, years
BW = Body weight, kg
AT = Averaging Time, days

Notes:

[a] Dermal absorption factors from soil are presented in Table 5.

TABLE 4
Exposure Assumptions
Former Romic Environmental Technologies Site
East Palo Alto, California

Parameter	Symbol	Potentially Exposed Populations					
		Construction Worker		Indoor Worker		Outdoor Worker	
Inhalation of Vapors and Particulates							
Transfer Coefficient [Dust] $(mg/m^3)/(mg/kg)$	PEF	6.90E-07	b	NA		7.35E-10	a
Exposure Time (hours/day)	ET	8	c	8	c	8	c
Conversion Factor (24 hours/day)	CF	24		24		24	
Ingestion of Soil							
Ingestion Rate (mg/day)	IR	330	a	50	a	100	a
Conversion Factor (kg/mg)	CF	1.0E-06		1.0E-06		1.0E-06	
Dermal Contact with Soil							
Surface Area (cm^2/day)	SA	3,300	a	NA		3,300	a
Adherence Factor (mg/cm^2)	AF	0.3	a	NA		0.2	a
Absorption Factor (unitless)	ABS	See Table 5		NA		See Table 5	
Conversion Factor (kg/mg)	CF	1.0E-06		NA		1.0E-06	
Population-Specific Assumptions							
Exposure Frequency (days/year)	EF	60	d	250	a	225	a
Exposure Duration (years)	ED	1	e	25	a	25	a
Body Weight (kg)	BW	70	a	70	a	70	a
Averaging Time for Carcinogens (days)	AT_c	25,550		25,550		25,550	
Averaging Time (chronic) for Noncarcinogens (days)	AT_{nc}	365		9,125		9,125	

Notes:

NA = Not applicable

m^3 = cubic meters; mg = milligram; kg = kilogram; cm^2 = square centimeters

[a] USEPA (2002).

[b] Cal/EPA (2008).

[c] USEPA (1991).

[d] It was assumed that the construction worker was exposed 5 days/week for 12 weeks in a year.

[e] An exposure duration of one year is assumed for a construction worker who is involved in short-term work at the Site.

Sources:

California Environmental Protection Agency Regional Water Quality Control Board - San Francisco Bay Region (Cal/EPA). 2008. *Screening for Environmental Concerns at Sites with Contaminated Soils and Ground Water.* Interim Final. May.

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United States Environmental Protection Agency (USEPA). 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. Office of Emergency and Remedial Response. OSWER 9355.4-24. December.

TABLE 5
Dermal Absorption Fraction from Soil
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Soil Absorption Factor	Source
Volatile Organic Compounds (VOCs)	0	a
Semi-Volatile Organic Compounds (SVOCs)		
Acenaphthylene	0.13	a
bis(2-Chloroethoxy)methane	0.1	a
bis(2-Chloroethyl) ether	0	a
bis(2-Ethylhexyl)phthalate	0.1	a
Butylbenzylphthalate	0.1	a
4-Chloroaniline	0.1	a
Dimethylphthalate	0.1	a
Di-n-butylphthalate	0.1	a
Di-n-octylphthalate	0.1	a
Fluoranthene	0.13	a
Hexachlorobutadiene	0.1	a
Hexachlorocyclopentadiene	0.1	a
Isophorone	0.1	a
2-Methylnaphthalene	0.13	a
2-Methylphenol	0.1	a
4-Methylphenol	0.1	a
Naphthalene	0.13	a
Phenol	0.1	a
Pesticides/Polychlorinated Biphenyls		
Total Polychlorinated Biphenyls	0.14	a
Aroclor 1016	0.14	a
Aroclor 1254	0.14	a
Aldrin	0.1	a
Chlordane	0.04	a
4,4'-DDD	0.1	a,b
4,4'-DDE	0.1	a,b
4,4'-DDT	0.03	a
Dieldrin	0.1	a
Endosulfan I	0.1	a
Endosulfan II	0.1	a
Endosulfan sulfate	0.1	a

TABLE 5
Dermal Absorption Fraction from Soil
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Soil Absorption Factor	Source
Endrin	0.1	a
Endrin aldehyde	0.1	a
Heptachlor	0.1	a
Heptachlor epoxide	0.1	a
alpha-Hexachlorocyclohexane	0.1	a,b
beta-Hexachlorocyclohexane	0.1	a,b
delta-Hexachlorocyclohexane	0.1	a,b,c
gamma-Hexachlorocyclohexane	0.04	a,c
Methoxychlor	0.1	a
Toxaphene	0.1	a
Metals		
Antimony	0	a
Arsenic	0.03	a
Barium	0	a
Beryllium	0	a
Cadmium	0.001	a
Chromium (total)	0	a
Chromium III	0	a
Chromium VI	0	a
Cobalt	0	a
Copper	0	a
Lead	0	a
Mercury	0	a
Molybdenum	0	a
Nickel	0	a
Selenium	0	a
Silver	0	a
Thallium	0	a
Tin	0	a
Vanadium	0	a
Zinc	0	a

TABLE 5
Dermal Absorption Fraction from Soil
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Soil Absorption Factor	Source

Notes:

[a] USEPA (2004). A chemical is defined as volatile for the purposes of assigning dermal absorption factors, if its molecular weight is below 200 gram per mole and the Henry's is constant greater than 10^{-5} atmosphere-cubic meter per mole (atm-m^3/mol).

[b] USEPA 2010.

[c] Value for alpha-Hexachlorocyclohexane used as a surrogate.

Source:

United States Environmental Protection Agency (USEPA). 2004. *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual. Part E, Supplemental Guidance for Dermal Risk Assessment - Final.* EPA/540/R/99/005. Washington, D.C. July.

United States Environmental Protection Agency (USEPA). 2010. *Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.*

TABLE 6
Intake Factors[a]
Former Romic Environmental Technologies Site
East Palo Alto, California

Exposure Pathway	Potentially Exposed Populations		
	Construction Worker	**Indoor Worker**	**Outdoor Worker**
Carcinogenic			
Air			
Inhalation of Vapors (unitless)	7.83E-04	8.15E-02	7.34E-02
Groundwater			
Inhalation of Groundwater Vapors - subsurface and tap water (unitless) [b]	7.83E-04	8.15E-02	7.34E-02
Ingestion of Groundwater - tap water (L/kg-day)	NC	NC	NC
Dermal Contact with Groundwater - tap water (L/kg-day) / (cm/event) [c]	NC	NC	NC
Soil			
Inhalation of Vapors (unitless) [b]	7.83E-04	8.15E-02	7.34E-02
Inhalation of Soil Particulates $(mg/m^3)/(mg/kg)$	5.40E-10	NC	5.40E-11
Ingestion of Soil (kg/kg-day)	1.11E-08	1.75E-07	3.15E-07
Dermal Contact with Soil (kg/kg-day) [c]	3.32E-08	NC	2.08E-06
Soil Gas			
Inhalation of Vapors (unitless) [b]	7.83E-04	8.15E-02	7.34E-02
Sediment			
Ingestion of Sediment (kg/kg-day)	1.11E-08	1.75E-07	1.75E-07
Dermal Contact with Sediments (kg/kg-day) [c]	3.32E-08	NC	2.08E-06
Noncarcinogenic			
Air			
Inhalation of Vapors (unitless)	5.48E-02	2.28E-01	2.05E-01
Groundwater			
Inhalation of Groundwater Vapors (unitless) [b]	5.48E-02	2.28E-01	2.05E-01
Ingestion of Groundwater (L/kg-day)	NC	NC	NC
Dermal Contact with Groundwater (L/kg-day) / (cm/event) [c]	NC	NC	NC
Soil			
Inhalation of Vapors (unitless) [b]	5.48E-02	2.28E-01	2.05E-01
Inhalation of Soil Particulates $(mg/m^3)/(mg/kg)$	3.78E-08	NC	1.51E-10
Ingestion of Soil (kg/kg-day)	7.75E-07	4.89E-07	8.81E-07
Dermal Contact with Soil (kg/kg-day) [c]	2.32E-06	NC	5.81E-06
Soil Gas			
Inhalation of Vapors (unitless) [b]	5.48E-02	2.28E-01	2.05E-01
Sediment			
Ingestion of Sediment (kg/kg-day)	7.75E-07	4.89E-07	4.89E-07
Dermal Contact with Sediments (kg/kg-day) [c]	2.32E-06	NC	5.81E-06

Notes:

mg = milligram
kg = kilogram
L = liter
m^3 = cubic meter
NC = Not calculated. The pathway was not included.

[a] The values listed in this table are media specific intake factors (e.g., m^3 air / kg body weight per day or kg soil / kg body weight per day).

[b] To calculate chemical specific groundwater, soil gas, or soil intake factors via inhalation, multiply listed value by chemical specific groundwater-to-air or soil gas-to-air transfer coefficient listed in Tables 9 and 10a, respectively.

[c] To calculate chemical specific intake factors via dermal contact with soil, multiply listed value by chemical specific dermal absorption fraction listed in Table 5.

TABLE 7
Physical/Chemical Properties of Volatile Chemicals[a]
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Molecular Weight MW (g/mol)	Organic Carbon Partition Coefficient, K_{oc} (cm^3/g)	Diffusivity in Air, D_a (cm^2/s)	Diffusivity in Water, D_w (cm^2/s)	Pure Component Water Solubility, S (mg/L)	Henry's Law Constant at 25° C H ($atm\text{-}m^3/mol$)	Normal Boiling Point, T_B (^oK)	Critical Temperature, T_C (^oK)	Enthalpy of Vaporization at the Normal Boiling Point, $\Delta Hv,b$ (cal/mol)	Source Notes
Volatile Organic Compounds (VOCs)										
Acetone	58.08	2.36E+00	1.1E-01	1.1E-05	1.00E+06	3.50E-05	329.20	508.10	6955.00	(b)
Benzene	78.11	1.46E+02	9.0E-02	1.0E-05	1.79E+03	5.55E-03	353.24	562.16	7342.00	(b)
2-Butanone	72.11	4.51E+00	9.1E-02	1.0E-05	2.23E+05	5.69E-05	352.50	536.78	7480.70	(b)
Carbon Disulfide	76.13	2.17E+01	1.1E-01	1.3E-05	2.16E+03	1.44E-02	319.00	552.00	6391.00	(b)
Chlorobenzene	112.56	2.34E+02	7.2E-02	9.5E-06	4.98E+02	3.11E-03	404.87	632.40	8410.00	(b)
Chloroethane	64.51	2.17E+01	1.0E-01	1.2E-05	6.71E+03	1.11E-02	285.30	460.40	5879.40	(b)
Chloroform	119.38	3.18E+01	7.7E-02	1.1E-05	7.95E+03	3.67E-03	334.32	536.40	6988.00	(b)
Chloromethane	50.49	1.32E+01	1.2E-01	1.4E-05	5.32E+03	8.82E-03	249.00	416.25	5114.60	(b)
Cumene	120.19	6.98E+02	6.0E-02	7.9E-06	6.13E+01	1.15E-02	425.56	631.10	10335.30	(b)
1,2-Dichlorobenzene	147.00	3.83E+02	5.6E-02	8.9E-06	1.56E+02	1.92E-03	453.57	705.00	9700.00	(b)
1,4-Dichlorobenzene	147.00	3.75E+02	5.5E-02	8.7E-06	8.13E+01	2.41E-03	447.21	684.75	9271.00	(b)
1,1-Dichloroethane	98.96	3.18E+01	8.4E-02	1.1E-05	5.04E+03	5.62E-03	330.55	523.00	6895.00	(b)
1,2-Dichloroethane	98.96	3.96E+01	8.6E-02	1.1E-05	8.60E+03	1.18E-03	356.65	561.00	7643.00	(b)
1,1-Dichloroethene	96.94	3.18E+01	8.6E-02	1.1E-05	2.42E+03	2.61E-02	304.75	576.05	6247.00	(b)
cis-1,2-Dichloroethene	96.94	3.96E+01	8.8E-02	1.1E-05	6.41E+03	4.08E-03	333.65	544.00	7192.00	(b)
trans-1,2-Dichloroethene	96.94	3.96E+01	8.8E-02	1.1E-05	4.52E+03	4.08E-03	320.85	516.50	6717.00	(b)
Ethylbenzene	106.17	4.46E+02	6.8E-02	8.5E-06	1.69E+02	7.88E-03	409.34	617.20	8501.00	(b)
2-Hexanone	100.16	1.50E+01	7.0E-02	8.4E-06	1.72E+04	9.32E-05	----	----	----	(c)
Methyl tert-butyl ether	88.15	1.16E+01	7.5E-02	8.6E-06	5.10E+04	5.87E-04	328.30	497.10	6677.66	(b)
4-Methyl-2-pentanone	100.16	1.26E+01	7.0E-02	8.3E-06	1.90E+04	1.38E-04	389.50	571.00	8243.11	(b)
Methylene Chloride	84.93	2.17E+01	1.0E-01	1.3E-05	1.30E+04	3.25E-03	313.00	510.00	6706.00	(b)
Styrene	104.15	4.46E+02	7.1E-02	8.8E-06	3.10E+02	2.75E-03	418.31	636.00	8737.00	(b)
1,1,2,2-Tetrachloroethane	167.85	9.49E+01	4.9E-02	9.3E-06	2.83E+03	3.67E-04	419.60	661.15	8996.00	(b)
Tetrachloroethene	165.83	9.49E+01	5.0E-02	9.5E-06	2.06E+02	1.77E-02	394.40	620.20	8288.00	(b)
Tetrahydrofuran	72.11	9.50E-01	9.8E-02	1.1E-05	1.00E+06	7.0E-05	----	----	----	(c)
Toluene	92.14	2.34E+02	7.8E-02	9.2E-06	5.26E+02	6.64E-03	383.78	591.79	7930.00	(b)
1,2,4-Trichlorobenzene	181.45	1.36E+03	4.0E-02	8.4E-06	4.90E+01	1.42E-03	486.15	725.00	10471.00	(b)
1,1,1-Trichloroethane	133.40	4.39E+01	6.5E-02	9.6E-06	1.29E+03	1.72E-02	347.24	545.00	7136.00	(b)
1,1,2-Trichloroethane	133.41	6.07E+01	6.7E-02	1.0E-05	4.59E+03	8.24E-04	386.15	602.00	8322.00	(b)
Trichloroethene	131.39	6.07E+01	6.9E-02	1.0E-05	1.28E+03	9.85E-03	360.36	544.20	7505.00	(b)
1,1,2-Trichloro-1,2,2-trifluoroethane	187.38	1.97E+02	3.8E-02	8.6E-06	1.70E+02	5.26E-01	320.70	487.30	6462.56	(b)
1,2,4-Trimethylbenzene	120.20	6.14E+02	6.1E-02	7.9E-06	5.70E+01	6.16E-03	442.30	649.17	9368.80	(b)
1,3,5-Trimethylbenzene	120.20	6.02E+02	6.0E-02	7.8E-06	4.82E+01	8.77E-03	437.89	637.25	9321.00	(b)
Vinyl Chloride	62.50	2.17E+01	1.1E-01	1.2E-05	8.80E+03	2.78E-02	259.25	432.00	5250.00	(b)
Xylenes (total)	106.17	3.83E+02	8.5E-02	9.9E-06	1.06E+02	5.18E-03	411.52	616.20	8525.00	(d)

TABLE 7
Physical/Chemical Properties of Volatile Chemicals[a]
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Molecular Weight MW (g/mol)	Organic Carbon Partition Coefficient, K_{oc} (cm^3/g)	Diffusivity in Air, D_a (cm^2/s)	Diffusivity in Water, D_w (cm^2/s)	Pure Component Water Solubility, S (mg/L)	Henry's Law Constant at 25° C H ($atm\text{-}m^3/mol$)	Normal Boiling Point, T_B (^oK)	Critical Temperature, T_C (^oK)	Enthalpy of Vaporization at the Normal Boiling Point, ΔHv,b (cal/mol)	Source Notes
Semi-Volatile Organic Compounds (SVOCs)										
Acenaphthylene	152.19	4.79E+03	4.21E-02	7.69E-06	3.93E+00	1.14E-04	----	----	----	(e)
bis(2-Chloroethyl) ether	143.11	3.22E+01	5.7E-02	8.7E-06	1.72E+04	1.7E-05	451.15	659.79	10803.00	(b)
2-Methylnaphthalene	142.21	2.48E+03	5.2E-02	7.8E-06	2.46E+01	5.18E-04	514.26	761.00	12600.00	(b)
Naphthalene	128.18	1.54E+03	6.0E-02	8.4E-06	3.10E+01	4.40E-04	491.14	748.40	10373.00	(b)
Metals										
Mercury	200.59	5.20E+01	3.1E-02	6.3E-06	6.00E-02	1.14E-02	629.88	1750.00	14127.00	(b)

<u>Notes:</u>

$atm\text{-}m^3/mol$ = atmosphere-cubic meter per mole

cm^2/s = square centimeter per second

mg/L = milligram per liter

cm^3/g = cubic centimeter per gram

g/mol = gram per mole

[a] Volatile compounds defined by USEPA (1991) as chemicals with molecular weights below 200 g/mol and Henry's constant greater than 10^{-5} $atm\text{-}m^3/mol$.

[b] All properties from USEPA (2004a), unless otherwise noted.

[c] USEPA (2010).

[d] para-Xylene used as a surrogate for total xylenes.

[e] K_{oc} (modeled), S (experimental), and H (experimental) are from EPISuite (USEPA 2007). 2-Methylnaphthalene was used as a surrogate for D_a and D_w.

<u>Sources:</u>

United States Environmental Protection Agency (USEPA). 1991. *Risk Assessment Guidance for Superfund. Volume I: Human Health Preliminary Remediation Goals*). Office of Emergency and Remedial Response. Publication 9285.7-01B. December.

United States Environmental Protection Agency (USEPA). 2004a. *User’s Guide for Evaluating Subsurface Vapor Intrusion Into Buildings* . Office of Emergency and Remedial Response. February 22.

United States Environmental Protection Agency (USEPA). 2007. Estimation Programs Interface Suite™ for Microsoft® Windows, v3.20.

United States Environmental Protection Agency (USEPA) Regions 3, 6, and 9. (2010). Regional Screening Levels for Chemical Contaminants at Superfund. May.

TABLE 8
Modeling Parameters for Groundwater and Soil Gas
Former Romic Environmental Technologies Site
East Palo Alto, California

Parameter	Symbol	Value	Units	Notes
Vadose Zone Parameters				
Depth to groundwater	L_{WT}	8	feet	Minimum depth to groundwater based on boring logs for the Site
Depth of construction trench	L_{trench}	5	feet	Assumed (groundwater scenarios only)
Soil gas sampling depths	L_S	5	feet	Assumed
Soil Parameters for J&E Groundwater and Soil Gas Model				
USCS Soil type above water table		Sandy clay	--	Assumes sandy clay soils, based on boring logs for the Site
USCS soil type in Horizon A		Sandy clay	--	Assumes sandy clay soils, based on boring logs for the Site
Thickness	h_A	8	feet	Equal to L_{WT}
Bulk density	ρ_b^A	1.63	gram/centimeter^3	Default value for Sandy clay (USEPA 2004)
Total porosity	n^A	0.385	unitless	Default value for Sandy clay (USEPA 2004)
Water content	θ_w^A	0.197	unitless	Default value for Sandy clay (USEPA 2004)
Soil organic carbon fraction	f_{oc}	0.002	unitless	Default value (USEPA 2004)
Soil/groundwater temperature	T_s	16.67	Celsius	Estimated average shallow groundwater temperature (USEPA 2004, Figure 8)
Surface Barrier Parameters - Indoor Air Scenarios				
Depth to Bottom of Foundation	L_F	15	centimeters	Default value (USEPA 2004)
Foundation crack ratio	η	0.005	unitless	Default value (CalEPA 2005)
Average vapor flow rate into building	Q_{soil}	5	liters/minute	Default value (USEPA 2004)
Foundation thickness	L_{crack}	10	centimeters	Default value (USEPA 2004)
Pressure Differential	ΔP	40	(gram/ centimeter-second^2)	Default value (USEPA 2004)
Air Dispersion Parameters				
Commercial Indoor Scenario				
Air exchange rate	ER	1	1/hour	Commercial default value (CalEPA 2005)
Length of building	L_B	32.81	feet	Default value (USEPA 2004)
Width of building	L_W	32.81	feet	Default value (USEPA 2004)
Mixing height of building	H_B	10	feet	Assumption
Outdoor Scenarios				
Average windspeed	V	2.73	m/s	Average for the San Carlos stataion in 2005 from BAAQMD. (CalEPA 2011)
Mixing length of trench	L	20	ft	Assumption
Mixing width of trench	W	5	ft	Assumption
Mixing height of trench	H	5	ft	Assumption
Outdoor air dispersion factor	Q/C	45.82	grams/meter^2-second per kilogram/meter^3	Value for a 30-acre source (USEPA 2002, Appendix D, using constants derived for San Francisco meteorological conditions)

Notes:

USCS = Unified Soil Classification System

Sources:

California Environmental Protection Agency (Cal/EPA) Bay Area Air Quality Management District (BAAQMD). 2011. http://hank.baaqmd.gov/tec/data/#. Accessed 3/2/2011

California Environmental Protection Agency (Cal/EPA). 2005. *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* . Interim Final. Department of Toxic Substances Control. February 7.

United States Environmental Protection Agency (USEPA). 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.* Office of Solid Waste and Emergency Response. OSWER 9355.4-24. December.

United States Environmental Protection Agency (USEPA). 2004. *User's Guide for Evaluating Subsurface Vapor Intrusion Into Buildings.* Office of Emergency and Remedial Response. February 22.

TABLE 9
Estimated Groundwater-to-Air Transfer Factors and Attenuation Factors
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Groundwater					
	Indoor [a]		Outdoor [b]			
	Indoor Worker Transfer Factor (mg/m^3) / (mg/L)	Attenuation Factor[c]	Construction Worker Transfer Factor (mg/m^3) / (mg/L)	Attenuation Factor[c]	Outdoor Worker Transfer Factor (mg/m^3) / (mg/L)	Attenuation Factor[c]
Volatile Organic Compounds (VOCs)						
Acetone	1.45E-04	1.41E-04	4.05E-06	3.95E-06	2.95E-06	2.88E-06
Benzene	1.17E-03	7.39E-06	1.25E-05	7.91E-08	2.05E-05	1.30E-07
2-Butanone	1.76E-04	1.10E-04	4.40E-06	2.76E-06	3.46E-06	2.17E-06
Carbon Disulfide	2.26E-03	5.14E-06	2.37E-05	5.40E-08	3.95E-05	9.01E-08
Chlorobenzene	8.89E-04	1.09E-05	9.84E-06	1.21E-07	1.57E-05	1.92E-07
Chloroethane	1.85E-03	5.27E-06	1.95E-05	5.55E-08	3.25E-05	9.24E-08
Chloroform	1.08E-03	1.00E-05	1.18E-05	1.10E-07	1.90E-05	1.77E-07
Chloromethane	2.02E-03	6.85E-06	2.14E-05	7.24E-08	3.55E-05	1.20E-07
Cumene	1.04E-03	3.96E-06	1.10E-05	4.19E-08	1.82E-05	6.93E-08
1,2-Dichlorobenzene	7.01E-04	1.53E-05	8.26E-06	1.80E-07	1.24E-05	2.70E-07
1,4-Dichlorobenzene	7.28E-04	1.24E-05	8.35E-06	1.42E-07	1.28E-05	2.18E-07
1,1-Dichloroethane	1.24E-03	7.49E-06	1.33E-05	8.04E-08	2.17E-05	1.32E-07
1,2-Dichloroethane	8.35E-04	2.54E-05	1.01E-05	3.06E-07	1.49E-05	4.54E-07
1,1-Dichloroethene	2.60E-03	3.22E-06	2.71E-05	3.36E-08	4.54E-05	5.64E-08
cis-1,2-Dichloroethene	1.14E-03	9.65E-06	1.24E-05	1.05E-07	2.01E-05	1.70E-07
trans-1,2-Dichloroethene	1.15E-03	9.44E-06	1.25E-05	1.02E-07	2.02E-05	1.66E-07
Ethylbenzene	1.04E-03	5.11E-06	1.11E-05	5.44E-08	1.82E-05	8.96E-08
2-Hexanone	2.67E-04	6.82E-05	5.15E-06	1.31E-06	5.00E-06	1.28E-06
Methyl tert-butyl ether	5.63E-04	3.24E-05	7.35E-06	4.22E-07	1.02E-05	5.84E-07
4-Methyl-2-pentanone	2.52E-04	7.00E-05	4.96E-06	1.38E-06	4.73E-06	1.31E-06
Methylene Chloride	1.27E-03	1.30E-05	1.39E-05	1.43E-07	2.24E-05	2.30E-07
Styrene	8.06E-04	1.15E-05	8.98E-06	1.28E-07	1.42E-05	2.03E-07
1,1,2,2-Tetrachloroethane	3.82E-04	4.12E-05	6.42E-06	6.91E-07	6.95E-06	7.49E-07
Tetrachloroethene	1.36E-03	2.91E-06	1.44E-05	3.06E-08	2.39E-05	5.08E-08
Tetrahydrofuran	2.94E-04	1.00E-04	6.24E-06	2.12E-06	5.71E-06	1.94E-06
Toluene	1.10E-03	6.12E-06	1.17E-05	6.52E-08	1.93E-05	1.07E-07
1,2,4-Trichlorobenzene	5.56E-04	1.77E-05	7.16E-06	2.28E-07	9.88E-06	3.14E-07
1,1,1-Trichloroethane	1.58E-03	3.21E-06	1.66E-05	3.36E-08	2.77E-05	5.61E-08
1,1,2-Trichloroethane	6.50E-04	2.97E-05	8.50E-06	3.89E-07	1.17E-05	5.34E-07
Trichloroethene	1.29E-03	4.70E-06	1.37E-05	4.98E-08	2.26E-05	8.24E-08
1,1,2-Trichloro-1,2,2-trifluoroethane	1.51E-02	9.56E-07	1.57E-04	9.91E-09	2.64E-04	1.67E-08
1,2,4-Trimethylbenzene	8.65E-04	5.86E-06	9.29E-06	6.30E-08	1.52E-05	1.03E-07
1,3,5-Trimethylbenzene	9.52E-04	4.53E-06	1.01E-05	4.82E-08	1.67E-05	7.94E-08
Vinyl Chloride	3.45E-03	3.74E-06	3.59E-05	3.91E-08	6.03E-05	6.55E-08
Xylenes (total)	1.08E-03	8.14E-06	1.16E-05	8.76E-08	1.90E-05	1.43E-07
Semi-Volatile Organic Compounds (SVOCs)						
Acenaphthylene	2.19E-04	4.56E-05	4.36E-06	9.10E-07	4.00E-06	8.34E-07
bis(2-Chloroethyl) ether	4.23E-05	1.14E-04	1.39E-06	3.75E-06	8.33E-07	2.25E-06
2-Methylnaphthalene	3.73E-04	3.75E-05	5.78E-06	5.82E-07	6.76E-06	6.80E-07
Naphthalene	4.12E-04	4.16E-05	6.32E-06	6.37E-07	7.50E-06	7.56E-07

Notes:

(mg/m^3)/(mg/L) = (milligrams per cubic meter) per (milligrams per Liter)

[a] Calculated using the Johnson and Ettinger Model.

[b] Calculated using the Ficks Law Diffusion Model.

[c] A system temperature of 15 degrees Celsius was assumed.

TABLE 10a
Estimated Soil Gas-to-Air Transfer Factors
Former Romic Environmental Technologies Site
East Palo Alto, California

	Soil Gas-to-Air Transfer Factors $(mg/m^3) / (mg/m^3)$		
	5-foot sample depth		
	Indoor [a]	Outdoor [b]	
Chemical	**Indoor Worker**	**Construction Worker**	**Outdoor Worker**
Volatile Organic Compounds (VOCs)			
Acetone	3.33E-04	2.66E-06	5.03E-06
Benzene	3.33E-04	1.96E-06	3.69E-06
2-Butanone	3.33E-04	2.14E-06	4.03E-06
Carbon Disulfide	3.33E-04	2.39E-06	4.51E-06
Chlorobenzene	3.33E-04	1.57E-06	2.96E-06
Chloroethane	3.33E-04	2.17E-06	4.10E-06
Chloroform	3.33E-04	1.68E-06	3.16E-06
Chloromethane	3.33E-04	2.61E-06	4.92E-06
Cumene	3.33E-04	1.30E-06	2.46E-06
1,2-Dichlorobenzene	3.33E-04	1.22E-06	2.31E-06
1,4-Dichlorobenzene	3.33E-04	1.20E-06	2.26E-06
1,1-Dichloroethane	3.33E-04	1.83E-06	3.45E-06
1,2-Dichloroethane	3.33E-04	1.88E-06	3.54E-06
1,1-Dichloroethene	3.33E-04	1.87E-06	3.53E-06
cis-1,2-Dichloroethene	3.33E-04	1.91E-06	3.61E-06
trans-1,2-Dichloroethene	3.33E-04	1.91E-06	3.61E-06
Ethylbenzene	3.33E-04	1.48E-06	2.79E-06
2-Hexanone	3.33E-04	1.58E-06	2.97E-06
Methyl tert-butyl ether	3.33E-04	1.64E-06	3.10E-06
4-Methyl-2-pentanone	3.33E-04	1.58E-06	2.98E-06
Methylene Chloride	3.33E-04	2.18E-06	4.11E-06
Styrene	3.33E-04	1.55E-06	2.92E-06
1,1,2,2-Tetrachloroethane	3.33E-04	1.09E-06	2.06E-06
Tetrachloroethene	3.33E-04	1.09E-06	2.05E-06
Tetrahydrofuran	3.33E-04	2.22E-06	4.20E-06
Toluene	3.33E-04	1.70E-06	3.20E-06
1,2,4-Trichlorobenzene	3.33E-04	8.76E-07	1.65E-06
1,1,1-Trichloroethane	3.33E-04	1.41E-06	2.67E-06
1,1,2-Trichloroethane	3.33E-04	1.47E-06	2.77E-06
Trichloroethene	3.33E-04	1.50E-06	2.83E-06
1,1,2-Trichloro-1,2,2-trifluoroethane	3.33E-04	8.26E-07	1.56E-06
1,2,4-Trimethylbenzene	3.33E-04	1.33E-06	2.50E-06
1,3,5-Trimethylbenzene	3.33E-04	1.30E-06	2.46E-06
Vinyl Chloride	3.33E-04	2.39E-06	4.51E-06
Xylenes (total)	3.33E-04	1.85E-06	3.49E-06
Semi-Volatile Organic Compounds (SVOCs)			
Naphthalene	3.33E-04	1.32E-06	2.50E-06

TABLE 10a
Estimated Soil Gas-to-Air Transfer Factors
Former Romic Environmental Technologies Site
East Palo Alto, California

	Soil Gas-to-Air Transfer Factors (mg/m^3) / (mg/m^3)		
	5-foot sample depth		
	Indoor [a]	Outdoor [b]	
Chemical	Indoor Worker	Construction Worker	Outdoor Worker

Notes:

(mg/m^3)/(mg/m^3) = (milligrams per cubic meter) per (milligrams per cubic meter)

[a] Indoor attenuation factor of 3000 (or a soil gas-to-air transfer factor of 3.33E-04) applied at the request of the oversight agencies for this project.

[b] Calculated using the Ficks Law Diffusion Model.

TABLE 10b
Estimated Soil-to-Air Transfer Factors
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Soil Transfer Factors $(mg/m^3) / (mg/kg)$		
	Indoor Worker [a]	Construction Worker [b]	Outdoor Worker [b]
Volatile Organic Compounds (VOCs)			
Acetone	2.71E-03	1.67E-04	5.69E-05
Benzene	1.22E-01	9.60E-04	3.27E-04
2-Butanone	4.09E-03	1.84E-04	6.25E-05
Carbon Disulfide	6.81E-01	2.51E-03	8.53E-04
Chlorobenzene	4.54E-02	5.24E-04	1.78E-04
Chloroethane	5.72E-01	2.19E-03	7.46E-04
Chloroform	1.82E-01	1.08E-03	3.69E-04
Chloromethane	5.43E-01	2.34E-03	7.96E-04
Cumene	5.67E-02	5.34E-04	1.82E-04
1,2-Dichlorobenzene	1.72E-02	2.84E-04	9.68E-05
1,4-Dichlorobenzene	2.24E-02	3.22E-04	1.09E-04
1,1-Dichloroethane	2.71E-01	1.38E-03	4.70E-04
1,2-Dichloroethane	5.38E-02	6.24E-04	2.13E-04
1,1-Dichloroethene	9.69E-01	2.64E-03	9.00E-04
cis-1,2-Dichloroethene	1.84E-01	1.17E-03	3.97E-04
trans-1,2-Dichloroethene	1.90E-01	1.18E-03	4.03E-04
Ethylbenzene	6.53E-02	6.10E-04	2.08E-04
2-Hexanone	8.64E-03	2.29E-04	7.80E-05
Methyl tert-butyl ether	3.97E-02	5.02E-04	1.71E-04
4-Methyl-2-pentanone	8.20E-03	2.23E-04	7.61E-05
Methylene Chloride	1.85E-01	1.25E-03	4.24E-04
Styrene	2.28E-02	3.69E-04	1.26E-04
1,1,2,2-Tetrachloroethane	9.92E-03	2.04E-04	6.95E-05
Tetrachloroethene	4.29E-01	1.34E-03	4.57E-04
Tetrahydrofuran	7.97E-03	2.61E-04	8.90E-05
Toluene	9.83E-02	8.02E-04	2.73E-04
1,2,4-Trichlorobenzene	3.70E-03	1.12E-04	3.80E-05
1,1,1-Trichloroethane	6.20E-01	1.84E-03	6.26E-04
1,1,2-Trichloroethane	2.98E-02	4.10E-04	1.40E-04
Trichloroethene	3.34E-01	1.39E-03	4.73E-04
1,1,2-Trichloro-1,2,2-trifluoroethane	2.25E+00	2.68E-03	9.12E-04
1,2,4-Trimethylbenzene	3.60E-02	4.29E-04	1.46E-04
1,3,5-Trimethylbenzene	5.19E-02	5.11E-04	1.74E-04
Vinyl Chloride	1.13E+00	3.23E-03	1.10E-03
Xylenes (total)	4.91E-02	5.92E-04	2.02E-04
Semi-Volatile Organic Compounds (SVOCs)			
Acenaphthylene	1.65E-04	2.46E-05	8.39E-06
bis(2-Chloroethyl) ether	6.68E-04	6.87E-05	2.34E-05
2-Methylnaphthalene	6.53E-04	5.38E-05	1.83E-05
Naphthalene	1.03E-03	7.26E-05	2.47E-05

TABLE 10b
Estimated Soil-to-Air Transfer Factors
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Soil Transfer Factors (mg/m^3) / (mg/kg)		
	Indoor Worker [a]	Construction Worker [b]	Outdoor Worker [b]
Metals			
Mercury	3.03E-01	8.87E-04	5.58E-05

Notes:

(mg/m^3)/(mg/kg) = (milligram per cubic meter) per (milligram per kilogram)

[a] Calculated using a partition factor between soil and soil gas multiplied by a soil gas attenuation factor of 3000 (or a soil gas-to-air transfer factor of 3.33E-4) applied at the request of the oversight agencies for this project.

[b] Calculated using the Jury Model.

Source:

United States Environmental Protection Agency (USEPA). 1991. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, (Part B, Development of Risk-based Preliminary Remediation Goals), Interim. EPA/540/R/92/003 December.

TABLE 11
Carcinogenic and Noncarcinogenic Toxicity Values
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Toxicity Values								Chemical Category [a]
	Carcinogenic				Noncarcinogenic				
	Inhalation Unit Risk Factor (mg/m^3)$^{-1}$	Source	Oral Cancer Slope Factor (CSF) (mg/kg-day)$^{-1}$	Source	Inhalation Reference Concentration (RfC) (mg/m^3)	Source	Oral Reference Dose (RfD) (mg/kg-day)	Source	
Volatile Organic Compounds (VOCs)									
Acetone	----		----		3.10E+01	ATSDR	9.00E-01	IRIS	----
Benzene	7.80E-03	IRIS	5.50E-02	IRIS	3.00E-02	IRIS	4.00E-03	IRIS	3
2-Butanone	----		----		5.00E+00	IRIS	6.00E-01	IRIS	----
Carbon Disulfide	----		----		7.00E-01	IRIS	1.00E-01	IRIS	----
Chlorobenzene	----		----		5.00E-02	PPRTV	2.00E-02	IRIS	----
Chloroethane	----		----		1.00E+01	IRIS	----		----
Chloroform	2.30E-02	IRIS	3.10E-02	CalEPA	9.80E-02	ATSDR	1.00E-02	IRIS	----
Chloromethane	----		----		9.00E-02	IRIS	----		----
Cumene	----		----		4.00E-01	IRIS	1.00E-01	IRIS	----
1,2-Dichlorobenzene	----		----		2.00E-01	HEAST	9.00E-02	IRIS	----
1,4-Dichlorobenzene	1.10E-02	CalEPA	5.40E-03	CalEPA	8.00E-01	IRIS	7.00E-02	ATSDR	----
1,1-Dichloroethane	1.60E-03	CalEPA	5.70E-03	CalEPA	----		2.00E-01	PPRTV	----
1,2-Dichloroethane	2.60E-02	IRIS	9.10E-02	IRIS	2.40E+00	ATSDR	2.00E-02	PPRTV	----
1,1-Dichloroethene	----		----		2.00E-01	IRIS	5.00E-02	IRIS	----
cis-1,2-Dichloroethene	----		----		----		2.00E-03	IRIS	----
trans-1,2-Dichloroethene	----		----		6.00E-02	PPRTV	2.00E-02	IRIS	----
Ethylbenzene	2.50E-03	CalEPA	1.10E-02	CalEPA	1.00E+00	IRIS	1.00E-01	IRIS	----
2-Hexanone	----		----		3.00E-02	IRIS	5.00E-03	IRIS	----
Methyl tert-butyl ether	2.60E-04	CalEPA	1.80E-03	CalEPA	3.00E+00	IRIS	----		----
4-Methyl-2-pentanone	----		----		3.00E+00	IRIS	8.00E-02	HEAST	----
Methylene Chloride	4.70E-04	IRIS	7.50E-03	IRIS	1.00E+00	ATSDR	6.00E-02	IRIS	----
Styrene	----		----		1.00E+00	IRIS	2.00E-01	IRIS	3
1,1,2,2-Tetrachloroethane	5.80E-02	CalEPA	2.00E-01	IRIS	----		2.00E-02	IRIS	----
Tetrachloroethene	5.90E-03	CalEPA	5.40E-01	CalEPA	2.70E-01	ATSDR	1.00E-02	IRIS	----
Tetrahydrofuran	----		----		----		----		----
Toluene	----		----		5.00E+00	IRIS	8.00E-02	IRIS	----
1,2,4-Trichlorobenzene	----		2.90E-02	PPRTV	2.00E-03	PPRTV	1.00E-02	IRIS	----
1,1,1-Trichloroethane	----		----		5.00E+00	IRIS	2.00E+00	IRIS	----
1,1,2-Trichloroethane	1.60E-02	IRIS	5.70E-02	IRIS	----		4.00E-03	IRIS	----
Trichloroethene	2.00E-03	CalEPA	5.90E-03	CalEPA	----		----		----
1,1,2-Trichloro-1,2,2-trifluoroethane	----		----		3.00E+01	HEAST	3.00E+01	IRIS	----
1,2,4-Trimethylbenzene	----		----		7.00E-03	PPRTV	----		----
1,3,5-Trimethylbenzene	----		----		----		1.00E-02	PPRTV	----
Vinyl Chloride	4.40E-03	IRIS	7.20E-01	IRIS	1.00E-01	IRIS	3.00E-03	IRIS	----
Xylenes (total)	----		----		1.00E-01	IRIS	2.00E-01	IRIS	2

TABLE 11
Carcinogenic and Noncarcinogenic Toxicity Values
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Toxicity Values								Chemical Category [a]
	Carcinogenic				Noncarcinogenic				
	Inhalation Unit Risk Factor $(mg/m^3)^{-1}$	Source	Oral Cancer Slope Factor (CSF) $(mg/kg\text{-}day)^{-1}$	Source	Inhalation Reference Concentration (RfC) (mg/m^3)	Source	Oral Reference Dose (RfD) (mg/kg-day)	Source	
Semi-Volatile Organic Compounds (SVOCs)									
Acenaphthylene	----		----		----		----	----	----
bis(2-Chloroethoxy)methane	----		----		----		3.00E-03	PPRTV	----
bis(2-Chloroethyl) ether	3.30E-01	IRIS	1.10E+00	IRIS	----		----		----
bis(2-Ethylhexyl)phthalate	2.40E-03	CalEPA	1.40E-02	IRIS	----		2.00E-02	IRIS	----
Butylbenzylphthalate	----		1.90E-03	PPRTV	----		2.00E-01	IRIS	----
4-Chloroaniline	----		2.00E-01	PPRTV	----		4.00E-03	IRIS	----
Dimethylphthalate	----		----		----		----		----
Di-n-butylphthalate	----		----		----		1.00E-01	IRIS	----
Di-n-octylphthalate	----		----		----		----		----
Fluoranthene	----		----		----		4.00E-02	IRIS	----
Hexachlorobutadiene	2.20E-02	IRIS	7.80E-02	IRIS	----		1.00E-03	PPRTV	----
Hexachlorocyclopentadiene	----		----		2.00E-04	IRIS	6.00E-03	IRIS	----
Isophorone	----		9.50E-04	IRIS	2.00E+00	CalEPA	2.00E-01	IRIS	----
2-Methylnaphthalene	----		----		----		4.00E-03	IRIS	----
2-Methylphenol	----		----		6.00E-01	CalEPA	5.00E-02	IRIS	----
4-Methylphenol	----		----		6.00E-01	CalEPA	5.00E-03	HEAST	----
Naphthalene	3.40E-02	CalEPA	----		3.00E-03	IRIS	2.00E-02	IRIS	----
Phenol	----		----		2.00E-01	CalEPA	3.00E-01	IRIS	----
Pesticides/Polychlorinated Biphenyls									
Total Polychlorinated Biphenyls	5.70E-01	IRIS	2.00E+00	IRIS	----		----		----
Aroclor 1016	2.00E-02	IRIS	7.00E-02	IRIS	----		7.00E-05	IRIS	----
Aroclor 1254	5.70E-01	IRIS	2.00E+00	IRIS	----		2.00E-05	IRIS	----
Aldrin	4.90E+00	IRIS	1.70E+01	IRIS	----		3.00E-05	IRIS	----
Chlordane	1.00E-01 b	IRIS	3.50E-01 b	IRIS	7.00E-04 b	IRIS	5.00E-04 b	IRIS	----
4,4'-DDD	6.90E-02	CalEPA	2.40E-01	IRIS	----		----		----
4,4'-DDE	9.70E-02	CalEPA	3.40E-01	IRIS	----		----		----
4,4'-DDT	9.70E-02	IRIS	3.40E-01	IRIS	----		5.00E-04	IRIS	----
Dieldrin	4.60E+00	IRIS	1.60E+01	IRIS	----		5.00E-05	IRIS	----
Endosulfan I	----		----		----		6.00E-03 c	IRIS	----
Endosulfan II	----		----		----		6.00E-03 c	IRIS	----
Endosulfan sulfate	----		----		----		6.00E-03 c	IRIS	----
Endrin	----		----		----		3.00E-04	IRIS	----
Endrin aldehyde	----		----		----		3.00E-04 d	IRIS	----
Heptachlor	1.30E+00	IRIS	4.50E+00	IRIS	----		5.00E-04	IRIS	----
Heptachlor epoxide	2.60E+00	IRIS	9.10E+00	IRIS	----		1.30E-05	IRIS	----

TABLE 11
Carcinogenic and Noncarcinogenic Toxicity Values
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Toxicity Values								Chemical Category [a]
	Carcinogenic				Noncarcinogenic				
	Inhalation Unit Risk Factor (mg/m^3)$^{-1}$	Source	Oral Cancer Slope Factor (CSF) (mg/kg-day)$^{-1}$	Source	Inhalation Reference Concentration (RfC) (mg/m^3)	Source	Oral Reference Dose (RfD) (mg/kg-day)	Source	
alpha-Hexachlorocyclohexane	1.80E+00	IRIS	6.30E+00	IRIS	----		8.00E-03	ATSDR	----
beta-Hexachlorocyclohexane	5.30E-01	IRIS	1.80E+00	IRIS	----		----		----
delta-Hexachlorocyclohexane	----		----		----		----		----
gamma-Hexachlorocyclohexane	3.10E-01	CalEPA	1.10E+00	CalEPA			3.00E-04	IRIS	----
Methoxychlor	----		----		----		5.00E-03	IRIS	----
Toxaphene	3.20E-01	IRIS	1.10E+00	IRIS	----		----		----
Metals									
Antimony	----		----		----		4.00E-04	IRIS	----
Arsenic	4.30E+00	IRIS	1.50E+00	IRIS	1.50E-05	CalEPA	3.00E-04	IRIS	----
Barium	----		----		5.00E-04	HEAST	2.00E-01	IRIS	----
Beryllium	2.40E+00	IRIS	----		2.00E-05	IRIS	2.00E-03	IRIS	----
Cadmium	1.80E+00	IRIS	----		1.00E-05	ATSDR	1.00E-03	IRIS	----
Chromium (total)	----		----		----		----		----
Chromium III	----		----		----		1.50E+00 [e]	IRIS	----
Chromium VI	1.50E+02	CalEPA	----		1.00E-04	IRIS	3.00E-03	IRIS	----
Cobalt	9.00E+00	PPRTV	----		6.00E-06	PPRTV	3.00E-04	PPRTV	----
Copper	----		----		----		4.00E-02	HEAST	----
Lead	----		----		----		----		----
Mercury	----		----		3.00E-04	IRIS	1.60E-04	CalEPA	----
Molybdenum	----		----		----		5.00E-03	IRIS	----
Nickel	2.60E-01 [f]	CalEPA	----		9.00E-05	ATSDR	2.00E-02 [f]	IRIS	----
Selenium	----		----		2.00E-02	CalEPA	5.00E-03	IRIS	----
Silver	----		----		----		5.00E-03	IRIS	----
Thallium	----		----		----		----		----
Tin	----		----		----		6.00E-01	HEAST	----
Vanadium	----		----		----		5.00E-03 [g]	IRIS	----
Zinc	----		----		----		3.00E-01	IRIS	----

TABLE 11
Carcinogenic and Noncarcinogenic Toxicity Values
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	**Toxicity Values**								**Chemical Category [a]**
	Carcinogenic				**Noncarcinogenic**				
	Inhalation Unit Risk Factor $(mg/m^3)^{-1}$	**Source**	**Oral Cancer Slope Factor (CSF) $(mg/kg\text{-}day)^{-1}$**	**Source**	**Inhalation Reference Concentration (RfC) (mg/m^3)**	**Source**	**Oral Reference Dose (RfD) (mg/kg-day)**	**Source**	

Notes:

---- = No cancer slope factor or noncancer reference dose available
CalEPA = California Environmental Protection Agency (cited in USEPA 2010)
HEAST = Health Effects Assessment Summary Tables (cited in USEPA 2010)
IRIS = Integrated Risk Information System (cited in USEPA 2010)
PPRTV = Provisional Peer Reviewed Toxicity Values (cited in USEPA 2010b)
RSL = Region 9 Regional Screening Level (USEPA 2010)

[a] Chemical category classified based on Table 2 of USEPA 2009.

[b] Chlordane (technical) was used as a surrogate for chlordane.

[c] Endosulfan was used as a surrogate for endosulfan I, endosulfan II, endosulfan sulfate.

[d] Endrin was used as a surrogate for endrin aldehyde.

[e] Oral RfD is for Chromium (III) insoluble salts

[f] Oral RfD is for nickel soluble salts.

[g] The oral RfD toxicity value for Vanadium was derived from the IRIS oral RfD for vanadium pentoxide using a ratio of molecular weight (MW) as described by USEPA (2010).

Sources:

United States Environmental Protection Agency (USEPA) Regional Screening Levels. 2010. USEPA Region 9 RSLs. November. Available online at http://www.epa.gov/region09/superfund/prg/index.html.

TABLE 12

Risk-Based Target Concentrations (RBTCs) for Groundwater
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Water Solubility Limit [a] (mg/L)	Carcinogenic RBTC (mg/L)			Non-Carcinogenic RBTC (mg/L)		
		Construction Worker	Outdoor Worker	Indoor Worker	Construction Worker	Outdoor Worker	Indoor Worker
Volatile Organic Compounds (VOCs)							
Acetone	1.00E+06	----	----	----	1.40E+08	5.12E+07	9.38E+05
Benzene	1.79E+03	1.31E+04	8.52E+01	1.35E+00	4.39E+04	7.12E+03	1.13E+02
2-Butanone	2.23E+05	----	----	----	2.07E+07	7.03E+06	1.24E+05
Carbon Disulfide	2.16E+03	----	----	----	5.39E+05	8.62E+04	1.36E+03
Chlorobenzene	4.98E+02	----	----	----	9.27E+04	1.55E+04	2.46E+02
Chloroethane	6.71E+03	----	----	----	9.34E+06	1.50E+06	2.36E+04
Chloroform	7.95E+03	4.71E+03	3.12E+01	4.95E-01	1.52E+05	2.51E+04	3.99E+02
Chloromethane	5.32E+03	----	----	----	7.67E+04	1.23E+04	1.95E+02
Cumene	6.13E+01	----	----	----	6.63E+05	1.07E+05	1.68E+03
1,2-Dichlorobenzene	1.56E+02	----	----	----	4.42E+05	7.84E+04	1.25E+03
1,4-Dichlorobenzene	8.13E+01	1.39E+04	9.64E+01	1.53E+00	1.75E+06	3.03E+05	4.82E+03
1,1-Dichloroethane	5.04E+03	6.01E+04	3.92E+02	6.19E+00	----	----	----
1,2-Dichloroethane	8.60E+03	4.88E+03	3.51E+01	5.65E-01	4.35E+06	7.82E+05	1.26E+04
1,1-Dichloroethene	2.42E+03	----	----	----	1.35E+05	2.14E+04	3.37E+02
cis-1,2-Dichloroethene	6.41E+03	----	----	----	----	----	----
trans-1,2-Dichloroethene	4.52E+03	----	----	----	8.79E+04	1.44E+04	2.29E+02
Ethylbenzene	1.69E+02	4.62E+04	2.99E+02	4.72E+00	1.65E+06	2.67E+05	4.22E+03
2-Hexanone	1.72E+04	----	----	----	1.06E+05	2.92E+04	4.92E+02
Methyl tert-butyl ether	5.10E+04	6.69E+05	5.16E+03	8.38E+01	7.45E+06	1.44E+06	2.33E+04
4-Methyl-2-pentanone	1.90E+04	----	----	----	1.10E+07	3.09E+06	5.21E+04
Methylene Chloride	1.30E+04	1.95E+05	1.29E+03	2.06E+01	1.31E+06	2.17E+05	3.45E+03
Styrene	3.10E+02	----	----	----	2.03E+06	3.42E+05	5.43E+03
1,1,2,2-Tetrachloroethane	2.83E+03	3.43E+03	3.38E+01	5.53E-01	----	----	----
Tetrachloroethene	2.06E+02	1.51E+04	9.68E+01	1.52E+00	3.43E+05	5.51E+04	8.66E+02
Tetrahydrofuran	1.00E+06	----	----	----	----	----	----
Toluene	5.26E+02	----	----	----	7.78E+06	1.26E+06	1.99E+04
1,2,4-Trichlorobenzene	4.90E+01	----	----	----	5.10E+03	9.85E+02	1.57E+01
1,1,1-Trichloroethane	1.29E+03	----	----	----	5.49E+06	8.79E+05	1.38E+04
1,1,2-Trichloroethane	4.59E+03	9.39E+03	7.29E+01	1.18E+00	----	----	----
Trichloroethene	1.28E+03	4.67E+04	3.01E+02	4.75E+00	----	----	----
1,1,2-Trichloro-1,2,2-trifluoroethane	1.70E+02	----	----	----	3.49E+06	5.53E+05	8.68E+03
1,2,4-Trimethylbenzene	5.70E+01	----	----	----	1.38E+04	2.25E+03	3.55E+01
1,3,5-Trimethylbenzene	4.82E+01	----	----	----	----	----	----
Vinyl Chloride	8.80E+03	8.08E+03	5.14E+01	8.09E-01	5.08E+04	8.07E+03	1.27E+02
Xylenes (total)	1.06E+02	----	----	----	1.57E+05	2.56E+04	4.05E+02
Semi-Volatile Organic Compounds (SVOCs)							
Acenaphthylene	3.93E+00	----	----	----	----	----	----
bis(2-Chloroethyl) ether	1.72E+04	2.78E+03	4.96E+01	8.79E-01	----	----	----
2-Methylnaphthalene	2.46E+01	----	----	----	----	----	----
Naphthalene	3.10E+01	5.95E+03	5.34E+01	8.75E-01	8.67E+03	1.95E+03	3.19E+01

Notes:

mg/L = milligram per Liter

---- = No toxicity value available.

[a] The chemical-specific water solubility limit is the maximum concentration of the dissolved chemical in water.

TABLE 13

Risk-Based Target Concentrations (RBTCs) for Soil Gas[a]
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Vapor Pressure Limit[b] (mg/m^3)	Carcinogenic RBTC (mg/m^3)			Non-Carcinogenic RBTC (mg/m^3)		
		Construction Worker	Outdoor Worker	Indoor Worker	Construction Worker	Outdoor Worker	Indoor Worker
Volatile Organic Compounds (VOCs)							
Acetone	1.44E+06	----	----	----	2.12E+08	3.00E+07	4.08E+05
Benzene	4.07E+05	8.37E+04	4.73E+02	4.72E+00	2.80E+05	3.95E+04	3.95E+02
2-Butanone	5.20E+05	----	----	----	4.27E+07	6.03E+06	6.58E+04
Carbon Disulfide	1.28E+06	----	----	----	5.34E+06	7.55E+05	9.21E+03
Chlorobenzene	6.35E+04	----	----	----	5.82E+05	8.22E+04	6.58E+02
Chloroethane	3.05E+06	----	----	----	8.40E+07	1.19E+07	1.32E+05
Chloroform	1.20E+06	3.32E+04	1.87E+02	1.60E+00	1.07E+06	1.51E+05	1.29E+03
Chloromethane	1.92E+06	----	----	----	6.30E+05	8.89E+04	1.18E+03
Cumene	2.89E+04	----	----	----	5.60E+06	7.91E+05	5.26E+03
1,2-Dichlorobenzene	1.23E+04	----	----	----	2.99E+06	4.22E+05	2.63E+03
1,4-Dichlorobenzene	8.03E+03	9.69E+04	5.47E+02	3.35E+00	1.22E+07	1.72E+06	1.05E+04
1,1-Dichloroethane	1.16E+06	4.37E+05	2.47E+03	2.30E+01	----	----	----
1,2-Dichloroethane	4.16E+05	2.62E+04	1.48E+02	1.42E+00	2.33E+07	3.30E+06	3.16E+04
1,1-Dichloroethene	2.59E+06	----	----	----	1.95E+06	2.76E+05	2.63E+03
cis-1,2-Dichloroethene	1.07E+06	----	----	----	----	----	----
trans-1,2-Dichloroethene	7.56E+05	----	----	----	5.72E+05	8.08E+04	7.89E+02
Ethylbenzene	5.46E+04	3.46E+05	1.95E+03	1.47E+01	1.23E+07	1.74E+06	1.32E+04
2-Hexanone	6.57E+04	----	----	----	3.48E+05	4.91E+04	3.95E+02
Methyl tert-butyl ether	1.23E+06	2.99E+06	1.69E+04	1.42E+02	3.33E+07	4.71E+06	3.95E+04
4-Methyl-2-pentanone	1.07E+05	----	----	----	3.47E+07	4.90E+06	3.95E+04
Methylene Chloride	1.74E+06	1.25E+06	7.06E+03	7.84E+01	8.39E+06	1.18E+06	1.32E+04
Styrene	3.50E+04	----	----	----	1.18E+07	1.67E+06	1.32E+04
1,1,2,2-Tetrachloroethane	4.26E+04	2.02E+04	1.14E+02	6.35E-01	----	----	----
Tetrachloroethene	1.49E+05	1.99E+05	1.13E+03	6.24E+00	4.53E+06	6.40E+05	3.55E+03
Tetrahydrofuran	2.87E+06	----	----	----	----	----	----
Toluene	1.43E+05	----	----	----	5.38E+07	7.60E+06	6.58E+04
1,2,4-Trichlorobenzene	2.85E+03	----	----	----	4.17E+04	5.89E+03	2.63E+01
1,1,1-Trichloroethane	9.07E+05	----	----	----	6.46E+07	9.12E+06	6.58E+04
1,1,2-Trichloroethane	1.55E+05	5.44E+04	3.07E+02	2.30E+00	----	----	----
Trichloroethene	5.17E+05	4.26E+05	2.41E+03	1.84E+01	----	----	----
1,1,2-Trichloro-1,2,2-trifluoroethane	3.67E+06	----	----	----	6.63E+08	9.37E+07	3.95E+05
1,2,4-Trimethylbenzene	1.44E+04	----	----	----	9.63E+04	1.36E+04	9.21E+01
1,3,5-Trimethylbenzene	1.73E+04	----	----	----	----	----	----
Vinyl Chloride	1.00E+07	1.21E+05	6.86E+02	8.37E+00	7.64E+05	1.08E+05	1.32E+03
Xylenes (total)	2.25E+04	----	----	----	9.87E+05	1.39E+05	1.32E+03
Semi-Volatile Organic Compounds (SVOCs)							
Naphthalene	5.59E+02	2.84E+04	1.60E+02	1.08E+00	4.13E+04	5.84E+03	3.95E+01

Notes:

mg/m^3 = milligram per cubic meter

---- = No toxicity value available.

[a] Calculated for soil gas at a depth of five feet below ground surface (bgs).

[b] The vapor pressure limit is the maximum concentration of the chemical in air. At the vapor pressure limit, the chemical is at equilibrium with pure liquid or solid chemical.

TABLE 14

Risk-Based Target Concentrations (RBTCs) for Soil
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Soil Saturation Limit (mg/kg)	Carcinogenic RBTC (mg/kg)													Non-Carcinogenic RBTC (mg/kg)												
		Construction Worker					Outdoor Worker					Indoor Worker			Construction Worker					Outdoor Worker					Indoor Worker		
		Inhalation Vapors	Inhalation Particulates	Incidental Ingestion	Dermal Contact	All Pathways	Inhalation Vapors	Inhalation Particulates	Incidental Ingestion	Dermal Contact	All Pathways	Inhalation Vapors	Incidental Ingestion	All Pathways	Inhalation Vapors	Inhalation Particulates	Incidental Ingestion	Dermal Contact	All Pathways	Inhalation Vapors	Inhalation Particulates	Incidental Ingestion	Dermal Contact	All Pathways	Inhalation Vapors	Incidental Ingestion	All Pathways
Volatile Organic Compounds (VOCs)																											
Acetone	1.26E+05	----	----	----	----	----	----	----	----	----	----	----	----	----	3.39E+06	V	1.16E+06	ND	8.65E+05	2.65E+06	V	1.02E+06	ND	7.38E+05	5.00E+04	1.84E+06	4.87E+04
Benzene	7.71E+02	1.71E+02	V	1.64E+03	ND	1.54E+02	5.34E+00	V	5.78E+01	ND	4.89E+00	1.29E-02	1.04E+02	1.29E-02	5.70E+02	V	5.16E+03	ND	5.13E+02	4.47E+02	V	4.54E+03	ND	4.07E+02	1.08E+00	8.18E+03	1.08E+00
2-Butanone	2.90E+04	----	----	----	----	----	----	----	----	----	----	----	----	----	4.97E+05	V	7.74E+05	ND	3.03E+05	3.89E+05	V	6.81E+05	ND	2.48E+05	5.35E+03	1.23E+06	5.33E+03
Carbon Disulfide	4.64E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	5.10E+03	V	1.29E+05	ND	4.91E+03	3.99E+03	V	1.14E+05	ND	3.86E+03	4.50E+00	2.04E+05	4.50E+00
Chlorobenzene	2.98E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	1.74E+03	V	2.58E+04	ND	1.63E+03	1.36E+03	V	2.27E+04	ND	1.29E+03	4.82E+00	4.09E+04	4.82E+00
Chloroethane	1.37E+03	----	----	----	----	----	----	----	----	----	----	----	----	----	8.33E+04	V	----	----	8.33E+04	6.53E+04	V	----	----	6.53E+04	7.65E+01	----	7.65E+01
Chloroform	1.57E+03	5.13E+01	V	2.91E+03	ND	5.04E+01	1.61E+00	V	1.03E+02	ND	1.58E+00	2.93E-03	1.85E+02	2.93E-03	1.65E+03	V	1.29E+04	ND	1.46E+03	1.29E+03	V	1.14E+04	ND	1.16E+03	2.36E+00	2.04E+04	2.36E+00
Chloromethane	9.65E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	7.03E+02	V	----	----	7.03E+02	5.50E+02	V	----	----	5.50E+02	7.26E-01	----	7.26E-01
Cumene	9.48E+01	----	----	----	----	----	----	----	----	----	----	----	----	----	1.37E+04	V	1.29E+05	ND	1.24E+04	1.07E+04	V	1.14E+05	ND	9.79E+03	3.09E+01	2.04E+05	3.09E+01
1,2-Dichlorobenzene	1.39E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	1.28E+04	V	1.16E+05	ND	1.16E+04	1.01E+04	V	1.02E+05	ND	9.15E+03	5.10E+01	1.84E+05	5.10E+01
1,4-Dichlorobenzene	7.14E+01	3.61E+02	V	1.67E+04	ND	3.54E+02	1.13E+01	V	5.89E+02	ND	1.11E+01	4.99E-02	1.06E+03	4.99E-02	4.54E+04	V	9.03E+04	ND	3.02E+04	3.56E+04	V	7.95E+04	ND	2.46E+04	1.57E+02	1.43E+05	1.57E+02
1,1-Dichloroethane	1.03E+03	5.78E+02	V	1.58E+04	ND	5.58E+02	1.81E+01	V	5.58E+02	ND	1.75E+01	2.83E-02	1.00E+03	2.83E-02	----	----	2.58E+05	ND	2.58E+05	----	----	2.27E+05	ND	2.27E+05	----	4.09E+05	4.09E+05
1,2-Dichloroethane	1.75E+03	7.87E+01	V	9.93E+02	ND	7.29E+01	2.47E+00	V	3.49E+01	ND	2.30E+00	8.76E-03	6.29E+01	8.76E-03	7.02E+04	V	2.58E+04	ND	1.89E+04	5.50E+04	V	2.27E+04	ND	1.61E+04	1.95E+02	4.09E+04	1.94E+02
1,1-Dichloroethene	6.72E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	1.38E+03	V	6.45E+04	ND	1.35E+03	1.08E+03	V	5.68E+04	ND	1.06E+03	9.04E-01	1.02E+05	9.04E-01
cis-1,2-Dichloroethene	1.37E+03	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	2.58E+03	ND	2.58E+03	----	----	2.27E+03	ND	2.27E+03	----	4.09E+03	4.09E+03
trans-1,2-Dichloroethene	9.68E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	9.26E+02	V	2.58E+04	ND	8.94E+02	7.25E+02	V	2.27E+04	ND	7.03E+02	1.39E+00	4.09E+04	1.39E+00
Ethylbenzene	1.75E+02	8.37E+02	V	8.21E+03	ND	7.60E+02	2.62E+01	V	2.89E+02	ND	2.40E+01	7.51E-02	5.20E+02	7.51E-02	2.99E+04	V	1.29E+05	ND	2.43E+04	2.34E+04	V	1.14E+05	ND	1.94E+04	6.70E+01	2.04E+05	6.70E+01
2-Hexanone	2.60E+03	----	----	----	----	----	----	----	----	----	----	----	----	----	2.39E+03	V	6.45E+03	ND	1.74E+03	1.87E+03	V	5.68E+03	ND	1.41E+03	1.52E+01	1.02E+04	1.52E+01
Methyl tert-butyl ether	7.45E+03	9.80E+03	V	5.02E+04	ND	8.20E+03	3.07E+02	V	1.77E+03	ND	2.61E+02	1.19E+00	3.18E+03	1.19E+00	1.09E+05	V	----	----	1.09E+05	8.55E+04	V	----	----	8.55E+04	3.31E+02	----	3.31E+02
4-Methyl-2-pentanone	2.78E+03	----	----	----	----	----	----	----	----	----	----	----	----	----	2.45E+05	V	1.03E+05	ND	7.26E+04	1.92E+05	V	9.08E+04	ND	6.17E+04	1.60E+03	1.64E+05	1.59E+03
Methylene Chloride	2.29E+03	2.18E+03	V	1.20E+04	ND	1.85E+03	6.83E+01	V	4.24E+02	ND	5.88E+01	1.41E-01	7.63E+02	1.41E-01	1.46E+04	V	7.74E+04	ND	1.23E+04	1.15E+04	V	6.81E+04	ND	9.82E+03	2.37E+01	1.23E+05	2.37E+01
Styrene	3.17E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	4.95E+04	V	2.58E+05	ND	4.15E+04	3.88E+04	V	2.27E+05	ND	3.31E+04	1.92E+02	4.09E+05	1.92E+02
1,1,2,2-Tetrachloroethane	8.82E+02	1.08E+02	V	4.52E+02	ND	8.71E+01	3.38E+00	V	1.59E+01	ND	2.79E+00	2.13E-02	2.86E+01	2.13E-02	----	----	2.58E+04	ND	2.58E+04	----	----	2.27E+04	ND	2.27E+04	----	4.09E+04	4.09E+04
Tetrachloroethene	7.52E+01	1.61E+02	V	1.67E+02	ND	8.22E+01	5.06E+00	V	5.89E+00	ND	2.72E+00	4.84E-03	1.06E+01	4.84E-03	3.67E+03	V	1.29E+04	ND	2.86E+03	2.88E+03	V	1.14E+04	ND	2.30E+03	2.76E+00	2.04E+04	2.76E+00
Tetrahydrofuran	1.23E+05	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Toluene	3.21E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	1.14E+05	V	1.03E+05	ND	5.41E+04	8.91E+04	V	9.08E+04	ND	4.50E+04	2.23E+02	1.64E+05	2.23E+02
1,2,4-Trichlorobenzene	1.39E+02	----	----	3.11E+03	ND	3.11E+03	----	----	1.10E+02	ND	1.10E+02	----	1.97E+02	1.97E+02	3.27E+02	V	1.29E+04	ND	3.19E+02	2.56E+02	V	1.14E+04	ND	2.50E+02	2.37E+00	2.04E+04	2.37E+00
1,1,1-Trichloroethane	3.43E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	4.97E+04	V	2.58E+06	ND	4.87E+04	3.89E+04	V	2.27E+06	ND	3.82E+04	3.53E+01	4.09E+06	3.53E+01
1,1,2-Trichloroethane	1.12E+03	1.95E+02	V	1.58E+03	ND	1.73E+02	6.10E+00	V	5.58E+01	ND	5.50E+00	2.58E-02	1.00E+02	2.58E-02	----	----	5.16E+03	ND	5.16E+03	----	----	4.54E+03	ND	4.54E+03	----	8.18E+03	8.18E+03
Trichloroethene	3.51E+02	4.59E+02	V	1.53E+04	ND	4.46E+02	1.44E+01	V	5.39E+02	ND	1.40E+01	1.84E-02	9.70E+02	1.84E-02	----	----	----	----	----	----	----	----	----	----	----	----	----
1,1,2-Trichloro-1,2,2-trifluoroethane	3.98E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	2.04E+05	V	3.87E+07	ND	2.03E+05	1.60E+05	V	3.41E+07	ND	1.59E+05	5.83E+01	6.13E+07	5.83E+01
1,2,4-Trimethylbenzene	7.79E+01	----	----	----	----	----	----	----	----	----	----	----	----	----	2.98E+02	V	----	----	2.98E+02	2.33E+02	V	----	----	2.33E+02	8.52E-01	----	8.52E-01
1,3,5-Trimethylbenzene	6.50E+01	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.29E+04	ND	1.29E+04	----	----	1.14E+04	ND	1.14E+04	----	2.04E+04	2.04E+04
Vinyl Chloride	2.38E+03	8.98E+01	V	1.25E+02	ND	5.23E+01	2.81E+00	V	4.42E+00	ND	1.72E+00	2.46E-03	7.95E+00	2.46E-03	5.64E+02	V	3.87E+03	ND	4.93E+02	4.42E+02	V	3.41E+03	ND	3.91E+02	3.86E-01	6.13E+03	3.86E-01
Xylenes (total)	9.56E+01	----	----	----	----	----	----	----	----	----	----	----	----	----	3.08E+03	V	2.58E+05	ND	3.05E+03	2.41E+03	V	2.27E+05	ND	2.39E+03	8.91E+00	4.09E+05	8.91E+00
Semi-Volatile Organic Compounds (SVOCs)																											
Acenaphthylene	3.81E+01	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
bis(2-Chloroethoxy)methane	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	3.87E+03	1.29E+04	2.98E+03	----	----	3.41E+03	5.16E+03	2.05E+03	----	6.13E+03	6.13E+03
bis(2-Chloroethyl) ether	3.19E+03	5.63E+01	V	8.21E+01	ND	3.34E+01	1.77E+00	V	2.89E+00	ND	1.10E+00	5.57E-02	5.20E+00	5.51E-02	----	----	----	----	----	----	----	----	----	----	----	----	----
bis(2-Ethylhexyl)phthalate	----	NV	7.71E+05	6.45E+03	2.15E+04	4.93E+03	NV	7.72E+06	2.27E+02	3.44E+02	1.37E+02	NV	4.09E+02	4.09E+02	----	----	2.58E+04	8.60E+04	1.99E+04	----	----	2.27E+04	3.44E+04	1.37E+04	----	4.09E+04	4.09E+04
Butylbenzylphthalate	----	----	----	4.75E+04	1.58E+05	3.66E+04	----	----	1.67E+03	2.54E+03	1.01E+03	----	3.01E+03	3.01E+03	----	----	2.58E+05	8.60E+05	1.99E+05	----	----	2.27E+05	3.44E+05	1.37E+05	----	4.09E+05	4.09E+05
4-Chloroaniline	----	----	----	4.52E+02	1.51E+03	3.47E+02	----	----	1.59E+01	2.41E+01	9.58E+00	----	2.86E+01	2.86E+01	----	----	5.16E+03	1.72E+04	3.97E+03	----	----	4.54E+03	6.88E+03	2.74E+03	----	8.18E+03	8.18E+03
Dimethylphthalate	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Di-n-butylphthalate	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.29E+05	4.30E+05	9.93E+04	----	----	1.14E+05	1.72E+05	6.84E+04	----	2.04E+05	2.04E+05
Di-n-octylphthalate	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Fluoranthene	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5.16E+04	1.32E+05	3.71E+04	----	----	4.54E+04	5.29E+04	2.44E+04	----	8.18E+04	8.18E+04
Hexachlorobutadiene	----	NV	8.42E+04	1.16E+03	3.86E+03	8.81E+02	NV	8.42E+05	4.08E+01	6.18E+01	2.46E+01	NV	7.34E+01	7.34E+01	----	----	1.29E+03	4.30E+03	9.93E+02	----	----	1.14E+03	1.72E+03	6.84E+02	----	2.04E+03	2.04E+03
Hexachlorocyclopentadiene	----	----	----	----	----	----	----	----	----	----	----	----	----	----	NV	5.29E+03	7.74E+03	2.58E+04	2.80E+03	NV	1.32E+06	6.81E+03	1.03E+04	4.09E+03	NV	1.23E+04	1.23E+04
Isophorone	----	----	----	9.51E+04	3.17E+05	7.31E+04	----	----	3.35E+03	5.07E+03	2.02E+03	----	6.02E+03	6.02E+03	NV	5.29E+07	2.58E+05	8.60E+05	1.98E+05	NV	1.32E+10	2.27E+05	3.44E+05	1.37E+05	NV	4.09E+05	4.09E+05
2-Methylnaphthalene	1.25E+02	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5.16E+03	1.32E+04	3.71E+03	----	----	4.54E+03	5.29E+03	2.44E+03	----	8.18E+03	8.18E+03
2-Methylphenol	----	----	----	----	----	----	----	----	----	----	----	----	----	----	NV	1.59E+07	6.45E+04	2.15E+05	4.95E+04	NV	3.97E+09	5.68E+04	8.60E+04	3.42E+04	NV	1.02E+05	1.02E+05
4-Methylphenol	----	----	----	----	----	----	----	----	----	----	----	----	----	----	NV	1.59E+07	6.45E+03	2.15E+04	4.96E+03	NV	3.97E+09	5.68E+03	8.60E+03	3.42E+03	NV	1.02E+04	1.02E+04
Naphthalene	9.95E+01	5.18E+02	V	----	----	5.18E+02	1.62E+01	V	----	----	1.62E+01	3.50E-01	----	3.50E-01	7.55E+02	V	2.58E+04	6.62E+04	7.25E+02	5.91E+02	V	2.27E+04	2.65E+04	5.64E+02	1.28E+01	4.09E+04	1.28E+01
Phenol	----	----	----	----	----	----	----	----	----	----	----	----	----	----	NV	5.29E+06	3.87E+05	1.29E+06	2.82E+05	NV	1.32E+09	3.41E+05	5.16E+05	2.05E+05	NV	6.13E+05	6.13E+05

TABLE 14

Risk-Based Target Concentrations (RBTCs) for Soil
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Soil Saturation Limit (mg/kg)	Carcinogenic RBTC (mg/kg)													Non-Carcinogenic RBTC (mg/kg)												
		Construction Worker					Outdoor Worker					Indoor Worker			Construction Worker					Outdoor Worker					Indoor Worker		
		Inhalation Vapors	Inhalation Particulates	Incidental Ingestion	Dermal Contact	All Pathways	Inhalation Vapors	Inhalation Particulates	Incidental Ingestion	Dermal Contact	All Pathways	Inhalation Vapors	Incidental Ingestion	All Pathways	Inhalation Vapors	Inhalation Particulates	Incidental Ingestion	Dermal Contact	All Pathways	Inhalation Vapors	Inhalation Particulates	Incidental Ingestion	Dermal Contact	All Pathways	Inhalation Vapors	Incidental Ingestion	All Pathways
Pesticides/Polychlorinated Biphenyls																											
Total Polychlorinated Biphenyls	----	NV	3.25E+03	4.52E+01	1.08E+02	3.15E+01	NV	3.25E+04	1.59E+00	1.72E+00	8.26E-01	NV	2.86E+00	2.86E+00	----	----	----	----	----	----	----	----	----	----	----	----	----
Aroclor 1016	----	NV	9.26E+04	1.29E+03	3.07E+03	9.00E+02	NV	9.27E+05	4.54E+01	4.92E+01	2.36E+01	NV	8.18E+01	8.18E+01	----	----	9.03E+01	2.15E+02	6.36E+01	----	----	7.95E+01	8.60E+01	4.13E+01	----	1.43E+02	1.43E+02
Aroclor 1254	----	NV	3.25E+03	4.52E+01	1.08E+02	3.15E+01	NV	3.25E+04	1.59E+00	1.72E+00	8.26E-01	NV	2.86E+00	2.86E+00	----	----	2.58E+01	6.14E+01	1.82E+01	----	----	2.27E+01	2.46E+01	1.18E+01	----	4.09E+01	4.09E+01
Aldrin	----	NV	3.78E+02	5.31E+00	1.77E+01	4.04E+00	NV	3.78E+03	1.87E-01	2.83E-01	1.13E-01	NV	3.37E-01	3.37E-01	----	----	3.87E+01	1.29E+02	2.98E+01	----	----	3.41E+01	5.16E+01	2.05E+01	----	6.13E+01	6.13E+01
Chlordane	----	NV	1.85E+04	2.58E+02	2.15E+03	2.28E+02	NV	1.85E+05	9.08E+00	3.44E+01	7.19E+00	NV	1.64E+01	1.64E+01	NV	1.85E+04	6.45E+02	5.38E+03	5.59E+02	NV	4.63E+06	5.68E+02	2.15E+03	4.49E+02	NV	1.02E+03	1.02E+03
4,4'-DDD	----	NV	2.68E+04	3.76E+02	1.25E+03	2.86E+02	NV	2.69E+05	1.32E+01	2.01E+01	7.98E+00	NV	2.38E+01	2.38E+01	----	----	----	----	----	----	----	----	----	----	----	----	----
4,4'-DDE	----	NV	1.91E+04	2.66E+02	8.86E+02	2.02E+02	NV	1.91E+05	9.35E+00	1.42E+01	5.63E+00	NV	1.68E+01	1.68E+01	----	----	----	----	----	----	----	----	----	----	----	----	----
4,4'-DDT	----	NV	1.91E+04	2.66E+02	2.95E+03	2.41E+02	NV	1.91E+05	9.35E+00	4.72E+01	7.81E+00	NV	1.68E+01	1.68E+01	----	----	6.45E+02	7.17E+03	5.92E+02	----	----	5.68E+02	2.87E+03	4.74E+02	----	1.02E+03	1.02E+03
Dieldrin	----	NV	4.02E+02	5.65E+00	1.88E+01	4.30E+00	NV	4.03E+03	1.99E-01	3.01E-01	1.20E-01	NV	3.58E-01	3.58E-01	----	----	6.45E+01	2.15E+02	4.96E+01	----	----	5.68E+01	8.60E+01	3.42E+01	----	1.02E+02	1.02E+02
Endosulfan I	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7.74E+03	2.58E+04	5.96E+03	----	----	6.81E+03	1.03E+04	4.10E+03	----	1.23E+04	1.23E+04
Endosulfan II	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7.74E+03	2.58E+04	5.96E+03	----	----	6.81E+03	1.03E+04	4.10E+03	----	1.23E+04	1.23E+04
Endosulfan sulfate	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7.74E+03	2.58E+04	5.96E+03	----	----	6.81E+03	1.03E+04	4.10E+03	----	1.23E+04	1.23E+04
Endrin	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	3.87E+02	1.29E+03	2.98E+02	----	----	3.41E+02	5.16E+02	2.05E+02	----	6.13E+02	6.13E+02
Endrin aldehyde	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	3.87E+02	1.29E+03	2.98E+02	----	----	3.41E+02	5.16E+02	2.05E+02	----	6.13E+02	6.13E+02
Heptachlor	----	NV	1.42E+03	2.01E+01	6.69E+01	1.53E+01	NV	1.43E+04	7.07E-01	1.07E+00	4.26E-01	NV	1.27E+00	1.27E+00	----	----	6.45E+02	2.15E+03	4.96E+02	----	----	5.68E+02	8.60E+02	3.42E+02	----	1.02E+03	1.02E+03
Heptachlor epoxide	----	NV	7.12E+02	9.93E+00	3.31E+01	7.55E+00	NV	7.13E+03	3.49E-01	5.29E-01	2.10E-01	NV	6.29E-01	6.29E-01	----	----	1.68E+01	5.59E+01	1.29E+01	----	----	1.48E+01	2.24E+01	8.89E+00	----	2.66E+01	2.66E+01
alpha-Hexachlorocyclohexane	----	NV	1.03E+03	1.43E+01	4.78E+01	1.09E+01	NV	1.03E+04	5.05E-01	7.65E-01	3.04E-01	NV	9.08E-01	9.08E-01	----	----	1.03E+04	3.44E+04	7.94E+03	----	----	9.08E+03	1.38E+04	5.47E+03	----	1.64E+04	1.64E+04
beta-Hexachlorocyclohexane	----	NV	3.49E+03	5.02E+01	1.67E+02	3.82E+01	NV	3.50E+04	1.77E+00	2.68E+00	1.06E+00	NV	3.18E+00	3.18E+00	----	----	----	----	----	----	----	----	----	----	----	----	----
delta-Hexachlorocyclohexane	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
gamma-Hexachlorocyclohexane	----	NV	5.97E+03	8.21E+01	6.84E+02	7.24E+01	NV	5.98E+04	2.89E+00	1.09E+01	2.29E+00	NV	5.20E+00	5.20E+00	NV	----	3.87E+02	3.23E+03	3.46E+02	NV	----	3.41E+02	1.29E+03	2.70E+02	NV	6.13E+02	6.13E+02
Methoxychlor	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	6.45E+03	2.15E+04	4.96E+03	----	----	5.68E+03	8.60E+03	3.42E+03	----	1.02E+04	1.02E+04
Toxaphene	----	NV	5.79E+03	8.21E+01	2.74E+02	6.25E+01	NV	5.79E+04	2.89E+00	4.38E+00	1.74E+00	NV	5.20E+00	5.20E+00	----	----	----	----	----	----	----	----	----	----	----	----	----
Metals																											
Antimony	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5.16E+02	ND	5.16E+02	----	----	4.54E+02	ND	4.54E+02	----	8.18E+02	8.18E+02
Arsenic	----	NV	4.31E+02	6.02E+01	6.69E+02	4.90E+01	NV	4.31E+03	2.12E+00	1.07E+01	1.77E+00	NV	3.82E+00	3.82E+00	NV	3.97E+02	3.87E+02	4.30E+03	1.87E+02	NV	9.93E+04	3.41E+02	1.72E+03	2.84E+02	NV	6.13E+02	6.13E+02
Barium	----	----	----	----	----	----	----	----	----	----	----	----	----	----	NV	1.32E+04	2.58E+05	ND	1.26E+04	NV	3.31E+06	2.27E+05	ND	2.13E+05	NV	4.09E+05	4.09E+05
Beryllium	----	NV	7.71E+02	----	----	7.71E+02	NV	7.72E+03	----	----	7.72E+03	NV	----	----	NV	5.29E+02	2.58E+03	ND	4.39E+02	NV	1.32E+05	2.27E+03	ND	2.23E+03	NV	4.09E+03	4.09E+03
Cadmium	----	NV	1.03E+03	----	----	1.03E+03	NV	1.03E+04	----	----	1.03E+04	NV	----	----	NV	2.64E+02	1.29E+03	1.08E+04	2.15E+02	NV	6.62E+04	1.14E+03	4.30E+03	8.86E+02	NV	2.04E+03	2.04E+03
Chromium (total)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Chromium III	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.94E+06	ND	1.94E+06	----	----	1.70E+06	ND	1.70E+06	----	3.07E+06	3.07E+06
Chromium VI	----	NV	1.23E+01	----	----	1.23E+01	NV	1.24E+02	----	----	1.24E+02	NV	----	----	NV	2.64E+03	3.87E+03	ND	1.57E+03	NV	6.62E+05	3.41E+03	ND	3.39E+03	NV	6.13E+03	6.13E+03
Cobalt	----	NV	2.06E+02	----	----	2.06E+02	NV	2.06E+03	----	----	2.06E+03	NV	----	----	NV	1.59E+02	3.87E+02	ND	1.13E+02	NV	3.97E+04	3.41E+02	ND	3.38E+02	NV	6.13E+02	6.13E+02
Copper	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5.16E+04	ND	5.16E+04	----	----	4.54E+04	ND	4.54E+04	----	8.18E+04	8.18E+04
Lead	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Mercury	5.02E+00	----	----	----	----	----	----	----	----	----	----	----	----	----	6.17E+00	V	2.06E+02	ND	5.99E+00	2.62E+01	V	1.82E+02	ND	2.29E+01	4.34E-03	3.27E+02	4.34E-03
Molybdenum	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	6.45E+03	ND	6.45E+03	----	----	5.68E+03	ND	5.68E+03	----	1.02E+04	1.02E+04
Nickel	----	NV	7.12E+03	----	----	7.12E+03	NV	7.13E+04	----	----	7.13E+04	NV	----	----	NV	2.38E+03	2.58E+04	ND	2.18E+03	NV	5.96E+05	2.27E+04	ND	2.19E+04	NV	4.09E+04	4.09E+04
Selenium	----	----	----	----	----	----	----	----	----	----	----	----	----	----	NV	5.29E+05	6.45E+03	ND	6.37E+03	NV	1.32E+08	5.68E+03	ND	5.68E+03	NV	1.02E+04	1.02E+04
Silver	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	6.45E+03	ND	6.45E+03	----	----	5.68E+03	ND	5.68E+03	----	1.02E+04	1.02E+04
Thallium	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Tin	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7.74E+05	ND	7.74E+05	----	----	6.81E+05	ND	6.81E+05	----	1.23E+06	1.23E+06
Vanadium	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	6.45E+03	ND	6.45E+03	----	----	5.68E+03	ND	5.68E+03	----	1.02E+04	1.02E+04
Zinc	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	3.87E+05	ND	3.87E+05	----	----	3.41E+05	ND	3.41E+05	----	6.13E+05	6.13E+05

Notes:
NV = not volatile.
mg/kg = milligram per kilogram
---- = No toxicity value available.
ND= The dermal absorption fraction from soil for this chemical is zero.

TABLE 15
Minimum Risk-Based Target Concentrations
Former Romic Environmental Technologies Site
East Palo Alto, California

	Environmental Media											
	Groundwater (mg/L)				**Soil Gas (mg/m^3) [a]**				**Soil (mg/kg)**			
Chemical	**RBTC**	**Water Solubility Limit**	**RBTC Scenario**		**RBTC**	**Vapor Pressure Limit**	**RBTC Scenario**		**RBTC**	**Saturation Limit**	**RBTC Scenario**	
Volatile Organic Compounds (VOCs)												
Acetone	940000	1000000	indoor worker	NC	410000	1400000	indoor worker	NC	49000	130000	indoor worker	NC
Benzene	1.3	1800	indoor worker	C	4.7	410000	indoor worker	C	0.013	770	indoor worker	C
2-Butanone	120000	220000	indoor worker	NC	66000	520000	indoor worker	NC	5300	29000	indoor worker	NC
Carbon Disulfide	1400	2200	indoor worker	NC	9200	1300000	indoor worker	NC	4.5	460	indoor worker	NC
Chlorobenzene	250	500	indoor worker	NC	660	63000	indoor worker	NC	4.8	300	indoor worker	NC
Chloroethane	**24000**	6700	indoor worker	NC	130000	3100000	indoor worker	NC	77	1400	indoor worker	NC
Chloroform	0.5	8000	indoor worker	C	1.6	1200000	indoor worker	C	0.0029	1600	indoor worker	C
Chloromethane	190	5300	indoor worker	NC	1200	1900000	indoor worker	NC	0.73	970	indoor worker	NC
Cumene	**1700**	61	indoor worker	NC	5300	29000	indoor worker	NC	31	95	indoor worker	NC
1,2-Dichlorobenzene	**1200**	160	indoor worker	NC	2600	12000	indoor worker	NC	51	140	indoor worker	NC
1,4-Dichlorobenzene	1.5	81	indoor worker	C	3.3	8000	indoor worker	C	0.05	71	indoor worker	C
1,1-Dichloroethane	6.2	5000	indoor worker	C	23	1200000	indoor worker	C	0.028	1000	indoor worker	C
1,2-Dichloroethane	0.56	8600	indoor worker	C	1.4	420000	indoor worker	C	0.0088	1800	indoor worker	C
1,1-Dichloroethene	340	2400	indoor worker	NC	2600	2600000	indoor worker	NC	0.9	670	indoor worker	NC
cis-1,2-Dichloroethene	----	6400	----	----	----	1100000	----	----	**2300**	1400	outdoor worker	NC
trans-1,2-Dichloroethene	230	4500	indoor worker	NC	790	760000	indoor worker	NC	1.4	970	indoor worker	NC
Ethylbenzene	4.7	170	indoor worker	C	15	55000	indoor worker	C	0.075	180	indoor worker	C
2-Hexanone	490	17000	indoor worker	NC	390	66000	indoor worker	NC	15	2600	indoor worker	NC
Methyl tert-butyl ether	84	51000	indoor worker	C	140	1200000	indoor worker	C	1.2	7400	indoor worker	C
4-Methyl-2-pentanone	**52000**	19000	indoor worker	NC	39000	110000	indoor worker	NC	1600	2800	indoor worker	NC
Methylene Chloride	21	13000	indoor worker	C	78	1700000	indoor worker	C	0.14	2300	indoor worker	C
Styrene	**5400**	310	indoor worker	NC	13000	35000	indoor worker	NC	190	320	indoor worker	NC
1,1,2,2-Tetrachloroethane	0.55	2800	indoor worker	C	0.63	43000	indoor worker	C	0.021	880	indoor worker	C
Tetrachloroethene	1.5	210	indoor worker	C	6.2	150000	indoor worker	C	0.0048	75	indoor worker	C
Tetrahydrofuran	----	1000000	----	----	----	2900000	----	----	----	120000	----	----
Toluene	**20000**	530	indoor worker	NC	66000	140000	indoor worker	NC	220	320	indoor worker	NC

TABLE 15
Minimum Risk-Based Target Concentrations
Former Romic Environmental Technologies Site
East Palo Alto, California

	Environmental Media											
	Groundwater (mg/L)				**Soil Gas (mg/m^3) [a]**				**Soil (mg/kg)**			
Chemical	**RBTC**	**Water Solubility Limit**	**RBTC Scenario**		**RBTC**	**Vapor Pressure Limit**	**RBTC Scenario**		**RBTC**	**Saturation Limit**	**RBTC Scenario**	
1,2,4-Trichlorobenzene	16	49	indoor worker	NC	26	2800	indoor worker	NC	2.4	140	indoor worker	NC
1,1,1-Trichloroethane	**14000**	1300	indoor worker	NC	66000	910000	indoor worker	NC	35	340	indoor worker	NC
1,1,2-Trichloroethane	1.2	4600	indoor worker	C	2.3	160000	indoor worker	C	0.026	1100	indoor worker	C
Trichloroethene	4.8	1300	indoor worker	C	18	520000	indoor worker	C	0.018	350	indoor worker	C
1,1,2-Trichloro-1,2,2-trifluoroethane	**8700**	170	indoor worker	NC	390000	3700000	indoor worker	NC	58	400	indoor worker	NC
1,2,4-Trimethylbenzene	35	57	indoor worker	NC	92	14000	indoor worker	NC	0.85	78	indoor worker	NC
1,3,5-Trimethylbenzene	----	48	----	----	----	17000	----	----	**11000**	65	outdoor worker	NC
Vinyl Chloride	0.81	8800	indoor worker	C	8.4	10000000	indoor worker	C	0.0025	2400	indoor worker	C
Xylenes (total)	**400**	110	indoor worker	NC	1300	23000	indoor worker	NC	8.9	96	indoor worker	NC
Semi-Volatile Organic Compounds (SVOCs)												
Acenaphthylene	----	3.9	----	----	----	18	----	----	----	38	----	----
bis(2-Chloroethoxy)methane	----	----	----	----	----	----	----	----	2100	----	outdoor worker	NC
bis(2-Chloroethyl) ether	0.88	17000	indoor worker	C	----	12000	----	----	0.055	3200	indoor worker	C
bis(2-Ethylhexyl)phthalate	----	----	----	----	----	----	----	----	140	----	outdoor worker	C
Butylbenzylphthalate	----	----	----	----	----	----	----	----	1000	----	outdoor worker	C
4-Chloroaniline	----	----	----	----	----	----	----	----	9.6	----	outdoor worker	C
Dimethylphthalate	----	----	----	----	----	----	----	----	----	----	----	----
Di-n-butylphthalate	----	----	----	----	----	----	----	----	68000	----	outdoor worker	NC
Di-n-octylphthalate	----	----	----	----	----	----	----	----	----	----	----	----
Fluoranthene	----	----	----	----	----	----	----	----	24000	----	outdoor worker	NC
Hexachlorobutadiene	----	3.2	----	----	----	1100	----	----	25	----	outdoor worker	C
Hexachlorocyclopentadiene	----	1.8	----	----	----	2000	----	----	4100	----	outdoor worker	NC
Isophorone	----	----	----	----	----	----	----	----	2000	----	outdoor worker	C
2-Methylnaphthalene	----	25	----	----	----	520	----	----	**2400**	120	outdoor worker	NC
2-Methylphenol	----	----	----	----	----	----	----	----	34000	----	outdoor worker	NC
4-Methylphenol	----	----	----	----	----	----	----	----	3400	----	outdoor worker	NC
Naphthalene	0.88	31	indoor worker	C	1.1	560	indoor worker	C	0.35	100	indoor worker	C
Phenol	----	----	----	----	----	----	----	----	210000	----	outdoor worker	NC

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Former Romic Environmental Technologies Site
East Palo Alto, California

	Environmental Media											
	Groundwater (mg/L)				**Soil Gas (mg/m^3) [a]**				**Soil (mg/kg)**			
Chemical	**RBTC**	**Water Solubility Limit**	**RBTC Scenario**		**RBTC**	**Vapor Pressure Limit**	**RBTC Scenario**		**RBTC**	**Saturation Limit**	**RBTC Scenario**	
Pesticides/Polychlorinated Biphenyls												
Total Polychlorinated Biphenyls	----	----	----	----	----	----	----	----	0.83	----	outdoor worker	C
Aroclor 1016	----	----	----	----	----	----	----	----	24	----	outdoor worker	C
Aroclor 1254	----	----	----	----	----	----	----	----	0.83	----	outdoor worker	C
Aldrin	----	0.017	----	----	----	----	----	----	0.11	----	outdoor worker	C
Chlordane	----	0.056	----	----	----	----	----	----	7.2	----	outdoor worker	C
4,4'-DDD	----	----	----	----	----	----	----	----	8	----	outdoor worker	C
4,4'-DDE	----	0.12	----	----	----	----	----	----	5.6	----	outdoor worker	C
4,4'-DDT	----	----	----	----	----	----	----	----	7.8	----	outdoor worker	C
Dieldrin	----	0.2	----	----	----	----	----	----	0.12	----	outdoor worker	C
Endosulfan I	----	----	----	----	----	----	----	----	4100	----	outdoor worker	NC
Endosulfan II	----	----	----	----	----	----	----	----	4100	----	outdoor worker	NC
Endosulfan sulfate	----	----	----	----	----	----	----	----	4100	----	outdoor worker	NC
Endrin	----	----	----	----	----	----	----	----	210	----	outdoor worker	NC
Endrin aldehyde	----	----	----	----	----	----	----	----	210	----	outdoor worker	NC
Heptachlor	----	0.18	----	----	----	----	----	----	0.43	----	outdoor worker	C
Heptachlor epoxide	----	----	----	----	----	----	----	----	0.21	----	outdoor worker	C
alpha-Hexachlorocyclohexane	----	2	----	----	----	----	----	----	0.3	----	outdoor worker	C
beta-Hexachlorocyclohexane	----	----	----	----	----	----	----	----	1.1	----	outdoor worker	C
delta-Hexachlorocyclohexane	----	----	----	----	----	----	----	----	----	----	----	----
gamma-Hexachlorocyclohexane	----	7.3	----	----	----	----	----	----	2.3	----	outdoor worker	C
Methoxychlor	----	0.1	----	----	----	----	----	----	3400	----	outdoor worker	NC
Toxaphene	----	----	----	----	----	----	----	----	1.7	----	outdoor worker	C

TABLE 15
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Former Romic Environmental Technologies Site
East Palo Alto, California

	Environmental Media											
	Groundwater (mg/L)				Soil Gas (mg/m^3) [a]				Soil (mg/kg)			
Chemical	**RBTC**	**Water Solubility Limit**	**RBTC Scenario**		**RBTC**	**Vapor Pressure Limit**	**RBTC Scenario**		**RBTC**	**Saturation Limit**	**RBTC Scenario**	
Metals												
Antimony	----	----	----	----	----	----	----	----	450	----	outdoor worker	NC
Arsenic	----	----	----	----	----	----	----	----	1.8	----	outdoor worker	C
Barium	----	----	----	----	----	----	----	----	210000	----	outdoor worker	NC
Beryllium	----	----	----	----	----	----	----	----	2200	----	outdoor worker	NC
Cadmium	----	----	----	----	----	----	----	----	890	----	outdoor worker	NC
Chromium (total)	----	----	----	----	----	----	----	----	----	----	----	----
Chromium III	----	----	----	----	----	----	----	----	1700000 (b)	----	outdoor worker	NC
Chromium VI	----	----	----	----	----	----	----	----	120	----	outdoor worker	NC
Cobalt	----	----	----	----	----	----	----	----	340	----	outdoor worker	NC
Copper	----	----	----	----	----	----	----	----	45000	----	outdoor worker	NC
Lead	----	----	----	----	----	----	----	----	320	----	commercial/ industrial CHHSL (c)	----
Mercury	----	0.06	----	----	----	----	----	----	0.0043	5	indoor worker	NC
Molybdenum	----	----	----	----	----	----	----	----	5700	----	outdoor worker	NC
Nickel	----	----	----	----	----	----	----	----	22000	----	outdoor worker	NC
Selenium	----	----	----	----	----	----	----	----	5700	----	outdoor worker	NC
Silver	----	----	----	----	----	----	----	----	5700	----	outdoor worker	NC
Thallium	----	----	----	----	----	----	----	----	----	----	----	----
Tin	----	----	----	----	----	----	----	----	680000	----	outdoor worker	NC
Vanadium	----	----	----	----	----	----	----	----	5700	----	outdoor worker	NC
Zinc	----	----	----	----	----	----	----	----	340000	----	outdoor worker	NC

TABLE 15
Minimum Risk-Based Target Concentrations
Former Romic Environmental Technologies Site
East Palo Alto, California

Chemical	Environmental Media								
	Groundwater (mg/L)			Soil Gas (mg/m^3) [a]			Soil (mg/kg)		
	RBTC	Water Solubility Limit	RBTC Scenario	RBTC	Vapor Pressure Limit	RBTC Scenario	RBTC	Saturation Limit	RBTC Scenario

Notes:

mg/L = milligram per Liter; mg/m^3 = milligram per cubic meter; mg/kg = milligram per kilogram

C = Cancer

NC = Noncancer

RBTC = Risk based target concentration

---- = RBTC was not calculated

[a] Calculated for soil gas at a depth of five feet below ground surface (bgs). None of the minimum soil gas RBTCs are greater than the vapor pressure limit.

[b] Minimum soil RBTC is greater than one million parts per million.

[c] 2009 commercial/industrial CHHSL is used as the screening level for lead.

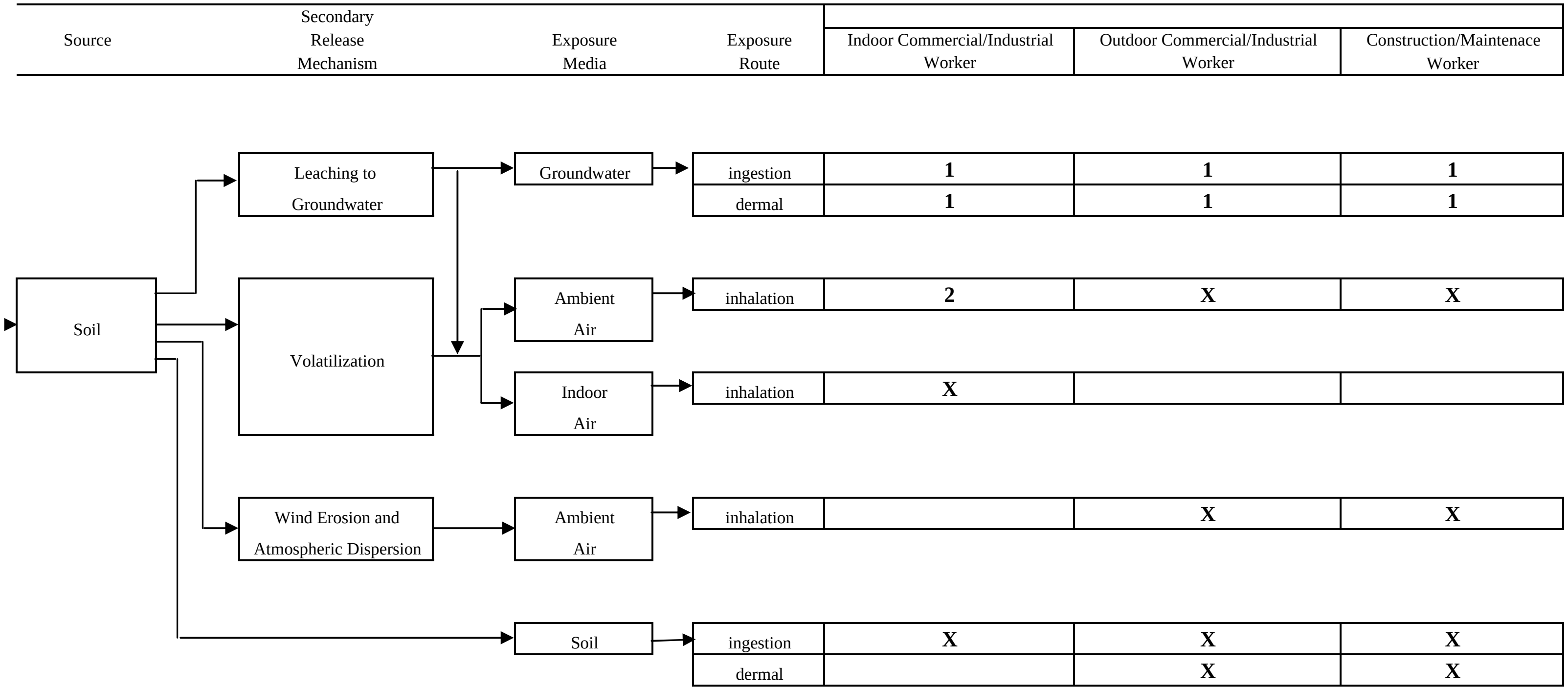
Bold values exceed either the water solubility limit, vapor pressure limit or soil saturation limit, for groundwater, soil gas or soil, respectively.

Sources:

California Environmental Protection Agency (Cal/EPA). 2009. *Revised California Human Health Screening Levels for Lead. Office of Environmental Health Hazard Assessment (OEHHA).* September.

FIGURES

Figure 1
Conceptual Site Model (CSM)
Former Romic Environmental Technologies Site
East Palo Alto, California



Source	Secondary Release Mechanism	Exposure Media	Exposure Route	Indoor Commercial/Industrial Worker	Outdoor Commercial/Industrial Worker	Construction/Maintenace Worker
Soil	Leaching to Groundwater	Groundwater	ingestion	**1**	**1**	**1**
			dermal	**1**	**1**	**1**
	Volatilization	Ambient Air	inhalation	**2**	**X**	**X**
		Indoor Air	inhalation	**X**		
	Wind Erosion and Atmospheric Dispersion	Ambient Air	inhalation		**X**	**X**
		Soil	ingestion	**X**	**X**	**X**
			dermal		**X**	**X**

Notes:

X = Potentially complete exposure route for further consideration

1 = Groundwater at the Site is not used as a municipal source and is not expected to be in the future.
Direct contact with groundwater is assumed to be limited (infrequent digging activities), and only under controlled scenarios (i.e., workers with protective equipment).

2 = This pathway occurs, but the indoor air exposure to volatile gases already provides a conservative estimate.

ATTACHMENTS

Table E-2. Shallow Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

	Physical State		Residential Exposure			Commercial/Industrial Land Use		
Chemcial			Lowest Residential (μg/m^3)	Carcinogenic Effects (μg/m^3)	Noncarcinogenic Effects (μg/m^3)	Lowest C/I (μg/m^3)	Carcinogenic Effects (μg/m^3)	Noncarcinogenic Effects (μg/m^3)
Acenaphthene	V	S	4.4E+04		4.4E+04	1.2E+05		1.2E+05
Acenaphthylene	V	S	2.2E+04		2.2E+04	6.1E+04		6.1E+04
Acetone	V	L	6.6E+05		6.6E+05	1.8E+06		1.8E+06
Aldrin	NV	S						
Anthracene	V	S	2.2E+05		2.2E+05	6.1E+05		6.1E+05
Antimony	NV	S						
Arsenic	NV	S						
Barium	NV	S						
Benzene	V	L	8.4E+01	8.4E+01	6.3E+03	2.8E+02	2.8E+02	1.8E+04
Benzo(a)anthracene	NV	S						
Benzo(b)fluoranthene	NV	S						
Benzo(k)fluoranthene	NV	S						
Benzo(g,h,i)perylene	NV	S						
Benzo(a)pyrene	NV	S						
Beryllium	NV	S						
1,1-Biphenyl	V	S						
Bis(2-chloroethyl) ether	V	L	7.4E+00	7.4E+00		2.5E+01	2.5E+01	
Bis(2-chloroisopropyl) ether	V	L	3.4E+00	3.4E+00	2.9E+04	1.2E+01	1.2E+01	8.2E+04
Bis(2-ethylhexyl) phthalate	NV	S						
Boron	NV	S						
Bromodichloromethane	V	L	1.4E+02	1.4E+02	1.5E+04	4.6E+02	4.6E+02	4.1E+04
Bromoform (Tribromomethane)	NV	S						
Bromomethane	V	G	1.0E+03		1.0E+03	2.9E+03		2.9E+03
Cadmium	NV	S						
Carbon tetrachloride	V	L	1.9E+01	1.9E+01	8.3E+03	6.3E+01	6.3E+01	2.3E+04
Chlordane	NV	S						
p-Chloroaniline	NV	S						
Chlorobenzene	V	L	2.1E+05		2.1E+05	5.8E+05		5.8E+05
Chloroethane	V	G	2.1E+04		2.1E+04	5.8E+04		5.8E+04
Chloroform	V	L	4.6E+02	4.6E+02	6.3E+04	1.5E+03	1.5E+03	1.8E+05
Chloromethane	V	G	1.9E+04		1.9E+04	5.3E+04		5.3E+04
2-Chlorophenol	V	L	3.7E+03		3.7E+03	1.0E+04		1.0E+04
Chromium (total)	NV	S						
Chromium III	NV	S						
Chromium VI	NV	S						

Table E-2. Shallow Soil Gas Screening Levels
for Evaluation of Potential Vapor Intrusion Concerns
(volatile chemicals only)

			Residential Exposure			Commercial/Industrial Land Use		
Chemcial	**Physical State**		**Lowest Residential (μg/m^3)**	**Carcinogenic Effects (μg/m^3)**	**Noncarcinogenic Effects (μg/m^3)**	**Lowest C/I (μg/m^3)**	**Carcinogenic Effects (μg/m^3)**	**Noncarcinogenic Effects (μg/m^3)**
Chrysene	NV	S						
Cobalt	NV	S						
Copper	NV	S						
Cyanide	NV	S	1.5E+04		1.5E+04	4.1E+04		4.1E+04
Dibenz(a,h)anthracene	NV	S						
Dibromochloromethane	V	S						
1,2-dibromo-3-chloropropane	V	L	1.3E+00	1.3E+00	4.2E+01	4.3E+00	4.3E+00	1.2E+02
1,2-Dibromoethane	V	S	4.1E+00	4.1E+00	1.9E+03	1.4E+01	1.4E+01	5.3E+03
1,2-Dichlorobenzene	V	L	4.2E+04		4.2E+04	1.2E+05		1.2E+05
1,3-Dichlorobenzene	V	L	2.2E+04		2.2E+04	6.1E+04		6.1E+04
1,4-Dichlorobenzene	V	S	2.2E+02	2.2E+02	1.7E+05	7.4E+02	7.4E+02	4.7E+05
3,3-Dichlorobenzidine	NV	S						
Dichlorodiphenyldichloroethane (DDD)	NV	S						
Dichlorodiphenyldichloroethene (DDE)	NV	S						
Dichlorodiphenyltrichloroethane (DDT)	NV	S						
1,1-Dichloroethane	V	L	1.5E+03	1.5E+03	1.0E+05	5.1E+03	5.1E+03	2.9E+05
1,2-Dichloroethane	V	L	9.4E+01	9.4E+01	1.0E+03	3.1E+02	3.1E+02	2.9E+03
1,1-Dichloroethene	V	L	4.2E+04		4.2E+04	1.2E+05		1.2E+05
cis -1,2-Dichloroethene	V	L	7.3E+03		7.3E+03	2.0E+04		2.0E+04
trans -1,2-Dichloroethene	V	L	1.5E+04		1.5E+04	4.1E+04		4.1E+04
2,4-Dichlorophenol	NV	S						
1,2-Dichloropropane	V	L	2.4E+02	2.4E+02	8.3E+02	8.2E+02	8.2E+02	2.3E+03
1,3-Dichloropropene	V	L	1.5E+02	1.5E+02	4.2E+03	5.1E+02	5.1E+02	1.2E+04
Dieldrin	NV	S						
Diethyl phthalate	NV	S						
Dimethyl phthalate	NV	S						
2,4-Dimethylphenol	V	S						
2,4-Dinitrophenol	NV	S						
2,4-Dinitrotoluene	NV	S						
1,4-Dioxane	NV	L						
Dioxin (2,3,7,8-TCDD)	NV	S						
Endosulfan	NV	S						
Endrin	NV	S						
Ethylbenzene	V	L	9.8E+02	9.8E+02	2.1E+05	3.3E+03	3.3E+03	5.8E+05
Fluoranthene	NV	S						

Table E-2. Shallow Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemcial	Physical State		Residential Exposure			Commercial/Industrial Land Use		
			Lowest Residential (µg/m^3)	Carcinogenic Effects (µg/m^3)	Noncarcinogenic Effects (µg/m^3)	Lowest C/I (µg/m^3)	Carcinogenic Effects (µg/m^3)	Noncarcinogenic Effects (µg/m^3)
Fluorene	V	S	2.9E+04		2.9E+04	8.2E+04		8.2E+04
Heptachlor	NV	S						
Heptachlor epoxide	NV	S						
Hexachlorobenzene	NV	S						
Hexachlorobutadiene	NV	S						
γ-Hexachlorocyclohexane (Lindane)	NV	S						
Hexachloroethane	NV	S						
Indeno(1,2,3-c,d)pyrene	NV	S						
Lead	NV	S						
Mercury (elemental)	V	S	1.9E+01		1.9E+01	5.3E+01		5.3E+01
Methoxychlor	NV	S						
Methylene chloride	V	L	5.2E+03	5.2E+03	8.3E+04	1.7E+04	1.7E+04	2.3E+05
Methyl ethyl ketone	V	L	1.0E+06		1.0E+06	2.9E+06		2.9E+06
Methyl isobutyl ketone	V	L	6.3E+05		6.3E+05	1.8E+06		1.8E+06
Methyl mercury	NV	S						
2-Methylnaphthalene	V	S						
tert -Butyl methyl ether	V	L	9.4E+03	9.4E+03	6.3E+05	3.1E+04	3.1E+04	1.8E+06
Molybdenum	NV	S						
Naphthalene	V	S	7.2E+01	7.2E+01	6.3E+02	2.4E+02	2.4E+02	1.8E+03
Nickel	NV	S						
Pentachlorophenol	NV	S						
Perchlorate	NV	S						
Phenanthrene	V	S	2.2E+04		2.2E+04	6.1E+04		6.1E+04
Phenol	NV	S						
Polychlorinated biphenyls (PCBs)	NV	S						
Pyrene	V	S	2.2E+04		2.2E+04	6.1E+04		6.1E+04
Selenium	NV	S						
Silver	NV	S						
Styrene	V	L	1.9E+05		1.9E+05	5.3E+05		5.3E+05
tert -Butyl alcohol	V	L						
1,1,1,2-Tetrachloroethane	V	L	3.2E+02	3.2E+02		1.1E+03	1.1E+03	
1,1,2,2-Tetrachloroethane	V	L	4.2E+01	4.2E+01	4.4E+04	1.4E+02	1.4E+02	1.2E+05
Tetrachloroethene	V	L	4.1E+02	4.1E+02	8.3E+04	1.4E+03	1.4E+03	2.3E+05
Thallium	NV	S						
Toluene	V	L	6.3E+04		6.3E+04	1.8E+05		1.8E+05

Table E-2. Shallow Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemcial	Physical State		Residential Exposure			Commercial/Industrial Land Use		
			Lowest Residential (μg/m^3)	Carcinogenic Effects (μg/m^3)	Noncarcinogenic Effects (μg/m^3)	Lowest C/I (μg/m^3)	Carcinogenic Effects (μg/m^3)	Noncarcinogenic Effects (μg/m^3)
Toxaphene	NV	S						
TPH (gasolines)	V	L	1.0E+04		1.0E+04	2.9E+04		2.9E+04
TPH (middle distillates)	V	L	1.0E+04		1.0E+04	2.9E+04		2.9E+04
TPH (residual fuels)	NV	L/S						
1,2,4-Trichlorobenzene	V	L	8.3E+02		8.3E+02	2.3E+03		2.3E+03
1,1,1-Trichloroethane	V	L	4.6E+05		4.6E+05	1.3E+06		1.3E+06
1,1,2-Trichloroethane	V	L	1.5E+02	1.5E+02	2.9E+03	5.1E+02	5.1E+02	8.2E+03
Trichloroethene	V	L	1.2E+03	1.2E+03	1.3E+05	4.1E+03	4.1E+03	3.5E+05
2,4,5-Trichlorophenol	V	S	7.3E+04		7.3E+04	2.0E+05		2.0E+05
2,4,6-Trichlorophenol	NV	S						
Vanadium	NV	S						
Vinyl chloride	V	G	3.1E+01	3.1E+01	2.1E+04	1.0E+02	1.0E+02	5.8E+04
Xylenes	V	L	2.1E+04		2.1E+04	5.8E+04		5.8E+04
Zinc	NV	S						

Notes:

Soil gas screening levels intended to be protective of indoor air quality, calculated for volatile chemicals only.
Physical state of chemical at ambient conditions (V - volatile, NV - nonvolatile, S - solid, L - liquid, G - gas).
Chemical considered to be volatile if Henry's Law constant (atm m^3/mole) >10^{-5} and molecular weight <200 (see Table E-1).
Dibromochloromethane, dibromochloropropane and pyrene considered volatile for purposes of modeling (USEPA 2004).
Target cancer risk = 1E-06, Target Hazard Quotient = 0.2 for all chemicals.
Residential soil gas:indoor air attenuation factor = 0.001 (1/1000). Commercial/industrial soil gas:indoor air attenuation factor = 0.0005 (1/2000).
Soil gas screening level for ethanol based on potential indoor air nuisance concerns (refer to Section 5.3.3 and Table H series).
soils or limited soil impacts and no groundwater source of VOCs.

Appendix C

Field Documentation

IRIS ENVIRONMENTAL
FIELD INVESTIGATION DAILY REPORT

Project Name ______________________________ **Sheet** _____ **of** _____

Contract No. ______________________________ **Date** __________

Field Staff ____________________ **Subcontractors** ____________________

____________________ ____________________

Equipment Used ______________________________

____

Visitors to Site ______________________________

____

Time	Activities

Reviewed by ______________________________ **Date** __________

IRIS ENVIRONMENTAL
FIELD INVESTIGATION PHOTOGRAPHIC LOG

Project Name ____________________ **Sheet** ____ **of** ____

Contract No. ____________________ **Date** ____________

Field Staff ____________________ **Subcontractors** ____________________

____________________ ____________________

Other Contractors ____________________

____

Visitors to Site ____________________

____

Photo #, Time	Photo Direction	Photo Description

Reviewed by ____________________ **Date** ____________

IRIS ENVIRONMENTAL
MULTIPARAMETER INSTRUMENT CALIBRATION RECORD

Project Name: ______________________________ **Date** ____________

Project Location: ______________________________

Contract No.: ______________________________

Instrument: ______________________________

Serial Number: ______________________________

Date	Calibrated by	Parameter	Standards Used	Calibration Achieved ? (Y/N)	Remarks

IRIS ENVIRONMENTAL
SOIL PID READINGS

Project Name: ______________________________ **Date** ____________

Project Location: ______________________________

Contract No.: ______________________________

Field Staff: ______________________________

Instrument: ______________________________

Serial Number: ______________________________

Date	Time	Area*	PID (ppm) Reading	Comments	Initials

* As shown on site map.

IRIS ENVIRONMENTAL
FIELD BORING LOG

Page 1 of ___

Project:	**Contract No:**	**Boring No:**	**Total Depth:**
Project Mgr:	**Logged By:**	**Start Time:**	**Date:**
Drilling Contractor:	**Sampling Methods:**	**Completed Time:**	**Date:**
Drill Rig Type:	**Driller's Name:**	**Backfilled Time:**	**Date:**

Sampler Depth	**Sampler Type**	**In. Driven**	**In. Recovered**	**PID / FID**	**Time**	**Sample No.**	**Sample ID**	**Depth in Feet**	**USCS Name**	
								0		
								1		
								2		
								3		
								4		
								5		
								6		
								7		
								8		
								9		
								10		
								11		
								12		
								13		
								14		
								15		

SOIL GAS PROBE CONSTRUCTION

Probe ID ____________________ **Site Location** ____________________
Project Name ____________________ **Field Personnel** ____________________
Project Number ____________________ **Recorded By** ____________________

Permit Number ____________________ **Drilling Contractor** ____________________
Installation Date(s) ____________________ **Driller** ____________________
Drilling Method ____________________
Borehole Diameter ____________________

Materials Used

Riser Pipe:☐ Diameter☐______☐______cm/inches
☐ ☐ Construction☐__☐______________
☐ PVC schedule ____________
☐ Stainless Steel
☐ Other ____________

Screen :☐ Length☐______☐ ☐ cm/inches☐
☐ ☐ Diameter☐______☐______ cm/inches
☐ ☐ Slot Size☐☐______☐______ cm/inches
☐ ☐ Construction☐ ☐
☐ PVC schedule ____________
☐ Stainless Steel
☐ Other ____________

Bottom End Cap: ☐ Male ☐ Female ☐ Slip
☐ PVC
☐ Stainless Steel
☐ Other ____________

Top Cap: ☐ Male ☐ Female
☐ PVC
☐ Stainless Steel
☐ Other ____________

Top Cap: ☐ Brass ☐ Stainless ☐ PVC

Protective Casing: ☐ Flush mount
☐ Above grade
☐ Length☐______☐ ☐ cm/inches☐ ☐
☐ ☐ Stickup☐ ____________ cm/inches
☐ ☐ Construction☐ ☐☐Cast Aluminum
☐. Cast Steel
☐ Other ____________

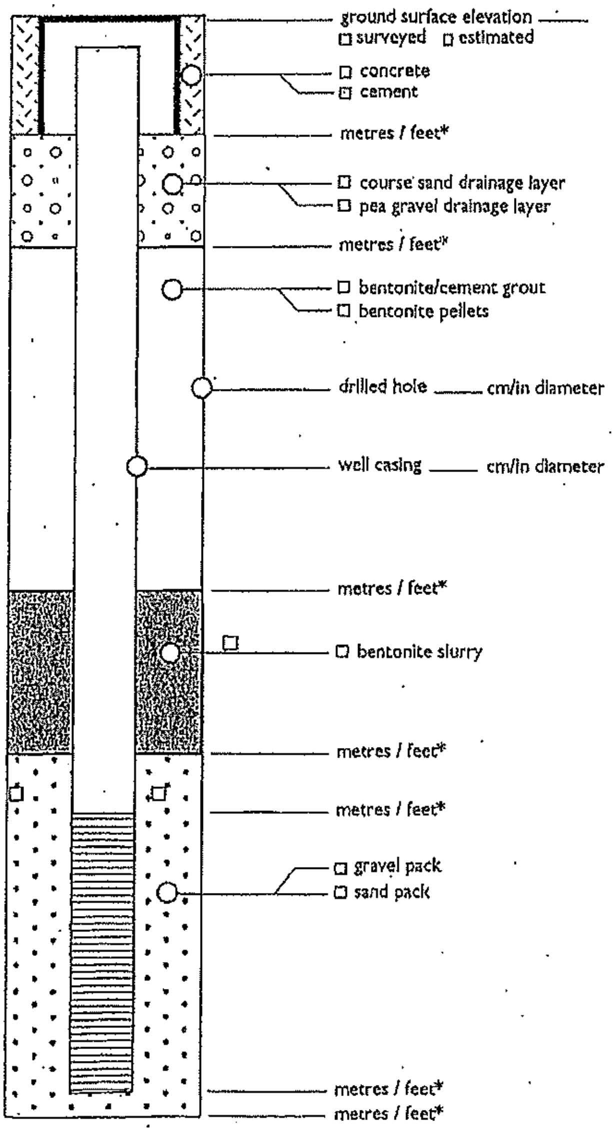
Casing Installation: Depth☐______☐ ☐ cm/inches☐ ☐
☐ ☐ Diameter☐______☐______ cm/inches

Drain:
Coarse Sand: ___bags of☐_kg/lb per bag☐ Size ________
Pea Gravel: ___bags of☐_kg/lb per bag☐ Size ________

Sandpack:
Coarse Sand: ___bags of☐_kg/lb per bag☐ Size ________
Fine Sand: ___bags of☐_kg/lb per bag☐ Size ________

Seal:
Bentonite Pellets:___bags of___kg/lb per bag☐ Type ________
Bentonite Slurry: ___bags of___kg/lb per bag☐ Type ________

Grout:
Cement: ___ bags of___ kg/lb per bag Type ________
Bentonite: ___bags of___kg/lb per bag Type ________



Measuring Point Is Top of Well Casing Unless Otherwise Noted

** Depth Below Ground Surface*

SOIL GAS PROBE MEASUREMENTS

① Project Name: ______ Probe No.: ______ ☐ Sub-slab probe ☐ Soil gas probe
Date: ______ Project Number: ______ Mini Rae 2000 Serial No.: ______ Lamp: 10.6 / 11.7 eV
Site Location: ______ Landtech GEM 2000 Landfill Gas Meter Serial No. M: ______
Weather: ______ MDG 2002 Helium detector Serial No.: ______
Field Personnel: ______ Tracer Gas: ☐ Helium ☐ Other ______
Recorded By: ______

② Surface Type: ☐ Asphalt ☐ Concrete ☐ Grass ☐ Other______
Surface Thickness ______ inches/centimeters ☐ Unknown
(i.e., asphalt or concrete)

③ 1 Casing Volume
☐ Sub-slab
<0.1 L
Soil gas probe ______ (L)

④ Initial Vacuum (prior to pumping) ______ in. H_2O

⑤ Shut in test prior to pneumatic test completed, ____ in. H_2O held for ____ seconds.

⑥ Start of Pneumatic Test: ______

Elapsed Time (min.)	Pump Flow Rate (LPM)	Well Head Vacuum in. H_2O
	0.1	
	0.2	
	0.5	

⑦ Field tubing blank reading (ppm$_v$) completed? ☐ Yes ☐ No PID Reading ______ ppm$_v$

⑧ Shut in test prior to purging completed? Yes ☐ No ☐

⑨ Purging

Date	Start Time	End Time	Elapsed Time (min.)	Bag Volume (L)	Purge Rate (LPM)	Cumulative Volume (L)	CH_4 (%)	CO_2 (%)	O_2 (%)	Tracer Gas Shroud (%) Min	Tracer Gas Shroud (%) Max	Tracer Gas Sample (ppm$_v$, %) (circle one)	VOCs by PID (ppm$_v$)

⑩ Helium concentration in field screened samples is less than 5% of minimum concentration in the shroud? ☐ Yes ☐ No **Note: 1% helium = 10,000 ppm$_v$**

⑪ Shut in test prior to sample collection completed? Yes ☐ No ☐

⑫ Sample Collection

Date	Time	Sample ID	Summa Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum (in. Hg)	Final Vacuum (in. Hg)
						/	

Comments:

SOIL GAS SAMPLING LOG
IRIS ENVIRONMENTAL

COMPLETE ONE LOG PER SAMPLING LOCATION 1 in^3=16.387 ml, 1 gallon=2785.412 ml

Project:	**Contract #:**	**Boring #:**
Date:	**Weather:**	**Sampler(s):**
# of purge volumes:	**Leak check compound: Helium**	**Sample flow rate:**

Helium Shroud

% Helium in shroud prior to sampling:	**% Helium in sample line prior to sampling:**	**% Difference (Greater than 10%?)**
% Helium in shroud post sampling:	**% Helium in sample line post sampling:**	**% Difference (Greater than 10%?)**

Sample 1

Depth:	**Time installed:**	**Calculated purge volume** (R_{tube}^2*3.14*L_{tube} + $R_{borehole}^2$*3.14*$H_{sandpack}$*0.3)**:**
Sample start time:	**Sample finish time:**	**Sample volume:**
Initial Summa vacuum:	**Final Summa vacuum:**	
Samples taken (circle): 1L Summa 6L Summa 1L Tedlar		
Analyses / Notes:		

Sample Dup

Depth:	**Time installed:**	**Calculated purge volume** (R_{tube}^2*3.14*L_{tube} + $R_{borehole}^2$*3.14*$H_{sandpack}$*0.3)**:**
Sample start time:	**Sample finish time:**	**Sample volume:**
Initial Summa vacuum:	**Final Summa vacuum:**	
Samples taken (circle): 1L Summa 6L Summa 1L Tedlar		
Analyses / Notes:		

SOIL GAS SAMPLING LOG
IRIS ENVIRONMENTAL

1 in^3=16.387 ml, 1 gallon=2785.412 ml

Project:	**Contract #:**	**Boring #:**
Date:	**Weather:**	**Sampler(s):**
# of purge volumes:	**Leak check compound: Helium**	**Sample flow rate:**

Purge Test

Probe Depth:	**Time installed:**	**Calculated purge volume** (R_{tube}^2*3.14*L_{tube} + $R_{borehole}^2$*3.14*$H_{sandpack}$*0.3)**:**
PID Reading, 1 Purge Volume:	**PID Reading, 3 Purge Volumes:**	**PID Reading, 7 Purge Volumes:**
Selected Purge Volume:		

1615 Broadway, Suite 1003
Oakland, CA 94612
(51 834-4747

IRIS ENVIRONMENTAL

CHAIN-OF-CUSTODY

Date: / / *Page*____ *of* ____

Samplers (signature):

Sample ID	**Date**	**Time**	**Matrix**	**Preserv.**	**Analyses Required**																	Number of Containers

Project Information
Project Name:______________________
Project Number____________________
Contact:_________________________
E-mail:________________@irisenv.com

Sample Receipt	
# of Containers	
Head space	
Temperature	
Conforms to Record	

Report: Routine Level 2 Level 3 Level 4 Electronic

TAT	5-Day	24	48	72	Other:

Special Instructions/Comments:

Relinquished By:	Received By:
(Signature):	(Signature):
(Name):	(Name):
(Company):	(Company):
Relinquished By:	Received By:
(Signature):	(Signature):
(Name):	(Name):
(Company):	(Company):

INVENTORY OF DRUMS AT PROJECT SITE

This form offers notification that material stored in drums is present at the following job site:

Facility #: ______________________

Address: ______________________

The material in the drums has been analyzed to determine levels of any contamintants and the most cost effective means of disposal or treatment.

The identification on each drum and its contents are as follows:

Drum I.D.	Boring or Well I.D.	Volume in Drum	Soil or Water	Date Collected	Lab Results

__________ The laboratory analyses are attached.

Summary: Total # w/Water: __________ Volume: __________

Summary: Total # w/Soil: __________ Volume: __________

Summary: Total # w/H.W.: __________ Volume: __________

Contractor: __________ Contact: __________ Phone: __________

Representative: __________ Phone: __________

Drilling/Soil-Sampling Event Supplies List

Project Name: ______________________________ **Project Number:**____________________

Paper Work

☐ Work Plan
☐ Health & Safety Plan
☐ Site Plan
☐ Map to Site
☐ Site Visit Report Forms
☐ Blank Boring Log Forms
☐ Prior Boring Logs
☐ Drilling/Monitoring Well Permits
☐ COC Forms/Stickers
☐ FedEx Labels
☐ Office Phone List

Personal Protective Equipment

☐ Safety Glasses
☐ Ear Protection
☐ Hard Hat
☐ Steel-Toed Boots
☐ Sunblock
☐ Gloves
☐ Respirator
☐ Kerchief
☐ Baseball Cap
☐ Wet Weather Gear
☐ Safety Vest
☐ First Aid Kit

Field Equipment

☐ Munsell Color Chart
☐ USCS Soil Classification Chart
☐ ASTM D2488
☐ Sieves
☐ Slide Hammer Sampler
☐ Soil Tubes
☐ Teflon Soil-Tube Tape
☐ Water Sample Containers
☐ Sample Labels
☐ Keys
☐ Cell Phone
☐ Camera, film, batteries
☐ White Paint

☐ Storage Drums
☐ Drum Labels
☐ Sharpies
☐ Bailers
☐ Ziplocks
☐ Storage Bags
☐ Cooler w/ Ice
☐ Water-Level Indicator
☐ Gastech/Pid
☐ Survey Wheel
☐ Well Locks
☐ Compass
☐ Walki talkies

☐ Buckets
☐ Paper Towels
☐ Decon Soap and Water
☐ Garbage Bags
☐ Shovel, Broom, Hose w/Nozzle
☐ Traffic Delineators/Cones
☐ Caution Tape
☐ Bungee Cords
☐ Mirror/Flashlight
☐ Tool Box
☐ Phone card
☐ Stop watch

Contact Information

☐ Site Contact Name/Number : ______________________________/______________________________

☐ Drilling Contractor Name/Number : ______________________________/______________________________

- Contact Name/Number :___________________/_________________

- Work Order Number ______________________________________

☐ Permitting Authority Name/Number : ______________________________/______________________________

- Contact Name/Number :___________________/_________________

☐ Regulatory Agency Name/Number : ______________________________/______________________________

- Contact Name/Number :___________________/_________________

☐ USA Clearance Number/Call Date : ______________________________/______________________________

☐ Subsurface Utility Locator/Number : ______________________________/______________________________

_ - Contact Name/Number :___________________/_________________

☐ Rental Agency/Number ______________________________/______________________________

☐ Hotel Phone/Reservation Number : _________________________/_________________

☐ Directions to Hotel / Lab / Rental Aigency

Appendix D

Standard Operating Procedures

Appendix D

Standard Operating Procedures

The quality of data collected in an environmental study is critically dependent upon the quality and thoroughness of field sampling activities. Therefore, general field operations, practices, specific sample collection, and inventory procedures must be carefully planned and implemented. This appendix presents the standard operating procedures (SOPs) that will be followed during field operations associated with implementation of this CSAP. In addition to the SOPs, QA/QC procedures (Appendix A) will be followed to ensure the data collected during this investigation are of the highest quality. Field documentation forms used to support the investigation are presented in Appendix C.

This appendix contains SOPs for the following field procedures:

- Soil drilling and sample collection (ARCADIS);
- Groundwater sampling using Hydropunch ™ (ARCADIS); and
- Soil vapor sampling (USEPA).

In addition to the above investigative methods, cone penetrometer testing (CPT) will be conducted at the Site. All CPT soundings will be performed in accordance with ASTM *Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils* (D 5778-07) (2007). Details regarding the CPT procedure, provided by Gregg Drilling & Testing, Inc. of Signal Hill, California, are also included in this appendix.

ARCADIS

Infrastructure, environment, facilities

Imagine the result

Soil Drilling and Sample Collection

Rev. #: 1

Rev Date: March 3, 2009

Approval Signatures

Prepared by: Caron Koll Date: 3/3/09

Reviewed by: Michael J Gefell Date: 3/3/09
(Technical Expert)

I. Scope and Application

Overburden drilling is commonly performed using the hollow-stem auger drilling method. Other drilling methods suitable for overburden drilling, which are sometimes necessary due to site-specific geologic conditions, include: drive-and-wash, spun casing, Rotasonic, dual-rotary (Barber Rig), and fluid/mud rotary. Direct-push techniques (e.g., Geoprobe or cone penetrometer) may also be used. The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling depths, site or regional geologic knowledge, types of sampling to be conducted, required sample quality and volume, and cost.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools).

II. Personnel Qualifications

The Project Manager (a qualified geologist, environmental scientist, or engineer) will identify the appropriate soil boring locations, depth and soil sample intervals in a written plan.

Personnel responsible for overseeing drilling operations must have at least 16 hours of prior training overseeing drilling activities with an experienced geologist, environmental scientist, or engineer with at least 2 years of prior experience.

III. Equipment List

The following materials will be available during soil boring and sampling activities, as required:

- Site Plan with proposed soil boring/well locations;
- Work Plan or Field Sampling Plan (FSP), and site Health and Safety Plan (HASP);
- personal protective equipment (PPE), as required by the HASP;
- drilling equipment required by the American Society for Testing and Materials (ASTM) D 1586, when performing split-spoon sampling;
- disposable plastic liners, when drilling with direct-push equipment;
- appropriate soil sampling equipment (e.g., stainless steel spatulas, knife);

- equipment cleaning materials;
- appropriate sample containers and labels;
- chain-of-custody forms;
- insulated coolers with ice, when collecting samples requiring preservation by chilling;
- photoionization detector (PID) or flame ionization detector (FID); and
- field notebook and/or personal digital assistant (PDA).

IV. Cautions

Prior to beginning field work, underground utilities in the vicinity of the drilling areas will be identified by one of the following three actions (lines of evidence):

- Contact the State One Call
- Obtain a detailed site utility plan drawn to scale, preferably an “as-built” plan
- Conduct a detailed visual site inspection

In the event that one or more of the above lines of evidence cannot be conducted, or if the accuracy of utility location is questionable, a minimum of one additional line of evidence will be utilized as appropriate or suitable to the conditions. Examples of additional lines of evidence include but are not limited to:

- Private utility locating service
- Research of state, county or municipal utility records and maps including computer drawn maps or geographical information systems (GIS)
- Contact with the utility provider to obtain their utility location records
- Hand augering or digging
- Hydro-knife
- Air-knife

- Radio Frequency Detector (RFD)
- Ground Penetrating Radar (GPR)
- Any other method that may give ample evidence of the presence or location of subgrade utilities.

Overhead power lines also present risks and the following safe clearance must be maintained from them.

Power Line Voltage Phase to Phase (kV)	**Minimum Safe Clearance (feet)**
50 or below	10
Above 50 to 200	15
Above 200 to 350	20
Above 350 to 500	25
Above 500 to 750	35
Above 750 to 1,000	35

ANSI Standard B30.5-1994, 5-3.4.5

Avoid using drilling fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

Water used for drilling and sampling of soil or bedrock, decontamination of drilling/sampling equipment, or grouting boreholes upon completion will be of a quality acceptable for project objectives. Testing of water supply should be considered.

Specifications of materials used for backfilling borehole will be obtained, reviewed and approved to meet project quality objectives.

V. Health and Safety Considerations

Field activities associated with overburden drilling and soil sampling will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities.

VI. Procedure

Drilling Procedures

The drilling contractor will be responsible for obtaining accurate and representative samples; informing the supervising geologist of changes in drilling pressure; and keeping a separate general log of soils encountered, including blow counts (i.e., the number of blows from a soil sampling drive weight [140 pounds] required to drive the split-barrel sampler in 6-inch increments). Records will also be kept of occurrences of premature refusal due to boulders or construction materials that may have been used as fill. Where a boring cannot be advanced to the desired depth, the boring will be abandoned and an additional boring will be advanced at an adjacent location to obtain the required sample. Where it is desirable to avoid leaving vertical connections between depth intervals, the borehole will be sealed using cement and/or bentonite. Multiple refusals may lead to a decision by the supervising geologist to abandon that sampling location.

Soil Sampling Procedures

Samples of subsurface materials encountered while drilling soil borings will be collected using one of the following methods:

- 2-inch split-barrel (split-spoon) sampler, if using the ASTM D 1586 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils

- Plastic internal soil sample sleeves if using direct-push drilling.

Soil samples are typically field screened with an FID or PID at sites where volatile organic compounds are present in the subsurface. Field screening is performed using one of the following methods:

- Upon opening the sampler, the soil is split open and the PID or FID probe is placed in the opening and covered with a gloved hand. Such readings should be obtained at several locations along the length of the sample

- A portion of the collected sample is placed in a jar, which is covered with aluminum foil, sealed, and allowed to warm to room temperature. After warming, the cover is removed, the foil is pieced with the FID or PID probe, and a reading is obtained.

Samples selected for laboratory analysis will be handled, packed, and shipped in accordance with the procedures outlined in the Work Plan, FSP, or Chain-of-Custody, Handling, Packing, and Shipping SOP.

A geologist will be onsite during drilling and sampling operations to describe each soil sample on the soil boring log, including:

- percent recovery;
- structure and degree of sample disturbance;
- soil type;
- color;
- moisture condition;
- density;
- grain-size;
- consistency; and
- other observations, particularly relating to the presence of waste materials

Further details regarding geologic description of soil samples are presented in the Soil Description SOP.

Particular care will be taken to fully describe any sheens observed, oil saturation, staining, discoloration, evidence of chemical impacts, or unnatural materials.

VII. Waste Management

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal.

PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

VIII. Data Recording and Management

The supervising geologist or scientist will be responsible for documenting drilling events using a bound field notebook and/or PDA to record all relevant information in a clear and concise format. The record of drilling events will include:

- start and finish dates of drilling;
- name and location of project;
- project number, client, and site location;
- sample number and depths;
- blow counts and recovery;
- depth to water;
- type of drilling method;
- drilling equipment specifications, including the diameter of drilling tools;
- documentation of any elevated organic vapor readings;
- names of drillers, inspectors, or other people onsite; and
- weather conditions.

IX. Quality Assurance

Equipment will be cleaned prior to use onsite, between each drilling location, and prior to leaving the site. Drilling equipment and associated tools, including augers, drill rods, sampling equipment, wrenches, and other equipment or tools that may have come in contact with soils and/or waste materials will be cleaned with high-pressure steam-cleaning equipment using a potable water source. The drilling equipment will be cleaned in an area designated by the supervising engineer or geologist that is located outside of the work zone. More elaborate cleaning procedures may be required for reusable soil samplers (split-spoons) when soil samples are obtained for laboratory analysis of chemical constituents.

X. References

American Society of Testing and Materials (ASTM) D 1586 - *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*.

Groundwater Sampling Using HydroPunch™

Rev. #: 01

Rev Date: March 3, 2009

Approval Signatures

Prepared by: Andrew Kamik Date: 3/3/09

Reviewed by: Michael J Gefell Date: 3/3/09
(Technical Expert)

I. Scope and Application

This document describes procedures for collecting discrete-depth groundwater samples using the HydroPunch™ sampling device (QED Environmental Services, Inc.), or equivalent, during drilling in unconsolidated materials. HydroPunch™ can be used to collect a single sample from a selected depth, or multiple samples from a single borehole to produce a profile of groundwater quality data versus depth. The HydroPunch™ sampler is typically driven through open-ended drill casing or hollow-stem augers.

HydroPunch™ consists of a drive point, a stainless steel screen section, a sample reservoir integral within the tool body, and assorted O-rings and check valves to create watertight seals within the various components. Two models of HydroPunch™ have been developed, having slightly different designs and/or component parts as shown on the attached HydroPunch™ schematic drawings. All components are made of stainless steel, Teflon, or other relatively inert materials. The tool can be disassembled easily for cleaning between samples.

Although this document refers to groundwater sample collection, HydroPunch™ is also capable of obtaining samples of light or dense non-aqueous phase liquid (LNAPL or DNAPL, respectively), if present at sufficient saturation and pressure head at the depth of the ampler during deployment.

II. Personnel Qualifications

ARCADIS personnel directing, supervising, or leading groundwater sample collection activities using HydroPunch™ should have a minimum of 2 years of previous groundwater sampling experience and current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. Field personnel will also be compliant with client-specific training requirements. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials are required for the collection of discrete-depth groundwater samples using HydroPunch™.

- HydroPunch™ sampling device provided by drilling subcontractor

- Drill casing or augers having an effective inside diameter of at least 1.25 inches (to be provided by drilling subcontractor)
- Electronic water-level probe
- Groundwater sample containers provided by the testing laboratory
- Health and safety monitoring equipment and personal protective equipment
- Materials for decontamination of the sampler between samples

IV. Cautions

Because the HydroPunch™ sampler is a groundwater sampling device, it must be used in saturated soils. Positive hydraulic head is required to fill the sampler, and the sampler may fill slowly or not at all at depths just below the water table. HydroPunch™ I and HydroPunch™ II in the "groundwater mode" cannot be used at sampling depths less than 5 feet below the water table. HydroPunch™ II in the "hydrocarbon mode" is preferred for sampling at the water table.

Some types of geologic materials may not allow effective use of the HydroPunch™ sampler, even at significant depth below the water table. For example, extremely dense soils or those containing cobbles or boulders may resist penetration of the sampler, precluding its use. Low permeability soil such as silt and clay may not produce groundwater at a sufficient rate to fill the HydroPunch™ sampler within a practicable timeframe. For these types of situations, an alternative approach should be considered, such as collecting a sample of saturated soil for analysis.

Groundwater samples collected using HydroPunch™ should be considered screening-level data, suitable for obtaining a general understanding of groundwater quality and selecting depths for monitoring well screens. Samples obtained using HydroPunch™ are commonly more turbid than those produced from installed, developed monitoring wells. Higher turbidity could affect sample quality if samples are to be analyzed for sorptive analytes such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), pesticides or metals. For these types of analytes, unfiltered HydroPunch™ samples could produce concentrations that are higher than those of sediment-free aquifer water. Field or laboratory filtering of the samples obtained for these types of constituents should be considered. For less-sorptive analytes (volatile organic compounds, anions such as chloride, etc.), sample turbidity is unlikely to adversely impact the direct usability of unfiltered samples.

V. Health and Safety Considerations

- Sample collection will be performed using procedures consistent with the project Health and Safety Plan.
- Appropriate personal protective equipment must be worn by ARCADIS field personnel

VI. Procedure

The following steps will be followed during the collection of discrete-depth groundwater Samples using HydroPunch™:

1. Select the desired groundwater sampling depth.
2. The drilling subcontractor will advance the borehole to approximately 2 feet above the depth from which a discrete water sample is to be obtained.
3. The drilling subcontractor will disassemble the HydroPunch™ sampling device according to the manufacturer's instructions to allow the sampler to be decontaminated. The sampler should be completely disassembled, including O-rings and/or check valves.
4. Decontaminate the sampler as appropriate for the range of groundwater analytes to be sampled for, by washing with laboratory-grade detergent and potable water wash, followed by solvent rinse (if sampling for organics) and final rinse with deionized or distilled water. Check the condition of the O-rings during each cleaning, and replace if necessary.
5. The drilling subcontractor will reassemble the decontaminated HydroPunch™ sampling device according to the manufacturer's instructions and lower the device to the bottom of the borehole.
6. The drilling subcontractor will push or drive the HydroPunch™ 5 feet below the bottom of the casing or augers, then retract the sampler 3 feet upward. Subsurface friction will retain the drive point in place, exposing the screen and allowing groundwater to enter the sampling tool.
7. Allow sufficient time to allow the sampler to fill with water. Typically 30 minutes is sufficient, except in low permeability materials.
8. Collect a groundwater sample by:

- Retracting the sampler to ground surface – the drilling subcontractor will then open the sampler allowing collection of the groundwater sample [if using the HydroPunch™ I or else the HydroPunch™ II in groundwater mode (see Attachment A)]

- Lowering a bailer or a peristaltic or inertia pump tube through the rods and body of the sampler, and retrieving the bailer or operating the pump to collect the groundwater sample [if using the HydroPunch™ II in hydrocarbon mode (see Attachment A)]

9. Perform field filtering of samples if required by the work plan, FSP and/or QAPP.

10. Obtain field water quality measurements if required by the work plan, FSP and/or QAPP.

11. Label the sample containers at the time of sampling with the following information.

    - Project name and number
    - Sample location
    - Sample number
    - Date and time of collection
    - Sampler initials
    - Analyses required

12. Preserve, store, handle, and ship samples to the analytical laboratory under chain of custody procedures as described in by the work plan, FSP and/or QAPP.

VII. Waste Management

Investigation-derived waste will be managed as described in the Investigation-Derived Waste Handling and Storage SOP.

VIII. Data Recording and Management

Borehole identification, sample depth, sample date and time will be recorded in the field notebook, the boring log, and/or the personal digital assistant (PDA). The sample will also be identified on an appropriate chain of custody form, as appropriate for submittal to an analytical laboratory for analysis, if required. Consider digital photography to record unusual field conditions or to document compliance.

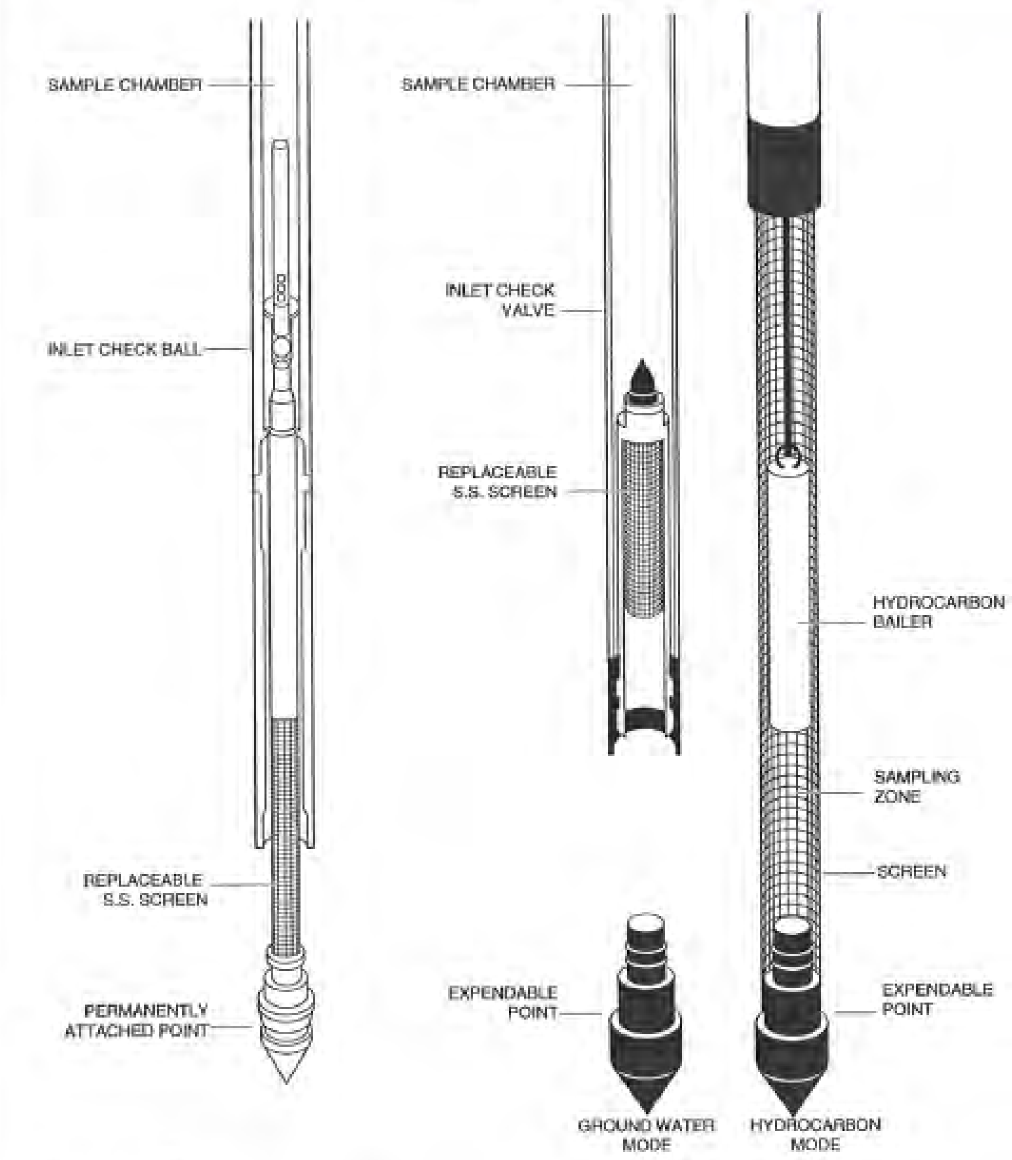
IX. Quality Assurance

The HydroPunch™ sampling device will be decontaminated as appropriate for the list of analytical parameters for which the groundwater samples are collected.

X. References

No references are required to accompany this SOP.

Attachment A - Hydropunch® Schematics



HydroPunch® I

- Collects ground water samples only (not floating layer)
- Permanently-attached drive cone and screen (leaves nothing in the ground)
- Can be used with cone penetrometer or drill rig

HydroPunch® II

- Collects floating layer and ground water
- Replaceable cones and screens are left in ground (note: screens may be retrievable)
- Stronger for tough duty; used with drill ring

SOIL GAS SAMPLING

SOP#: 2042
DATE: 06/01/96
REV. #: 0.0

1.0 SCOPE AND APPLICATION

Soil gas monitoring provides a quick means of waste site evaluation. Using this method, underground contamination can be identified, and the source, extent, and movement of the pollutants can be traced.

This standard operating procedure (SOP) outlines the methods used by U.S. EPA/ERT in installing soil gas wells; measuring organic vapor levels in the soil gas using a Photoionization Detector (PID), Flame Ionization Detector (FID) and/or other air monitoring devices; and sampling the soil gas using Tedlar bags, Tenax sorbent tubes, and/or Summa canisters.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

A 3/8" diameter hole is driven into the ground to a depth of four to five feet using a commercially available slam bar. Soil gas can also be sampled at other depths by the use of a longer bar or bar attachments. A 1/4" O.D. stainless steel probe is inserted into the hole. The hole is then sealed around the top of the probe using modeling clay. The gas contained in the interstitial spaces of the soil is sampled by pulling the sample through the probe using an air sampling pump. The sample may be stored in Tedlar bags, drawn through sorbent cartridges, or analyzed directly using a direct reading instrument. The air sampling pump is not used for Summa canister sampling of soil gas. Sampling is achieved by soil gas equilibration with the evacuated Summa canister.

Other field air monitoring devices, such as the combustible gas indicator (MSA CGI/02 Meter, Model 260) and the Organic Vapor Analyzer (Foxboro OVA, Model 128), can also be used dependent on specific site conditions. Measurement of soil temperature using a temperature probe may also be desirable. Bagged samples are usually analyzed in a field laboratory using a portable Photovac GC.

Power driven sampling probes may be utilized when soil conditions make sampling by hand unfeasible (i.e., frozen ground, very dense clays, pavement, etc.). Commercially available soil gas sampling probes (hollow, 1/2 = O.D. steel probes) can be driven to the desired depth using a power hammer (e.g., Bosch Demolition Hammer or Geoprobe™). Samples can be drawn through the probe itself, or through Teflon tubing inserted through the probe and attached to the probe point. Samples are collected and analyzed as described above.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Tedlar Bags

Soil gas samples are generally contained in 1.0-L Tedlar bags. Bagged samples are best stored in dark plastic bags placed in coolers to protect the bags from any damage that may occur in the field or in transit. In addition, coolers insure the integrity of the samples by keeping them at a cool temperature and out of direct sunlight. Samples should be analyzed as soon as possible, preferably within 24 - 48 hours.

3.2 Tenax Tubes

Bagged samples can also be drawn onto Tenax or other sorbent tubes to undergo lab GC/MS analysis. If Tenax tubes are to be utilized, special care must be taken to avoid contamination. Handling of the tubes should be kept to a minimum and only while wearing nylon or other lint-free gloves. After sampling, each tube should be stored in a clean, sealed culture tube; the ends packed with clean glass wool to protect the sorbent tube from breakage. The culture tubes should be kept cool and wrapped in aluminum foil to prevent any photodegradation of samples (see Section 7.4.).

3.3 Summa Canisters

The Summa canisters used for soil gas sampling have a 6 liter sample capacity and are certified clean by GC/MS analysis before being utilized in the field. After sampling is completed, they are stored and shipped in travel cases.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 PID Measurements

A number of factors can affect the response of a PID (such as the HNu PI 101). High humidity can cause lamp fogging and decreased sensitivity. This can be significant when soil moisture levels are high, or when a soil gas well is actually in groundwater. High concentrations of methane can cause a downscale deflection of the meter. High and low temperature, electrical fields, FM radio transmission, and naturally occurring compounds, such as terpenes in wooded areas, will also affect instrument response.

Other field screening instruments can be affected by interferences. Consult the manufacturers manuals.

4.2 FID Measurements

A number of factors can affect the response of an FID (such as the OVA model 128). High humidity can cause the FID to flame out or not ignite at all. This can be significant when soil moisture levels are high, or when a soil gas well is actually in groundwater. The FID can only read organic based compounds (they must contain carbon in the molecular structure). The FID also responds poorly to hydrocarbons and halogenated hydrocarbons (such as gasoline, propane fuel). High and low temperature, electrical fields and FM radio transmission will also affect instrument response.

4.3 Factors Affecting Organic Concentrations in Soil Gas

Concentrations in soil gas are affected by dissolution, adsorption, and partitioning. Partitioning refers to the ratio of component found in a saturated vapor above an aqueous solution to the amount in the solution; this can, in theory, be calculated using the Henry's Law constants. Contaminants can also be adsorbed onto inorganic soil components or "dissolved" in organic components. These factors can result in a lowering of the partitioning coefficient.

Soil "tightness" or amount of void space in the soil matrix, will affect the rate of recharging of gas into the soil gas well.

Existence of a high, or perched, water table, or of an impermeable underlying layer (such as a clay lens or layer of buried slag) may interfere with sampling of the soil gas. Knowledge of site geology is useful in such situations, and can prevent inaccurate sampling.

4.4 Soil Probe Clogging

A common problem with this sampling method is soil probe clogging. A clogged probe can be identified by using an in-line vacuum gauge or by listening for the sound of the pump laboring. This problem can usually be eliminated by using a wire cable to clear probe (see Section 7.1.3.).

4.5 Underground Utilities

Prior to selecting sample locations, an underground utility search is recommended. The local utility companies can be contacted and requested to mark the locations of their underground lines. Sampling plans can then be drawn up accordingly. Each sample location should also be screened with a metal detector or magnetometer to verify that no underground pipes or drums exist.

5.0 EQUIPMENT/APPARATUS

5.1 Slam Bar Method

- Slam Bar (1 per sampling team).
- Soil gas probes, stainless steel tubing, 1/4" O.D., 5 ft length.
- Flexible wire or cable used for clearing the

tubing during insertion into the well.

- "Quick Connect" fittings to connect sampling probe tubing, monitoring instruments, and Gilian pumps to appropriate fittings on vacuum box.
- Modeling clay.
- Vacuum box for drawing a vacuum around Tedlar bag for sample collection (1 per sampling team).
- Gilian pump Model HFS113A adjusted to approximately 3.0 L/min (1 to 2 per sample team).
- 1/4" Teflon tubing, 2 ft to 3 ft lengths, for replacement of contaminated sample line.
- 1/4" Tygon tubing, to connect Teflon tubing to probes and quick connect fittings.
- Tedlar bags, 1.0 L, at least 1 bag per sample point.
- Soil Gas Sampling labels, field data sheets, logbook, etc.
- PID/FID, or other field air monitoring devices, (1 per sampling team).
- Ice chest, for carrying equipment and for protection of samples (2 per sampling team).
- Metal detector or magnetometer, for detecting underground utilities/pipes/drums (1 per sampling team).
- Photovac GC, for field-lab analysis of bagged samples.
- Summa canisters (plus their shipping cases) for sample, storage and transportation.
- Large dark plastic garbage bags

5.2 Power Hammer Method

- Bosch demolition hammer.
- 1/2" O.D. steel probes, extensions, and points.
- Dedicated aluminum sampling points.
- Teflon tubing, 1/4".
- "Quick Connect" fittings to connect sampling probe tubing, monitoring instruments, and Gilian pumps to appropriate fittings on vacuum box.
- Modeling clay.
- Vacuum box for drawing a vacuum around Tedlar bag for sample collection (1 per sampling team).
- Gilian pump Model HFS113A adjusted to approximately 3.0 L/min (1 to 2 per sample team).
- 1/4" Teflon tubing, 2 ft to 3 ft lengths, for replacement of contaminated sample line.
- 1/4" Tygon tubing, to connect Teflon tubing to probes and quick connect fittings.
- Tedlar bags, 1.0 L, at least 1 bag per sample point.
- Soil Gas Sampling labels, field data sheets, logbook, etc.
- HNu Model P1101, or other field air monitoring devices, (1 per sampling team).
- Ice chest, for carrying equipment and for protection of samples (2 per sampling team).
- Metal detector or magnetometer, for detecting underground utilities/pipes/drums (1 per sampling team).
- Photovac GC, for field-lab analysis of bagged samples.
- Summa canisters (plus their shipping cases) for sample, storage and transportation.
- Generator w/extension cords.
- High lift jack assembly for removing probes.

5.3 Geoprobe^{TM} Method

The Geoprobe is a hydraulically-operated sampling device mounted in a customized four-wheel drive vehicle. The sampling device can be deployed from the truck and positioned over a sample location. The base of the sampling device is positioned on the ground. The weight of the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven past some dense stratigraphic horizons. When the probe reaches the sample depth, up to 50 feet under favorable geologic situations, samples can be collected.

Soil gas can be collected from specific depths in two general ways. One method involves withdrawing a sample directly from the probe rods, after evacuating a sufficient volume of air from the probe rods. The other method involves collecting a sample through tubing attached by an adaptor to the bottom probe rod section. Correctly used, this method provides more reliable results. Manufacturer’s instructions and the SOP for the Model 5400 Geoprobe^{TM} Operation should be followed when using this method.

6.0 REAGENTS

- PID/FID or calibration gases for field air monitoring devices (such as methane and

isobutylene).
- Deionized organic-free water, for decontamination.
- Methanol, HPLC grade, for decontamination.
- Ultra-zero grade compressed air, for field blanks.
- Standard gas preparations for Photovac GC calibration and Tedlar bag spikes.
- Propane Torch (for decontamination of steel probes)

7.0 PROCEDURES

7.1 Soil Gas Well Installation

1. Initially a hole slightly deeper than the desired depth is made. For sampling up to 5 feet, a 5-ft single piston slam bar is used. For deeper depths, a piston slam bar with threaded 4-foot-long extensions can be used. Other techniques can be used, so long as holes are of narrow diameter and no contamination is introduced.

2. After the hole is made, the slam bar is carefully withdrawn to prevent collapse of the walls of the hole. The soil gas probe is then inserted.

3. It is necessary to prevent plugging of the probe, especially for deeper holes. A metal wire or cable, slightly longer than the probe, is placed in the probe prior to inserting into the hole. The probe is inserted to full depth, then pulled up three to six inches, then cleared by moving the cable up and down. The cable is removed before sampling.

4. The top of the sample hole is sealed at the surface against ambient air infiltration by using modeling clay molded around the probe at the surface of the hole.

5. If conditions preclude hand installation of the soil gas wells, the power driven system may be employed. The generator powered demolition hammer is used to drive the probe to the desired depth (up to 12 Ft may be attained with extensions). The probe is pulled up 1-3 inches if the retractable point is used. No clay is needed to seal the hole. After sampling, the probe is retrieved using the high lift jack assembly.

6. If semi-permanent soil gas wells are required, the dedicated aluminum probe points are used. These points are inserted into the bottom of the power driven probe and attached to the Teflon tubing. The probe is inserted as in step 5. When the probe is removed, the point and Teflon tube remain in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.2 Screening with Field Instruments

1. The well volume <u>must</u> be evacuated prior to sampling. Connect the Gilian pump, adjusted to 3.0 L/min, to the sample probe using a section of Teflon tubing as a connector. The pump is turned on, and a vacuum is pulled through the probe for approximately 15 seconds. Longer time is required for sample wells of greater depths.

2. After evacuation, the monitoring instrument(s) (i.e. HNu or OVA) is connected to the probe using a Teflon connector. When the reading is stable, or peaks, the reading is recorded on soil gas data sheets.

3. Of course, readings may be above or below the range set on the field instruments. The range may be reset, or the response recorded as a greater than or less than figure. Recharge rate of the well with soil gas must be considered when resampling at a different range setting.

7.3 Tedlar Bag Sampling

1. Follow step 7.2.1 to evacuate well volume. If air monitoring instrument screening was performed prior to sample taking, evacuation is not necessary.

2. Use the vacuum box and sampling train (Figure 1) to take the sample. The sampling train is designed to minimize the introduction of contaminants and losses due to adsorption. All wetted parts are either Teflon or stainless steel. The vacuum is drawn indirectly to avoid contamination from sample pumps.

3. The Tedlar bag is placed inside the vacuum box, and attached to the sampling port. The sample probe is attached to the sampling port via Teflon tubing and a "Quick Connect" fitting.

4. A vacuum is drawn around the outside of the bag, using a Gilian pump connected to the vacuum box evacuation port, via Tygon tubing and a "Quick Connect" fitting. The vacuum causes the bag to inflate, drawing the sample.

5. Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close valve. Record data on data sheets or in logbooks. Record the date, time, sample location ID, and the PID/FID instrument reading(s) on sample bag label.

CAUTION: Labels should not be pasted directly onto the bags, nor should bags be labeled directly using a marker or pen. Inks and adhesive may diffuse through the bag material, contaminating the sample. Place labels on the edge of the bags, or tie the labels to the metal eyelets provided on the bags. Markers with inks containing volatile organics (i.e., permanent ink markers) should not be used.

Chain of Custody Sheets must accompany all samples submitted to the field laboratory for analysis.

7.4 Tenax Tube Sampling

Samples collected in Tedlar bags may be adsorbed onto Tenax tubes for further analysis by GC/MS.

7.4.1 Additional Apparatus

A. Syringe with a luer-lock tip capable of drawing a soil gas or air sample from a Tedlar bag onto a Tenax/CMS sorbent tube. The syringe capacity is dependent upon the volume of sample begin drawn onto the sorbent tube.

B. Adapters for fitting the sorbent tube between the Tedlar bag and the sampling syringe. The adapter attaching the Tedlar bag to the sorbent tube consists of a reducing union (1/4" to 1/16" O.D. -- Swagelok cat. # SS-400-6-ILV or equivalent) with a length of 1/4" O.D. Teflon tubing replacing the nut on the 1/6" (Tedlar bag) side. A 1/4" I.D. silicone O-ring replaces the ferrules in the nut on the 1/4" (sorbent tube) side of the union.

The adapter attaching the sampling syringe to the sorbent tube consists of a reducing union (1/4" to 1/16" O.D. -- Swagelok Cat. # SS-400-6-ILV or equivalent) with a 1/4" I.D. silicone O-ring replacing the ferrules in the nut on the 1/4" (sorbent tube) side and the needle of a luer-lock syringe needle inserted into the 1/16" side. (Held in place with a 1/16" ferrule.) The luer-lock end of the needle can be attached to the sampling syringe. It is useful to have a luer-lock on/off valve situated between the syringe and the needle.

C. Two-stage glass sampling cartridge (1/4" O.D. x 1/8" I.D. x 5 1/8") contained in a flame-sealed tube (Manufacturer: Supelco Custom Tenax/Spherocarb Tubes) containing two sorbent sections retained by glass wool:

Front section: 150 mg of Tenax-GC
Back section: 150 mg of CMS (Carbonized Molecular Sieve)

These tubes are prepared and cleaned in accordance with EPA Method EMSL/RTP-SOP-EMD-013 by the vendor. The vendor sends ten tubes per lot made to the REAC GC/MS Laboratory and they are tested for cleanliness, precision, and reproductability.

D. Teflon-capped culture tubes or stainless steel tube containers for sorbent tube storage and shipping. These containers should be conditioned by baking at 120 degrees C for at least two hours. The culture tubes should contain a glass wool plug to prevent sorbent tube breakage during transport. Reconditioning of the containers should occur between uses or after extended periods of disuse (i.e., two weeks or more).

E. Nylon gloves or lint-free cloth. (Hewlett Packard Part # 8650-0030 or equivalent.)

7.4.2 Sample Collection

Handle sorbent tubes with care, using nylon gloves (or other lint-free material) to avoid contamination.

Immediately before sampling, break one end of the sealed tube and remove the Tenax cartridge.

Connect the valve on the Tedlar bag to the sorbent tube adapter. Connect the sorbent tube to the sorbent tube adapter with the Tenax (white granular) side of the tube facing the Tedlar bag. Connect the sampling syringe assembly to the CMS (black) side of the sorbent tube. Fittings on the adapters should be finer-tight. Open the valve on the Tedlar bag. Open the on/off valve of the sampling syringe. Depending on work plan stipulations, at least 10% of the soil gas samples analyzed by this GC method must be submitted for confirmational GC/MS analysis (according to modified methods TO-1 [Tenax absorbent] and TO-2 [Carbon Molecular Sieve (CMS) absorbent]). Each soil gas sample must be absorbed on replicate Tenax/CMS tubes. The volume absorbed on a Tenax/CMS tube is dependent on the total concentration of the compounds measured by the photovac/GC or other applicable GC:

Total Concentration (ppm)	Sample Volume (mL)
>10	Use Serial Dilution
10	10 - 50
5	20-100
1	100-250

After sampling, remove the tube from the sampling train with gloves or a clean cloth. DO NOT LABEL OR WRITE ON THE TENAX/CMS TUBE.

Place the sorbent tube in a conditioned stainless steel tube holder or culture tube. Culture tube caps should be sealed with Teflon tape.

7.4.3 Sample Labeling

Each sample tube container (not tube) must be labeled with the site name, sample station number, date sampled, and volume sampled.

Chain of custody sheets must accompany all samples to the laboratory.

7.4.4 Quality Assurance (QA)

Before field use, a QA check should be performed on each batch of sorbent tubes by analyzing a tube by thermal desorption/cryogenic trapping GC/MS.

At least one blank sample must be submitted with each set of samples collected at a site. This trip blank must be treated the same as the sample tubes except no sample will be drawn through the tube.

Sample tubes should be stored out of UV light (i.e., sunlight) and kept on ice until analysis. Samples should be taken in duplicate, when possible.

7.5 Summa Canister Sampling

1. Follow step 7.2.1 to evacuate well volume. If PID/FID readings were taken prior to taking a sample, evacuation is not necessary.

2. Attach a certified clean, evacuated 6-liter Summa canister via the 1/4" Teflon tubing.

3. Open valve on Summa canister. The soil gas sample is drawn into the canister by pressure equilibration. The approximate sampling time for a 6 liter canister is 20 minutes.

4. Site name, sample location, number, and date must be recorded on a chain of custody form and on a blank tag attached to the canister.

8.0 CALCULATIONS

8.1 Field Screening Instruments

Instrument readings are usually read directly from the meter. In some cases, the background level at the soil gas station may be subtracted:

Final Reading = Sample Reading - Background

8.2 Photovac GC Analysis

Calculations used to determine concentrations of individual components by Photovac GC analysis are beyond the scope of this SOP and are covered in ERT SOP #2109, *Photovac GC Analysis for Soil Water and Air/Soil Gas*.

9.0 CALIBRATION

9.1 Field Instruments

It is recommended that the manufacturers' manuals be consulted for correct use and calibration of all instrumentation.

9.2 Gilian Model HFS113A Air Sampling Pumps

Flow should be set at approximately 3.0 L/min; accurate flow adjustment is not necessary. Pumps should be calibrated prior to bringing into the field.

10.0 QUALITY ASSURANCE/ QUALITY CONTROL

10.1 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe via a Gilian pump and checking the response of the FID/PID. If readings are higher than background, replacement or decontamination is necessary.

Sample probes may be decontaminated simply by drawing ambient air through the probe until the HNu reading is at background. More persistent contamination can be washed out using methanol and water, then air drying. For persistent volatile contamination, use of a portable propane torch may be needed. Using a pair of pliers to hold the probe, run the torch up and down the length of the sample probe for approximately 1-2 minutes. Let the probe cool before handling. When using this method, make sure to wear gloves to prevent burns. Having more than one probe per sample team will reduce lag times between sample stations while probes are decontaminated.

10.2 Sample Train Contamination

The Teflon line forming the sample train from the probe to the Tedlar bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it should be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a Gilian pump, for approximately 30 seconds between each sample. After purging, the sampling train can be checked using an FID or PID, or other field monitoring device, to establish the cleanliness of the Teflon line.

10.3 FID/PID Calibration

The FID and PIDs should be calibrated at least once a day using the appropriate calibration gases.

10.4 Field Blanks

Each cooler containing samples should also contain one Tedlar bag of ultra-zero grade air, acting as a field blank. The field blank should accompany the samples in the field (while being collected) and when they are delivered for analysis. A fresh blank must be provided to be placed in the empty cooler pending additional sample collection. One new field blank per cooler of samples is required. A chain of custody sheet must accompany each cooler of samples and should include the blank that is dedicated to that group of samples.

10.5 Trip Standards

Each cooler containing samples should contain a Tedlar bag of standard gas to calibrate the analytical instruments (Photovac GC, etc.). This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. A chain of custody sheet should accompany each cooler of samples and should include the trip standard that is dedicated to that group of samples.

10.6 Tedlar Bag Check

Prior to use, one bag should be removed from each lot (case of 100) of Tedlar bags to be used for sampling and checked for possible contamination as follows: the test bag should be filled with ultra-zero grade air; a sample should be drawn from the bag and analyzed via Photovac GC or whatever method is to be used for sample analysis. This procedure will ensure sample container cleanliness prior to the start of the sampling effort.

10.7 Summa Canister Check

From each lot of four cleaned Summa canisters, one is to be removed for a GC/MS certification check. If the canister passes certification, then it is re-evacuated and all four canisters from that lot are available for sampling.

If the chosen canister is contaminated, then the entire lot of four Summas must be recleaned, and a single canister is re-analyzed by GC/MS for certification.

10.8 Options

10.8.1 Duplicate Samples

A minimum of 5% of all samples should be collected in duplicate (i.e., if a total of 100 samples are to be collected, five samples should be duplicated.) In choosing which samples to duplicate, the following criteria applies: if, after filling the first Tedlar bag, and, evacuating the well for 15 seconds, the second HN (or other field monitoring device being used) reading matches or is close to (within 50%) the first reading, a duplicate sample may be taken.

10.8.2 Spikes

A Tedlar bag spike and Tenax tube spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (landfills, etc.). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. Summa canisters containing samples are not spiked.

11.0 DATA VALIDATION

11.1 Blanks (Field and Tedlar Bag Check)

For each target compound, the level of concentration found in the sample must be greater than three times the level (for that compound) found in the field blank which accompanied that sample to be considered valid. The same criteria apply to target compounds detected in the Tedlar bag pre-sampling contamination check.

12.0 HEALTH AND SAFETY CONSIDERATIONS

Due to the remote nature of sampling soil gas, special considerations can be taken with regard to health and safety. Because the sample is being drawn from underground, and no contamination is introduced into the breathing zone, soil gas sampling usually occurs in Level D. Ambient air is constantly monitored using the HNu PI101 to obtain background readings during the sampling procedure. As long as the levels in ambient air do not rise above background, no upgrade of the level of protection is needed.

When conducting soil gas sampling, leather gloves should be worn, and proper slam bar techniques should be implemented (bend knees). Also, an underground utility search should be performed prior to sampling. (See Section 4.5).

13.0 REFERENCES

Gilian Instrument Corp., Instruction Manual for Hi Flow Sampler: HFS113, HFS 113 T, HFS 113U, HFS 113 UT, 1983.

HNu Systems, Inc., Instruction Manual for Model PI 101 Photoionization Analyzer, 1975.

N.J.D.E.P., Field Sampling Procedures Manual, Hazardous Waste Programs, February, 1988.

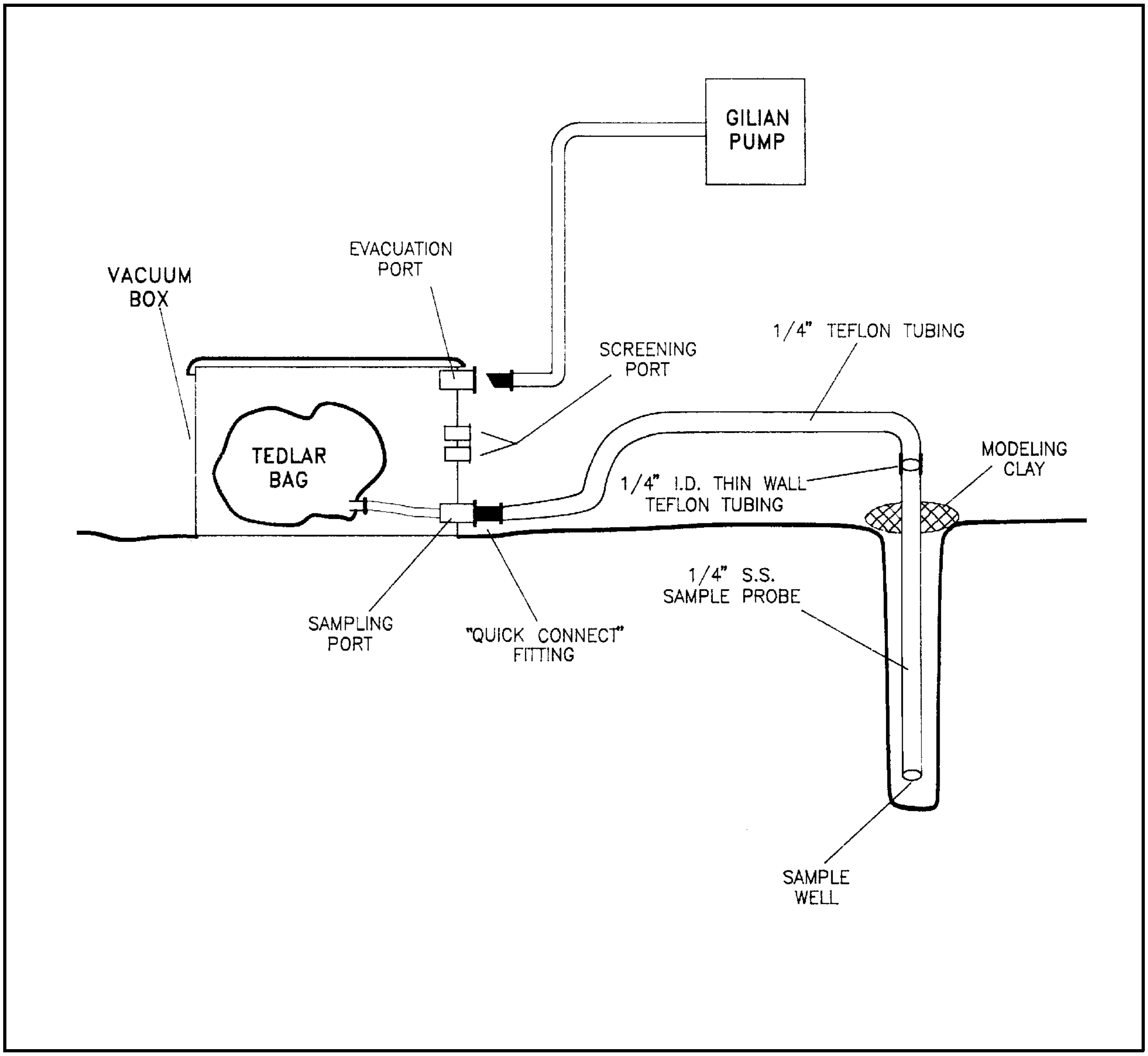
Roy F. Weston, Inc., Weston Instrumentation Manual, Volume I, 1987.

U.S.E.P.A., Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, 2nd Edition, EPA-600/4-84-076, December, 1984.

APPENDIX A

Figure

FIGURE 1. Sampling Train Schematic



APPENDIX B

HNu Field Protocol

Field Procedure

The following sections detail the procedures that are to be followed when using the HNu in the field.

Startup Procedure

a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug in; don't force.

b. Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery are on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging.

c. Turn the function switch to any range setting. Look into the end of the probe for no more than two to three seconds to see if the lamp is on. If it is on, it will give a purple glow. Do not stare into the probe any longer than three seconds. Long term exposure to UV light can damage eyes. Also, listen for the hum of the fan motor.

d. To ZERO the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed since this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero.

Operational Check

a. Follow the startup procedure.

b. With the instrument set on the 0-20 range, hold a solvent-based major market near the probe tip. If the meter deflects upscale, the instrument is working.

Field Calibration Procedure

a. Follow the startup procedure and the operational check.

b. Set the function switch to the range setting for the concentration of the calibration gas.

c. Attach a regulator (HNu 101-351) to a disposable cylinder of isobutylene gas (HNu 101-351). Connect the regulator to the probe of the HNu with a piece of clean Tygon tubing. Turn on the value on the regulator.

d. After fifteen seconds, adjust the span dial until the meter reading equals the concentration of the calibration gas used. Be careful to unlock the span dial before adjusting it. If the span has to be set below 3.0, calibration internally or return to equipment maintenance for repair.

e. Record in the field logbook: the instrument ID no. (EPA decal or serial number if the instrument is a rental); the initial and final span settings; the date and time; concentration and type of calibration has used; and the name of the person who calibrated the instrument.

Operation

a. Follow the startup procedure, operational check, and calibration check.

b. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0-20 ppm range. Adjust it if necessary.

c. While taking care not to permit the HNu to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the Site Health and Safety Plan.

d. When the activity is completed or at the end of the day, carefully clean the outside of the HNu with a damp disposable towel to remove any visible dirt. Return the HNu to a secure area and place on charge.

e. With the exception of the probe's inlet and exhaust, the HNu can be wrapped in clear plastic to prevent it form becoming contaminated and to prevent water from getting inside in the event of precipitation.

Cone Penetration Testing Procedure (CPT)

Gregg Drilling & Testing, Inc. carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, Figure CPT. The soundings are conducted using a 20 ton capacity cone with a tip area of 15 cm^2 and a friction sleeve area of 225 cm^2. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80.

The cone takes measurements of cone bearing (q_c), sleeve friction (f_s) and dynamic pore water pressure (u_2) at 5-cm intervals during penetration to provide a nearly continuous hydrogeologic log. CPT data reduction and interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored on disk for further analysis and reference. All CPT soundings are performed in accordance with revised (2002) ASTM standards (D 5778-95).

The cone also contains a porous filter element located directly behind the cone tip (u_2), Figure CPT. It consists of porous plastic and is 5.0mm thick. The filter element is used to obtain dynamic pore pressure as the cone is advanced as well as Pore Pressure Dissipation Tests (PPDT's) during appropriate pauses in penetration. It should be noted that prior to penetration, the element is fully saturated with silicon oil under vacuum pressure to ensure accurate and fast dissipation.

When the soundings are complete, the test holes are grouted using a Gregg Drilling support rig. The grouting procedure consists of pushing a hollow CPT rod with a "knock out" plug to the termination depth of the test hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

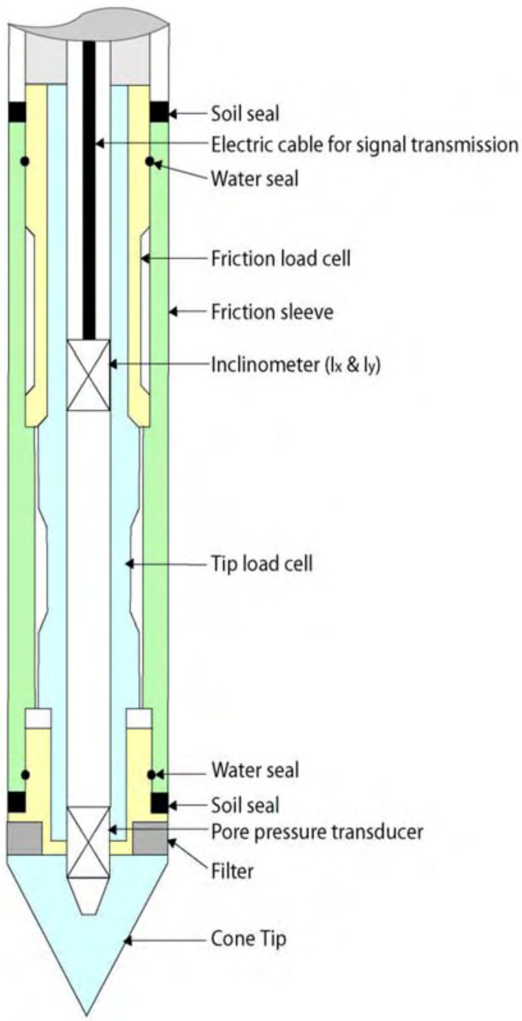


Figure CPT