Work Plan

Additional Vapor Intrusion Evaluation

The Companies Offsite Operable Unit
Sunnyvale, California

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Locus
TECHNOLOGIES

Work Plan
Additional Vapor Intrusion Evaluation

The Companies Offsite Operable Unit
Sunnyvale, California

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LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
cis-1,2-DCE	cis-1,2-dichloroethene
The Companies	Advanced Micro Devices, Philips Semiconductors Inc., and TRW, Inc.
Locus	Locus Technologies
the Orders	Regional Water Quality Control Board Order Nos. 91-102, 91-103, and 91-104
OOU	The Companies Offsite Operable Unit
PCE	tetrachloroethene
Philips	Philips Semiconductors Inc.
QA/QC	Quality Assurance/Quality Control
RWQCB	Regional Water Quality Control Board
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
EPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

WORK PLAN
ADDITIONAL VAPOR INTRUSION EVALUATION
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

1 INTRODUCTION

This work plan was prepared by Locus Technologies in response to the RWQCB letter dated 10 January 2014 and subsequent comments from EPA in a letter dated 11 August 2014. Together, the letters requested a work plan for vapor intrusion evaluation for the Companies Offsite Operable Unit (OOU) to address concerns raised by EPA for additional vapor intrusion investigations. The initial phase of this investigation would be implemented at the following properties: 790 East Duane Avenue, 562 North Britton Avenue, 794 East Duane Avenue, 777 San Miguel Avenue, and some residential buildings. Additional vapor intrusion evaluations will expand to surrounding properties, as needed. Separate appendices to this work plan would be prepared for subsequent phases, which would follow the general approach and methods described in this document.

1.1 Purpose

The purpose of this work plan is to address additional groundwater-to-indoor air vapor intrusion concerns within selected portions of the Companies Offsite Operable Unit (OOU) as requested by EPA. The scope of the work plan was selected to represent typical exposure (ambient air) for the building occupants and evaluate exposure pathways at the evaluation study area.

After data are collected and evaluated, an evaluation report of site conditions will be submitted to the EPA. Recommendations for additional phases of sampling will be considered, as needed.

1.2 Scope of Work

The activities to be completed under this Work Plan consist of the following tasks:

1. Pre-sampling tasks:

    - Collection of information on chemical use and storage through building walkthroughs as necessary.
    - Preparation of building layouts, as necessary, and identification of the locations to be sampled at each vapor intrusion evaluation study area.
    - Submittal to EPA of proposed sample location maps.

    Some of these tasks have already been completed for certain properties where vapor intrusion investigation activities have already been implemented. Where available, this information is included in the appendices to this work plan.

2. Collection of air samples in selected buildings and outdoors.

3. Notification to EPA within 48 hours of receipt of results that exceed the short-term screening levels.

4. Preparation of a report to EPA within 30 days of completion of data review.

5. Discussion with EPA regarding the need for further vapor intrusion investigations of properties.

6. Technical support and input on EPA-lead community outreach materials

1.3 Work Plan Organization

This Work Plan for Additional Vapor Intrusion Evaluation describes the general approach for vapor intrusion evaluations at the OOU. Site-specific work plans that outline the history of investigations and proposed sample locations are provided in the appendices to this work plan. The general work plan begins with a discussion of the site and previous vapor intrusion evaluations in Chapter 2. Project team organization is listed in Chapter 3. The sampling protocol is listed in Chapter 4. The approach to reporting of the sample results is discussed in Chapter 5. Appendices A and B contain the commercial and residential building checklists, which will be used for all properties, as appropriate. Appendix H contains a Quality Assurance Project Plan (QAPP), which describes the data quality objectives (DQO) process used in the design of the evaluation study.

2 SITE DESCRIPTION

2.1 Site Background

The OOU is located in Sunnyvale, California (Figure 1). The OOU extends from the northern property boundary of 440 North Wolfe Road to just north of Lakehaven Drive (north of U.S. Highway 101) and is approximately bounded by Santa Paula Avenue on the east and the Sunnyvale East Drainage Channel on the west (Figure 2). The groundwater beneath the site is impacted with trichloroethene (TCE). The OOU consists of the commingled plumes of the Philips Semiconductors site at 811 East Arques Avenue, the AMD site at 901/902 Thompson Place, and the TRW site at 825 Stewart Drive. An extensive groundwater extraction and monitoring program has been in operation since 1988 to monitor and control the migration of TCE in the groundwater beneath the site. The vapor intrusion study area is defined as areas overlying shallow groundwater concentrations of 5 micrograms per liter (µg/L) or higher (Figure 3). Various investigation methods will be used, as appropriate, to evaluate vapor intrusion within this area.

2.2 Regulatory Background

Vapor intrusion investigations at this site were initiated by a request from RWQCB in March 2003. Several rounds of soil-gas and indoor air samples have been collected under the oversight of RWQCB to address the vapor intrusion concerns. In October 2006, RWQCB concluded that the only further action needed regarding vapor intrusion at OOU was annual monitoring at the 790 Duane Avenue property. Annual monitoring has been conducted for the property since 2007. On 10 January 2014, RWQCB issued a new requirement for a work plan pursuant to Water Code section 13267. A draft work plan was submitted to RWQCB on 1 May 2014. Subsequently, EPA issued a letter on 7 August 2014 with comments on the initial work plan and confirming that EPA was taking over the responsibility for regulating response actions in the OOU from the RWQCB. This indoor air investigation work plan incorporates those comments from EPA.

2.3 Site Hydrogeology

The aquifer system at the site has been described in detail in the most recent Five-Year Evaluation Report (Locus, 2011b). The subsurface has been divided into the "A" and "B" aquifer zones. The "B" aquifer zone has been further divided into the "B1", "B2", "B3", and "B4" aquifers. The aquifers occur at the approximate depths listed in the table below.

Aquifer	Depth Below Ground Surface (bgs)
"A"	10 – 25
"B1"	25 – 40
"B2"	40 – 60
"B3"	60 – 80
"B4"	80 – 100
"B5"	100 – 120

Previous investigations at the site have revealed that the aquifers at the site have varying thicknesses and are frequently discontinuous. At some locations, more than one water-bearing unit may be present within an aquifer. There are also localized areas where aquifers coalesce. This is particularly the case between the "B2" and "B3" aquifers. The "A" and "B4" aquifers are generally more laterally continuous at the site than the other aquifers (Locus, 2001).

Regional groundwater flow in the "A" and "B" aquifers is generally northward at the site. However, operating extraction wells, trenches, and sumps influence the groundwater flow direction in the vicinity of the site.

2.4 Nature and Extent of Chemicals at the Site

In 1984, investigations began in the groundwater north of Duane Avenue to determine the vertical and horizontal extent of chemicals at the OOU. A series of investigations followed, which included groundwater monitoring, soil borings, and soil-gas surveys. The results of these investigations were detections of chemicals in the groundwater. Chemicals were not observed in the soil at the OOU.

Chemicals of concern (COCs) for the OOU as established in the Orders are: 1,1-dichloroethane (1,1-DCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (cis-1,2-DCE); trans-1,2-dichloroethene (trans-1,2-DCE); Freon 113; 1,1,1-trichloroethane (1,1,1-TCA); TCE; and tetrachloroethene (PCE). These eight chemicals were identified by the RWQCB as chemicals of concern for the OOU site and will be used for the vapor intrusion evaluation. Because TCE is the chemical most commonly present within the OOU and the neighboring operable units, it serves as the indicator chemical for the site.

An extensive groundwater sampling program has been established for the OOU to monitor the effectiveness of the system and verify the containment of the plume. Since 1987, this program has produced a vast database defining the extent of the chemical-bearing groundwater. Groundwater samples have been analyzed for a comprehensive list of volatile organic compounds (VOCs), using Environmental Protection Agency (EPA) Methods 8010 and 8020 or equivalents. The maximum 2013 groundwater concentrations in the shallow "A" aquifer are included in Table 1 for the COCs and additional detected chemicals (chloroform and vinyl chloride).

Chemicals have been detected in the upper four aquifers at the OOU. Groundwater monitoring is conducted in these aquifers as well as the "B5" aquifer to verify the vertical containment of the plume. The chemicals have not impacted the deeper aquifers that are used for public water supply.

Groundwater extraction and treatment began at the OOU in 1986. Currently, a total of 29 groundwater extraction wells are operating within the OOU. Groundwater extracted from these sources are treated by a combination of UV oxidation and air stripping and discharged in accordance with RWQCB requirements.

2.5 Previous Vapor Intrusion Investigations

In 2003 and 2004, a series of soil and soil-gas samples were collected to evaluate vapor intrusion concerns within the OOU, as requested by RWQCB. In April 2003, samples were collected along Duane Avenue in the vicinity of 790 East Duane Avenue where the highest groundwater concentrations within the OOU are present. Results from the evaluation showed that vapor intrusion did not present a concern at the OOU at this time. In February 2004, additional soil-gas investigation was conducted at 562 North Britton Avenue and the surrounding residential area. Results concluded that indoor air concentrations at the site would be below all applicable health criteria. However, since the soil-gas concentrations were elevated in some areas south of Duane Avenue, the modeled indoor air concentrations were in the range where uncertainties in model parameters could affect the results. Therefore, indoor air sampling was conducted at 790 East Duane Avenue and 562 North Britton Avenue to evaluate these uncertainties.

Indoor and outdoor air samples were collected during 2004 and 2005 in the school buildings located at 562 Britton Avenue and annually from 2004 through the present in the school buildings located at 790 Duane Avenue. Multiple rounds of indoor air sample collection were performed to evaluate the air quality during different seasons and during normal occupancy activity periods. In buildings where the potential for vapor intrusion was identified, HVAC units were upgraded to provide adequate air flow in the building. Suggestions for regular ventilation inspection and maintenance to prevent inadequate ventilation conditions were also provided to the building owners, tenants, and ventilation maintenance staff. Annual HVAC inspections and indoor air sampling continue at 790 East Duane Avenue. Results of the indoor air and soil-gas evaluations are discussed in the site-specific work plans for 790 East Duane Avenue and 562 North Britton Avenue.

Community outreach was conducted in association with these vapor intrusion investigations to parties including government agencies, the building owners/occupants, and the PRPs at the sites. Inspection and analytical results were presented to the owners, occupants, and the RWQCB.

3 CONCEPTUAL SITE MODEL

This chapter presents a conceptual site model of the OOU site. Pollutant sources are identified and evaluated, the site is characterized, and exposure pathways and receptors are assessed.

3.1 Identification and Evaluation of Pollutant Sources

Primary and secondary pollutant sources are discussed below.

3.1.1 Primary Source

As discussed in Section 2.4, the OOU consists of the commingled plumes of the Philips Semiconductors site at 811 East Arques Avenue, the AMD site at 901/902 Thompson Place, and the TRW site at 825 Stewart Drive. Past investigations at these sites have found that solvents related to semiconductor manufacturing may have contributed to the VOC concentrations in groundwater. Various organic solvents were used in the manufacturing processes at the sites.

In 1984, investigations began in the groundwater north of Duane Avenue to determine the vertical and horizontal extent of chemicals at the OOU. A series of investigations followed, which included groundwater monitoring, soil borings, and soil-gas surveys. The results of these investigations were detections of chemicals in the groundwater. Chemicals were not observed in the soil at the OOU.

3.1.2 Secondary Sources

Based on the "1 percent of solubility" rule-of-thumb, Dense Non-Aqueous Phase Liquids (DNAPLs) are suspected to be present when the concentration of a chemical in groundwater is greater than one percent of its pure-phase solubility (US EPA, 1992). The aqueous solubility of TCE at 25 °C is 1,472,000 µg/L (US EPA, 2004). Since 1982, the highest observed TCE concentration at the site has been 9,900 µg/L, which is approximately 0.67% of its aqueous solubility. Therefore, DNAPL as a secondary source is not suspected to be present at the site.

Soil and soil-gas samples were collected in a series of investigations. Soil sampling programs conducted at the site yielded nondetectable concentrations of VOCs in the soil. The maximum observed TCE concentration of all of the soil-gas samples was 13,000 µg/m^3. The soil-gas concentrations that were observed were attributed to volatilization from groundwater and upward migration into the vadose zone (Locus, 2004a). All available data suggest that there are no residual VOCs entrained within or sorbed to soil as secondary sources at the site. In particular, the Responsible Parties never occupied nor conducted operations on the OOU site.

3.2 Site Characterization

A discussion of pollutant distribution and migration pathways and the nature of the industry that caused the VOC release are included in the site characterization below.

3.2.1 Pollutant Distribution

Pollutant distribution in soil, soil-gas, and groundwater is discussed below.

3.2.1.1. Soil

The Responsible Parties never occupied nor conducted operations on the OOU site, and soil sampling programs conducted at the site yielded nondetectable concentrations of VOCs in the soil.

3.2.1.2. Soil-Gas

Per request from RWQCB dated 20 August 2003, two rounds of soil-gas investigations were conducted in 2003 and 2004 in the following three areas within the OOU site: along Duane Avenue where the highest groundwater concentrations within the OOU are present, in the residential complex north of Duane Avenue, and in the vicinity of 562 North Britton Avenue.

Results from the evaluation showed that vapor intrusion did not present a concern at the OOU at this time. In February 2004, additional soil-gas investigation was conducted at 562 North Britton Avenue and the surrounding residential area. Results concluded that indoor air concentrations at the site would be below all applicable health criteria. However, since the soil-gas concentrations were elevated in some areas south of Duane Avenue, the modeled indoor air concentrations were in the range where uncertainties in model parameters could affect the results. Therefore, indoor air sampling was conducted at 790 East Duane Avenue and 562 North Britton Avenue to evaluate these uncertainties (Locus, 2004a).

3.2.1.3. Groundwater

The majority of the impacted groundwater has been found in in the "A" and “B1” aquifers at the OOU. Groundwater monitoring is currently conducted in these aquifers.

3.2.1.3.1. Description of the Groundwater Monitoring Program

Programs have been established for groundwater elevation monitoring and groundwater sampling to monitor the effectiveness of groundwater remediation and the conditions at the site.

Water elevations are currently measured annually in a set of 111 monitoring wells and former extraction wells at the site. Annually, the water elevation measurements are coordinated with the surrounding sites (AMD 915 site, AMD 901/902 site, TRW site, and Arques site) so that water elevation contours can be generated for the entire area. These wells are mapped in Figure 2. Groundwater elevation contours for the entire area can be found in the OOU site Annual Groundwater Monitoring Reports submitted on 30 January each year and available to the public on California's Geotracker website (https://geotracker.waterboards.ca.gov/).

Groundwater monitoring wells and extraction wells are sampled annually at the OOU site. The wells that are sampled during the semiannual and annual sampling events are also mapped in Figure 2. The wells are distributed to provide well-defined plume boundaries in the "A", "B1", "B2", "B3", and "B4" aquifers, and to verify the lack of chemicals in the "B5" aquifer. The extraction wells are also sampled during a semiannual event, which provides information used to gauge the effectiveness of the remedial effort. All samples are analyzed using EPA Methods 8010 and 8020.

3.2.1.3.2. Description of the Groundwater Extraction System

To control and remediate the chemicals present in the groundwater, a groundwater extraction and treatment system has been installed at the OOU. The system consists of 29 groundwater extraction wells which pump water to the treatment system located at 813 Stewart Drive. Extracted groundwater is treated by an ultraviolet (UV) peroxide oxidation system followed by air stripping and discharged to the Sunnyvale East Channel in accordance with NPDES Permit No. CAG912003, Order No. R2-2009-0059.

3.2.1.3.3. Distribution of COCs in the Groundwater

TCE concentration contours for the OOU site for 2013 are shown in Figure 3 for the “A” aquifer. Because TCE is the chemical most commonly present within the OOU and the neighboring operable units, it serves as the indicator chemical for the site.

Contour of the TCE concentrations in the "A" aquifer is presented in Figure 3. The distribution of TCE in the "A" aquifer in 2013 is generally consistent with data from previous sampling events, with the highest VOC concentrations detected in the southernmost portion of the site.

3.2.2 Identification of Potential Pollutant Migration Pathways

Potential pollutant migration pathways in soil and groundwater are discussed below.

3.2.2.1. Soil

Previous soil sampling programs have yielded nondetectable results of VOCs in the soil at the OOU site. Therefore potential migration pathways from the soil are not a concern.

3.2.2.2. Groundwater

The general direction of groundwater flow at the site is to the north, toward the baylands of San Francisco Bay. Currently, VOCs are vertically contained within the “A”, “B1”, “B2”, “B3”, “B4”, and "B5" aquifers. If the aquitard between each pair of aquifers ("A/B1", "B1/B2", "B3/B2", "B4/B3", or "B5/B4") is compromised and a downward hydraulic gradient occurs, there is a potential for the downward migration of VOCs to the lower aquifer. However, recent hydraulic gradient observations have shown that the direction of flow across the aquitards is mostly upwards.

3.2.3 Nature of the Industry that Caused the Release

As discussed in Section 2, groundwater beneath the site is impacted with VOCs, and past investigations at the site have found that solvents related to upgradient semiconductor manufacturing may have contributed to the VOC concentrations in groundwater. Various organic solvents were used in the manufacturing processes at the site.

The pollutants of concern for this site were established by the Orders issued by the RWQCB. These chemicals are: 1,1-dichloroethane (1,1-DCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (cis-1,2-DCE); trans-1,2-dichloroethene (trans-1,2-DCE); Freon 113; 1,1,1-trichloroethane (1,1,1-TCA); TCE; and tetrachloroethene (PCE).

3.3 Identification and Assessment of Exposure Pathways, Receptors, and Potential Risks, Threats, and Other Environmental Concerns

Because this work plan is intended to evaluate vapor intrusion, this discussion is limited to that exposure pathway. Other potential human receptors, water resource receptors, and ecological receptors will not be evaluated by this investigation, and are therefore not discussed here.

3.3.1 Human Receptors

3.3.1.1. Current Use Conditions

The majority of the OOU area is currently occupied by residential buildings, including multi-tenant apartment complexes, duplexes, and single family homes. The potential human receptor for these structures is assumed to be consistent with standard exposure parameters for residential occupancy.

The area also includes a private high school (562 North Britton Avenue), two elementary schools (790 East Duane Avenue and 777 San Miguel Avenue), and a day-care center (794 East Duane Avenue). The potential human receptors for these properties would include children as well as staff. Exposure parameters for residential occupancy would be conservative and appropriate for these occupants.

3.3.1.2. Future Use Conditions

Future use (also referred to as anticipated use) of the OOU site may differ from the current use. However, the area has been occupied by residences and schools for many years. According to the current zoning map for the City of Sunnyvale, the OOU currently includes areas designated as PF (public facilities), R3 (medium density residential), R2 (low medium density residential), and R1 (low density residential). Changes to the potential use conditions of this area are not likely.

4 PROJECT TEAM ORGANIZATION

4.1 Project Team Contact

The Project Team consists of the following main personnel:

Title	Name	Contact
Senior Project Manager	J. Wesley Hawthorne	415-663-4702
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Project Engineer	Nancy-Jeanne LeFevre	(415) 992-5360
		LeFevren@locustec.com
Assistant Project Engineer	Ning Du	(415) 390-2430
		dun@locustec.com

Additional staff are available from Locus to assist with implementation of the work plan.

4.2 Responsibilities of Project Personnel

The Senior Project Manager will oversee the entire investigation and supervise inspection of building ventilation systems and installation of ventilation improvements if necessary. The role also involves coordinating public communication activities for the project, including meetings with building owners, tenants, and agency representatives to facilitate the progress of ongoing investigation and mitigation activities.

The Project Engineer and Assistant Project Engineer will coordinate collection of samples, arrange analytical laboratories to conduct sample analysis, perform QA/QC on field and laboratory data, and report on the investigation results. Additional staff members, including engineers and environmental technicians, will assist with sample collection as needed.

5 SAMPLING PROTOCOL

This chapter discusses the methods and reporting procedures to be used for indoor air samples in this investigation. Results will be used to assess potential groundwater-to-indoor air vapor intrusion.

5.1 Site Inspections

An inspection of the buildings to be evaluated will be conducted prior to the sampling date, using the checklist in Appendix A or Appendix B, depending on whether the building use is residential or commercial/institutional. A knowledgeable contact for each building or residence will be consulted for completion of the checklist. These checklists are designed to evaluate characteristics of the building use and ventilation systems that may impact indoor air quality. Any identified current or recent chemical usage that may impact VOC concentrations in the air will be noted on these forms. The completed forms will be stored in a web-based database that contains an inventory of documented sampling and related activities for all of the project sites. Real-time access to the database will be given to EPA for oversight.

5.2 Site Specific Sample Strategy

Work plans addressing specific properties on this site are provided in the appendices. As discussed with EPA, the initial phase of vapor intrusion investigations will include 790 East Duane Avenue (Appendix C), 562 North Britton Avenue (Appendix D), 794 East Duane Avenue

(Appendix E), and 777 San Miguel Avenue (Appendix F). Additionally, the initial investigations will include residential buildings, which are collectively addressed in Appendix G. The general approach to the investigations for all properties is further described below.

5.2.1 Indoor Air Samples

For this investigation, indoor air sample locations will be selected in areas that are most representative of building occupancy, as well as other areas with characteristics that might facilitate vapor intrusion. On average, two indoor air samples will be collected per building, one with the HVAC system on and one with the HVAC system off. Many buildings and rooms at these properties have been sampled previously, and results for all COCs have been within or below EPA's risk protective range. Proposed sampling efforts at these properties are focused on locations that have not been sampled previously.

The indoor air sampling will be representative of inhalation exposure point concentrations for the occupants of the buildings. Indoor air samples will be collected at the breathing zone elevation of building occupants, and will be documented for each sample. Refer to site-specific work plans for the selected sampling heights above floor level.

5.2.2 Pathway Samples

Pathway samples will be selected for selected areas which are accessible but not routinely occupied for extended periods (e.g. electrical closets, janitor's closets). Where identified as a potential source to the routinely occupied areas of the building, these areas will be sampled to evaluate whether preferential pathways exist. This information could be used in consideration of mitigation options for the building, should they be necessary.

Additionally, some buildings at this site have crawlspaces or subfloor areas that are generally not accessed by occupants. However, sampling results from those areas may be used to distinguish between chemical concentrations originating through vapor intrusion and chemicals originating from other sources. Where possible, samples will be collected from these areas for evaluation of potential pathways for vapor intrusion.

5.2.3 Outdoor Air Samples

Representative outdoor samples will be collected to compare indoor and outdoor air concentrations, as necessary. The outdoor air samples provide data to quantify contributions from outdoor sources. Previous outdoor air sampling results at this site have shown minimal variability between outdoor air samples collected on the same date. Therefore, it is expected that the outdoor air concentrations can be adequately represented using a few outdoor air samples, distributed throughout the properties near buildings where indoor air is being sampled. On average, one outdoor sample will be taken per five school buildings or residences. If accessible, outdoor samples may also be collected at the HVAC system intakes to directly monitor outdoor concentrations that would be entering the building.

5.3 Sampling Equipment

Sampling will be conducted using two methods, depending on the duration of the sampling (refer to Section 5.4 and site-specific work plans regarding sampling duration). Radiello radial passive samplers for VOC sampling (RAD145) will be used for sampling periods of 24 hours (or longer). For sampling periods of less than 24 hours, such as the 12-hour and 8-hour exposure durations for the schools, the minimum reporting limits for passive samplers are above the current EPA long-term screening levels. Therefore, for sampling events less than 24-hours in duration, six-liter summa-passivated canisters must be used.

5.3.1 Passive Samplers

HVAC-off samples will be collected using Radiello passive samplers (refer to Section 5.4). Radiello passive samplers rely on the diffusion of analytes through a diffusive surface onto an adsorbent. The analytical laboratory will provide the Radiello samplers, which each consist of a supporting plate with clip, a cartridge, and a diffusive body. Before use, the supporting plate and clip will be assembled for suspending the sampler. The cartridge will be delivered in a tube in a sealed plastic bag to prevent contamination during transit. At the time sampling is to begin, the cartridge will be transferred from the tube in the plastic bag into the diffusive body without touching the cartridge. The cartridge will be seated securely in the diffusive body, correctly centered, and not sticking out from the diffusive body by even half a millimeter. The diffusive body will then be seated on the supporting plate while being kept vertical; keeping the diffusive body vertical will prevent the cartridge from becoming unseated. Care will be taken not to bend the diffusive body nor touch the cartridge during assembly. At the conclusion of sampling, samplers will be replaced into their tubes and original packaging for shipment back to the laboratory. After sampling, the analytes are thermally desorbed and analyzed by USEPA Method TO-17.

5.3.2 Summa Canisters

HVAC-on samples will be collected in six-liter passivated steel Summa canisters (refer to Section 5.4). The samples will be time-integrated over the normal operating hours for the building. For time-integrated air samples, a sample of air is drawn through a sampling train of components that regulate the rate and duration of sampling into a pre-evacuated, specially prepared passivated canister. The analytical laboratory will provide the pre-evacuated Summa canisters. The canisters are stainless steel containers that are supplied under negative pressure. Once received from the laboratory, a pre-evacuated Summa canister can hold a high vacuum (i.e., >30 inches of mercury (" Hg)) for up to 30 days. It should be used during this period to ensure appropriate vacuum during sampling.

Each pre-evacuated canister received from the laboratory is to be equipped with a brass plug, vacuum gauge, flow controller, and particulate filter. The brass plug ensures that there is no loss of vacuum due to a valve accidentally opening during shipment. The plug also prevents dust from contacting the valve. A vacuum gauge will be used to measure the initial and final vacuum of the canister and to monitor the canister when collecting an integrated sample. A flow controller (critical orifice) is used when taking an integrated sample over time. Various orifices are available. A fixed-rate flow controller will be used. A particulate filter will also be used with the flow controller to prevent particulates from entering the orifice. Prior to shipment, the laboratory is to confirm the flow rates for each orifice. It is imperative that orifices are certified "clean" prior to use; therefore, orifices should not be re-used in the field.

When the canisters are requested from the laboratory, the sampling duration will be specified so that the laboratory can pre-set the flow controller rates. The flow rate is to be set at the laboratory using a pressure of 30" Hg to ambient air. If the source of the air sample is at a pressure other than ambient pressure, the canisters will fill faster or slower depending on the sample pressure. By providing the appropriate pressure to the laboratory, the laboratory can simulate the proper pressure and set flow controllers accordingly. A fixed-flow controller is set to collect 5 liters (L) of sample over the time interval so that a net negative pressure is maintained in the canister. The appropriate flow rate will be set by the laboratory based on the duration of the sampling event (refer to site-specific work plans). For example, the flow rate for a 6-L canister collecting a 12-hour composite sample would be approximately 6.9 milliliters per minute. For an 8-hour composite, the sample collection rate would be approximately 10.4 milliliters per minute.

After sample collection is completed, the canisters are sent to the laboratory, where they are analyzed according to USEPA Method TO-15 in Selective Ion Mode (SIM).

5.4 Sampling Conditions

Based on the EPA finding that TCE indoor air concentrations from vapor intrusion in the San Francisco Bay Area are up to two-to-three times higher during the colder months, weather forecasts will be reviewed to determine when the daily low temperature falls below 50° F. This temperature was selected as a reasonable determination of colder weather without being overly restrictive on the sampling schedule. Wherever practicable, indoor air sampling will be planned for dates when the forecast meets that criterion. This is generally expected to occur between December and February. The weather forecast from the National Weather Service will be used to schedule the air sampling during these conditions. This forecast can be obtained from: http://forecast.weather.gov/MapClick.php?lat=37.3688&lon=-122.03634. It is recommended that indoor temperatures be about 10° F above outdoor temperatures during sampling events. This recommendation is not a requirement for sampling but is expected to be met given that indoor air thermostats are likely to be set to 65° F or above.

Indoor air sampling events will be completed in two rounds, one to be representative of normal occupied conditions, and another sampling event to represent reasonable maximum vapor intrusion conditions. Samples representative of normal occupied conditions includes the operational HVAC systems, if applicable, and sampling times representative of actual exposure conditions (e.g. 8 or 12 hours, refer to site-specific work plans). Samples representative of reasonable maximum vapor intrusion conditions entails turning off HVAC systems and sampling for a longer duration (24 hours) per EPA guidelines. Samples collected for a duration of 24 hours or more will be sampled using sorbent passive samplers. Samples collected for durations shorter than 24 hours will be collected using Summa canisters in order to achieve reporting limits low enough for comparison to screening levels; at durations less than 24 hours, reporting limits of passive samplers are too high. Note that although there are differences in sampling time, conditions, and devices between the HVAC on/off samples, it is not the intent for the two samples to be comparable for statistical purposes. Rather, each type of sample represents different exposure conditions (actual versus reasonable maximum). Additional details regarding sampling conditions follow.

The initial sampling will be implemented with active HVAC systems, if applicable for the building. Samples will be collected with the HVAC systems in normal weekday operating condition, in order to best represent exposure concentrations for the occupants. First round samples will be collected during the normal occupied hours for the building. If exposure conditions are less than 24 hours, those samples will be collected using Summa passivated canisters over periods of 8 hours or 12 hours, depending on the actual exposure conditions in each building. Selection of the specific sampling duration for each project site is discussed in Appendices C-G.

The second round of sampling will be conducted with all HVAC systems shut down to evaluate the potential for subsurface vapor intrusion into buildings without reliance on the ventilation system. For HVAC-off sampling, sample collection will begin at least 24 hours following shut-down of the building ventilation systems and continue while HVAC systems remain off. Since this sampling approach requires keeping the HVAC system off for a minimum of 48 hours, it may not be feasible at certain buildings which are in use seven days per week. In that case, the second round of sampling will be implemented under conditions that would present the greatest vapor intrusion risk while still being acceptable to the building owners/occupants. Second round samples will be collected over a 24-hour period using passive samplers.

The building owners and occupants will be advised to prohibit activities involving products that typically contain TCE, e.g. painting, waxing or polishing floors or furniture, or application of pesticides or herbicides. Building operators will also be requested to maintain regular operation of the ventilation systems, except during HVAC-off sampling events.

On the day of sampling, the sampler will note conditions that might affect the interpretation of the results under which the sample is taken. These conditions include weather conditions and current building ventilation status. Local measurements of outdoor conditions at a nearby weather station can be obtained from:

http://www.wunderground.com/history/.

5.5 Sampling Procedures

For each sample location using passive samplers, the collection will follow the steps below.

1. Unpack the sampler from shipping container. Verify that all sampling components are present and the plastic bag containing the cartridge is sealed.

2. Assemble the supporting plate and clip for each sampler including sticking the adhesive label pocket onto the plate in a central position.

3. Prepare a label for the sampler with a discreet sample number and insert it into the pocket on the supporting plate. Indicate the sample number on the chain of custody.

4. Remove the tube from the plastic bag and transfer the cartridge from the tube into the diffusive body being careful not to touch the cartridge.

5. Seat the cartridge centrally in the diffusive body; ensure that not even a half a millimeter is sticking out.

6. Connect the diffusive body to the supporting plate being careful not to bend the cartridge. Keeping the diffusive body vertical during this step will prevent the cartridge from becoming unseated.

7. Promptly securely suspend the sampler at the specified breathing zone height (refer to site-specific work plans) at the planned sample location. Record the date and time of the beginning of exposure.

8. At the end of the sampling period, return the cartridge to the original tube and affix the label to the tube such that the barcode is parallel to the axis of the tube. Return the tube to the original box. Record the date and time of the end of exposure.

9. Complete the chain of custody and ensure that air samples are properly labeled. Indicate TO-17 as the analytical method to be used.

10. Return the samplers to the laboratory with the chain of custody. Transport and store the samples at 4°C or less to help minimize diffusion off of the sorbent material.

For samples collected using Summa passivated canisters, the following procedure will be used:

1. Unpack the canisters from shipping container. Verify that all equipment components are present and the canister valve is closed.

2. Mark each canister with a discreet sample number. Indicate the sample number and the flow controller serial numbers on the chain of custody.

3. Remove the brass plug from the canister valve, and attach the vacuum gauge tightly. If using a gauge with a "Tee" fitting, cap the side arm of the "Tee" with the brass plug.

4. Open and close the canister valve. The gauge will register the level of vacuum present. Record this value on the chain of custody for the canister. The initial vacuum of the canister should be >25 inches of mercury (" Hg). If the canister vacuum is less than 25" Hg, do not use it and arrange for a replacement canister.

5. Verify that the canister valve is closed. Remove the vacuum gauge and replace the brass plug on the canister valve.

6. Remove the particulate filter and pre-calibrated flow controller from the packaging. Place the particulate filter on the flow controller inlet.

7. Remove the brass plug from the canister valve, and attach the flow controller (with the particulate filter) to the canister valve.

8. Place the canister at the specified breathing zone height (refer to site-specific work plans) at the planned sample location. In general, the material of the canister is thermal resistant, but the canisters should be kept out of direct sunlight during sampling.

9. Open the valve and the record sampling start time.

10. Check the canister integrity during the sampling interval. The flow controller often includes a pressure gauge as part of the hardware. This gauge should not be used in place of the vacuum gauge used to record pre- and post-vacuum readings, but can provide a general indication of pressure exchange. For example, 6 hours into a 12-hour sampling event, the canister should contain 2.5 L, and the pressure should be approximately 15" Hg. More than 20" Hg indicates that the canister is filling too slowly; less than 10" Hg indicates the canister is filling too quickly, and corrective action may be necessary, including adjusting the flow, or resampling.

11. At the end of the sampling period, close the valve and record the time, temperature and final canister pressure.

12. Remove the flow controller (with the particulate filter) and attach the vacuum gauge. Open and close the canister valve. The gauge will register the level of vacuum present at the conclusion of sampling. Record this value on the chain of custody for the canister. The final pressure of a 6-L canister should range between 4 and 8" Hg. If the vacuum is greater than 8" Hg, the sample was collected at a lower flow rate. The laboratory will need to apply a greater dilution factor to the sample, resulting in elevated detection limits. If the final vacuum is less than 4" Hg, either the flow rate was too high or the pressure difference across the flow controller diaphragm was too small. Either condition means that the sample is skewed toward the initial sampling interval. This is a non-linear sample, but it may still be considered valid. If the final pressure is near ambient (less than 1" Hg), it must be considered an invalid integrated sample.

13. Remove the vacuum gauge. Place the brass plug on canister valve and tighten. It is not necessary to over-tighten the fittings. Finger tight plus 1/16 turn is adequate. However, it is essential that all the connections between the canister and the flow controller be tight and immobile by hand. A leak in any one of these connections means that some air will be pulled in through the leak and not through the flow controller. A final pressure near ambient is one indication that there may have been a leak.

14. Repackage the sampling hardware. Complete the chain of custody (see procedure below) and ensure that air samples are properly labeled. Indicate TO-15 (SIM) as the analytical method to be used.

15. Return the canisters to the laboratory with the chain of custody. Transport and store canisters at ambient temperature, avoiding temperature extremes and direct sunlight. The canisters will be shipped to the laboratory in the original box.

Sample collection in a crawlspace will follow the same procedures although the height at which the sample is collected will be adjusted based on the configuration of the crawlspace.

5.6 Quality Assurance/Quality Control Samples

This section discusses additional samples that will be taken concurrently with the other samples to maintain an acceptable level of quality assurance. All quality QA/QC samples will be shipped to the same analytical laboratory and analyzed using the same preparatory and analytical methods used for the other samples.

5.6.1 Field Duplicates

At least one co-located replicate sample will be collected during each sampling event for each type of sampling (passive samplers or canisters). The replicate samples are intended to evaluate analytical variability between samples. The co-located replicate sample should be obtained over the same time interval as the original sample. The replicate canisters should be placed within 2 feet of the original sample, at the same elevation, and should be sampled according to the same procedures described above. The precision goal is discussed in the QAPP, Section 2.5 of Appendix H.

5.6.2 Field Blanks

At least one field blank sample will be obtained during each sampling event for each type of sampling (passive samplers or canisters). The cartridges of the field blank samplers remain in their packaging although they are shipped along with the other samplers to the site and back to the laboratory for analysis. The methods for sample logging and shipping are the same as those described above. The field blank results are intended to verify sample integrity during field sample collection.

5.6.3 Laboratory Control Samples

Laboratory blanks, laboratory control spikes, and analytical surrogates will be provided and analyzed by the laboratory operating the instrument as described in the analytical method protocol. The laboratory control samples are independent source reference standards used to validate the accuracy of the initial calibration of the instrument used to analyze the samples.

5.7 Sample Analysis and Evaluation

All passive air samples will be analyzed using USEPA Method TO-17. All Summa passivated canisters will be analyzed using USEPA Method TO-15 SIM. Both analyses will be conducted by

Eurofins Air Toxics. The analytes for this study are the eight chemicals listed in Table 2, which were selected because they are identified by the RWQCB as the chemicals of concern (COCs). Table 2 also lists the regulatory limits which the data will be compared against. Laboratory Quality Assurance/Quality Control (QA/QC) data will be reported with the sample data. Laboratory reporting limits, data validation approach and personnel, data quality objectives, and internal laboratory quality control criteria are documented in the QAPP (Appendix H).

The maximum 2013 groundwater concentrations in the shallow "A" aquifer are included in Table 1 for the COCs and two additional detected chemicals (chloroform and vinyl chloride). Vinyl chloride and chloroform are present at low concentrations in groundwater and are not identified by the RWQCB as COCs. Therefore, they are not included in the list of analytes for the vapor intrusion investigation.

Once collected and analyzed, the potential public health impacts associated with measured levels of site-related chemicals in air will be evaluated with three tiers of data and/or criteria. A flow chart for the evaluation of sampling results is provided in Figure 4.

5.7.1 Tier 1

Chemicals detected in indoor air will be compared with site outdoor air concentrations for each chemical (site-wide and building-specific) and with local and regional background ambient air concentrations of these chemicals. One outdoor air sample will be collected per five residences or school buildings. The outdoor samples will be evaluated statistically to determine the 95% confidence interval against which individual indoor air concentrations will be compared.Additional regional background or reference concentrations will also be considered to provide context regarding long-term regional trends. Indoor air concentrations within or below the 95% confidence interval of outdoor concentrations will be reasonably determined to be background concentrations and not due to vapor intrusion from groundwater. Indoor air concentrations outside of the 95% confidence interval of outdoor air concentrations will be further evaluated using Tiers 2 and 3 as described below.

5.7.2 Tier 2

Concentrations which are significantly greater than background will be compared with standard screening levels for acceptable air concentrations. Tier 2 would include short-term and urgent response comparison criteria. These values are generally based on effects other than cancer and are available for short-term exposure durations. For the short-term evaluation, the Agency for Toxic Substances and Disease Registry (ATSDR) provides minimal risk levels (MRLs) for acute (1-14 days), intermediate (14-365 days), and chronic (>365 days) exposure to these chemicals. The MRL is defined by ATSDR as “an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specific duration of exposure.” Additional Tier 2 values for comparisons can be made to the acute and chronic Reference Exposure Levels (RELs) provided by the California Office of Environmental Health Hazard Assessment (OEHHA). OEHHA defines the REL as “the concentration at or below which no adverse health effects are anticipated.” EPA Regional Screening Levels (RSLs) for non-carcinogenic exposure are also used to evaluate short-term health effects. Based on the memo dated 3 December 2013, EPA Region 9 has recently issued short term "accelerated response" and "urgent response" action levels for TCE. These values will also be included as part of the Tier 2 evaluation. Tier 2 comparison criteria are listed in Table 2 for the chemicals of concern at this site. The lowest criteria listed in Table 2 will be used for comparison in this evaluation. All data evaluated against Tier 2 criteria will also be evaluated against Tier 3 criteria.

5.7.3 Tier 3

Tier 3 criteria are derived based on consideration of long-term carcinogenic effects in a residential setting. Air sample results are compared to the Environmental Screening Levels (ESLs) published by the RWQCB, as well as EPA Regional Screening Levels (RSLs) for carcinogenic exposure. It is important to note that these values are not intended to identify "unsafe" conditions. Rather, the screening levels are used to identify areas or buildings that warrant further evaluation. In addition, these long-term risk comparison values were developed for a residential scenario (i.e. 26-year duration, 24 hours per day, 350 days per year). Use of these residential screening levels to evaluate air concentrations in buildings where these occupancy parameters are lower is a conservative comparison. Tier 3 comparison criteria are listed in Table 2 for the chemicals of concern (COCs) at this site. The analytes for the vapor intrusion evaluation are the COCs identified by the RWQCB in the regulatory Orders.

5.7.4 Evaluation Process

A flow chart for the evaluation of sampling results using the three tiers is provided in Figure 4. Draft sample results will be initially compared to EPA's accelerated response action level for TCE. If the results exceed that level, EPA will be notified within 48 hours of receipt of analytical results. Data will then be reviewed and validated, with priority given to higher concentrations, if found.

The results will then be compared with Tier 1 (background) criteria to determine if the indoor air concentrations are statistically different from outdoor and background sample results. If not, then indoor air concentrations would not be significantly affected by vapor intrusion, and no further action is anticipated. Likewise, if the results are lower than Tier 3 (long-term) screening levels, then it can be concluded that the concentrations do not pose health concerns, and no further action is anticipated. However, all data evaluated against Tier 2 and Tier 3 criteria will be used for cumulative risk assessment, and later in the Remedial Investigation/Feasibility Study (RI/FS).

Results that exceed the Tier 1 and Tier 3 screening levels will be compared against Tier 2 (short term) to determine whether interim measures should be taken to temporarily mitigate the building. In either case, results that exceed the Tier 2 or Tier 3 screening levels will be confirmed through another sampling event, after a more thorough inspection of the building to search for potential indoor air sources and preferential vapor intrusion pathways. Additional sample locations may be added during the confirmation sampling to provide more detailed information on potential sources or pathways. Confirmation samples may be analyzed on an accelerated schedule. After confirmation samples are collected, the data will be evaluated to consider whether observed concentrations result from vapor intrusion. This will include evaluation of other potential indoor sources of the detected chemicals, and comparison of sample results against pathway samples. If chemical concentrations are absent in pathway samples collected from crawlspaces and subfloor areas (or significantly less than concentrations found inside living spaces), this would indicate that the vapor intrusion pathway is incomplete or insignificant, and indoor concentrations, if observed, would be originating from other sources. In this case, no further action is anticipated.

If confirmation sampling indicates that vapor intrusion is a potential source for the indoor air concentrations, mitigation measures and/or further monitoring will be evaluated and implemented. Concentrations that are above the Tier 3 screening levels but below Tier 2 screening levels are within EPA's risk-protective range. Buildings with concentrations in this range may be either directly addressed with mitigation, or may be further evaluated to determine the variability of the measured concentrations.

5.7.5 Mitigation Considerations

Mitigation measures will be evaluated where chemical concentrations related to vapor migration exceed the comparison values. Mitigation options may also be considered if action levels are exceeded in pathway samples. If available information collected during the pre-sampling activities demonstrates a potential for vapor intrusion issues that could be addressed, pre-emptive mitigation options may be considered and implemented prior to sampling. When considering mitigation options, the extent and location of concentrations will be evaluated as described above. Concentrations in a single room or isolated area are typically addressed differently than elevated concentrations in the building air as a whole. If mitigation measures are warranted, a supplemental feasibility study of remedial alternatives will be submitted to EPA. If action levels are not exceeded in ambient or pathway air samples, then no further action will be needed. In particular, if indoor air concentrations are consistent with outdoor background concentrations, mitigation measures would not be effective.

Interim Mitigation Measures

If indoor air TCE concentrations exceed the short-term urgent or accelerated response action levels, early or interim mitigation measures will be evaluated and implemented to address concerns for building occupants, and the effectiveness of the mitigation measures will be confirmed through re-sampling. The following interim response actions will be considered to mitigate short-term exposure:

- Increasing building pressurization and/or ventilation mechanically with fans or the building ventilation system by increasing outdoor air intake.
- Installing and operating engineered, sub-floor exposure controls (sub-slab and/or crawlspace depressurization).
- Sealing and/or ventilating potential conduits where vapors may be entering building.
- Indoor air purifiers or adsorption systems such as carbon filtration.

Not all of these options will be feasible for every scenario. The most appropriate choice will be selected considering the building characteristics and cooperation of the occupants.

Long-term Mitigation Measures

The following potential long-term mitigation systems are considered to mitigate TCE long-term exposure, along with plans for long-term operation and monitoring:

- Improved operation and maintenance of the HVAC systems to enhance circulation.
- Sealing and/or ventilating potential conduits where vapors may be entering building.
- Installing vapor barriers beneath buildings with crawlspaces.
- Installing a sub-slab venting layer beneath buildings with crawlspaces, with either passive or active ventilation.

Remedial alternatives may be developed as a combination of one or more of the remedial technologies listed above. Evaluation of remedial alternatives will be based on multiple criteria that include overall protection of human health and environment, long-term or short-term effectiveness, implementability, etc. Further evaluation of the alternatives may be addressed in a separate feasibility study as needed where mitigation efforts are found to be necessary.

Some relevant references provided by EPA for long-term mitigation measures are as follows:

- Department of Toxic Substances Control California Environmental Protection Agency (DTSC). 2011. *Vapor Intrusion Mitigation Advisory, Final, Revision 1,* October, https://dtsc.ca.gov/SiteCleanup/upload/VIMA_Final_Oct_20111.pdf
- ITRC (Interstate Technology & Regulatory Council). 2007. *Vapor Intrusion Pathway: A Practical Guide.* VI-1. Washington, D.C.: Interstate Technology & Regulatory Council, Vapor Intrusion Team. www.itrcweb.org
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General Verification/Monitoring Plan

Verification and monitoring plans of long-term mitigation measures can vary based on the alternatives used.

- Sub-slab Pressurization & Surface Coating: Long-term verification includes monitoring of system components (blower, control) to ensure operation and pressure readings in sub-slab.

- Sub-slab Pressurization & Synthetic Vapor Barriers: Similar to alternative above.
- Sub-slab Depressurization: Long-term verification includes monitoring of system components (blower, controls, etc) to ensure operation.
- Vapor Barrier and Passive Venting: Long-term verification would consist of collection of indoor air samples.
- Ventilation: Ventilation systems would be inspected annually to ensure optimal operations efficiency. Inspection results would be provided to the building owners/occupants and also included in monitoring reports, as appropriate. Long-term operation and monitoring includes obtaining HVAC service reports to verify operations and repairing defective HVAC components.

6 DATA MANAGEMENT, REPORTING & SCHEDULING

6.1 Data Management

Compilation and submittal of data related to the OOU site is discussed in the QAPP in Appendix H, Sections 2.7 and 3.1.

6.2 Reporting

Before sampling, the following items will be submitted to EPA:

- Building layouts and non-confidential floor plan maps, if available, from building owners or tenants.
- Proposed sample locations.

Within 30 days of completion of data review, the sampling and analytical data will also be assembled, tabulated, and provided to the EPA in report form and including:

- Ventilation assessment based on ventilation system inspections for all buildings included in the sampling event.
- A summary of the air sampling process.
- Interpretation of the data, including comparing indoor concentrations to outdoor and background concentrations and to relevant risk-based criteria for the sampled analytes.
- A table listing the results of analysis of the air samples.

- A QA/QC evaluation of the data, including calculation of percent differences between co-located replicate samples. Significant percent differences between co-located replicates (i.e. outside the range of 50 to 150 percent), if present, will be evaluated and discussed with respect to the impact on data quality. If chemicals are detected in the field blank(s) or laboratory blank(s), an explanation of the impact on data quality will also be provided.
- Recommendations for further work, as appropriate

6.3 Scheduling

The schedule for all work plan activities will be set after approval of the work plan is received from the EPA. Work will proceed as follows, with estimated time of completion dependent on response from agencies:

- Contact will be established with building owners and occupants to arrange access and pre-sampling walkthroughs.
- Proposed sample locations will be submitted to EPA.
- Samples will be collected.
- Analysis of samples will be completed. Notification to EPA will occur within 48 hours of receipt of results that exceed the short-term screening levels.
- The final report will be submitted to the EPA within 30 days of completion of data validation.

Estimated dates associated with these milestones are provided in the property-specific appendices to this work plan. The project task schedule is contingent on EPA approval of this Work Plan and the proposed sample locations at least 60 days before sampling is scheduled, so that appropriate coordination with building owners and occupants can be arranged, and sampling equipment can be procured. Detailed schedule of the sampling events will be provided through a web-based calendar, which will be accessible to EPA for real-time updates. The schedule may also be revised as needed to accommodate requests from the property owner or occupants (e.g. to arrange sampling when the building will not be in use).

Respectfully submitted,

J. Wesley Hawthorne, P.E., P.G.
Senior Vice President

JWH/nd

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TABLE 1
2013 A AQUIFER MAXIMUM CONCENTRATIONS
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

Parameter Name	Sample Date	Concentration	Units
1,1-Dichloroethane (1,1-DCA)	6/4/2013	0.7	µg/L
1,1-Dichloroethene (1,1-DCE)	10/26/2013	3.2	µg/L
1,1,1-Trichloroethane (1,1,1-TCA)	10/26/2013	ND 4.2	µg/L
1,1,2-Trichlorotrifluoroethane (CFC 113)	11/14/2013	27	µg/L
Chloroform	10/26/2013	2.9	µg/L
cis-1,2-Dichloroethene	11/14/2013	250	µg/L
Tetrachloroethene (PCE)	11/14/2013	3.3	µg/L
trans-1,2-Dichloroethene	11/18/2013	1.8	µg/L
Trichloroethene (TCE)	11/14/2013	550	µg/L
Vinyl Chloride	11/15/2013	1.3	µg/L

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Table 2
INDOOR AIR QUALITY EVALUATION CRITERIA
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

		1,1-Dichloroethene (1,1-DCE)	1,1,2-Trichlorotrifluoroethane (FREON 113)	1,1-Dichloroethane (1,1-DCA)	cis-1,2-Dichloroethene	1,1,1-Trichloroethane (TCA)	Trichloroethene (TCE)	Tetrachloroethene (PCE)	trans-1,2-Dichloroethene
Tier 2	EPA Region 9 Interim Urgent Response Action Levels (residential)	NA	NA	NA	NA	NA	6	NA	NA
	EPA Region 9 Interim Urgent Response Action Levels (commercial 8-hour work day)	NA	NA	NA	NA	NA	24	NA	NA
	ATSDR MRL (acute)	NA	NA	NA	NA	10,912	NA	1,356	793
	ATSDR MRL (intermediate)	79	NA	NA	NA	3,819	NA	NA	793
	OEHHA REL (acute)	NA	NA	NA	NA	68,000	NA	20,000	NA
	EPA RSL (industrial, noncarcinogenic)	880	130,000	NA	NA	22,000	8.8	180	NA
	EPA RSL (residential, noncarcinogenic)	210	31,000	NA	NA	5,200	2.1	40	NA
	EPA Region 9 Interim Accelerated Response Action Levels (residential)	NA	NA	NA	NA	NA	2	NA	NA
	EPA Region 9 Interim Accelerated Response Action Levels (commercial 8-hour work day)	NA	NA	NA	NA	NA	8	NA	NA
Tier 3	OEHHA REL (chronic)	70	NA	NA	NA	1,000	600	35	NA
	ATSDR MRL (chronic)	NA	NA	NA	NA	NA	2.15	271	NA
	RWQCB ESL (Table E Residential Land Use)	210	NA	1.5	NA	5,200	0.59	0.41	63
	EPA RSL (industrial, carcinogenic)	NA	NA	7.7	NA	NA	3.0	2	NA
	EPA RSL (residential, carcinogenic)	NA	NA	1.8	NA	NA	0.48	0.4	NA

Notes:

NA - Not Available or Not Applicable

All results are reported in μg/m3 (micrograms per cubic meter).

Assume 25 degree C and 1 atmosphere for ATSDR MRL values.

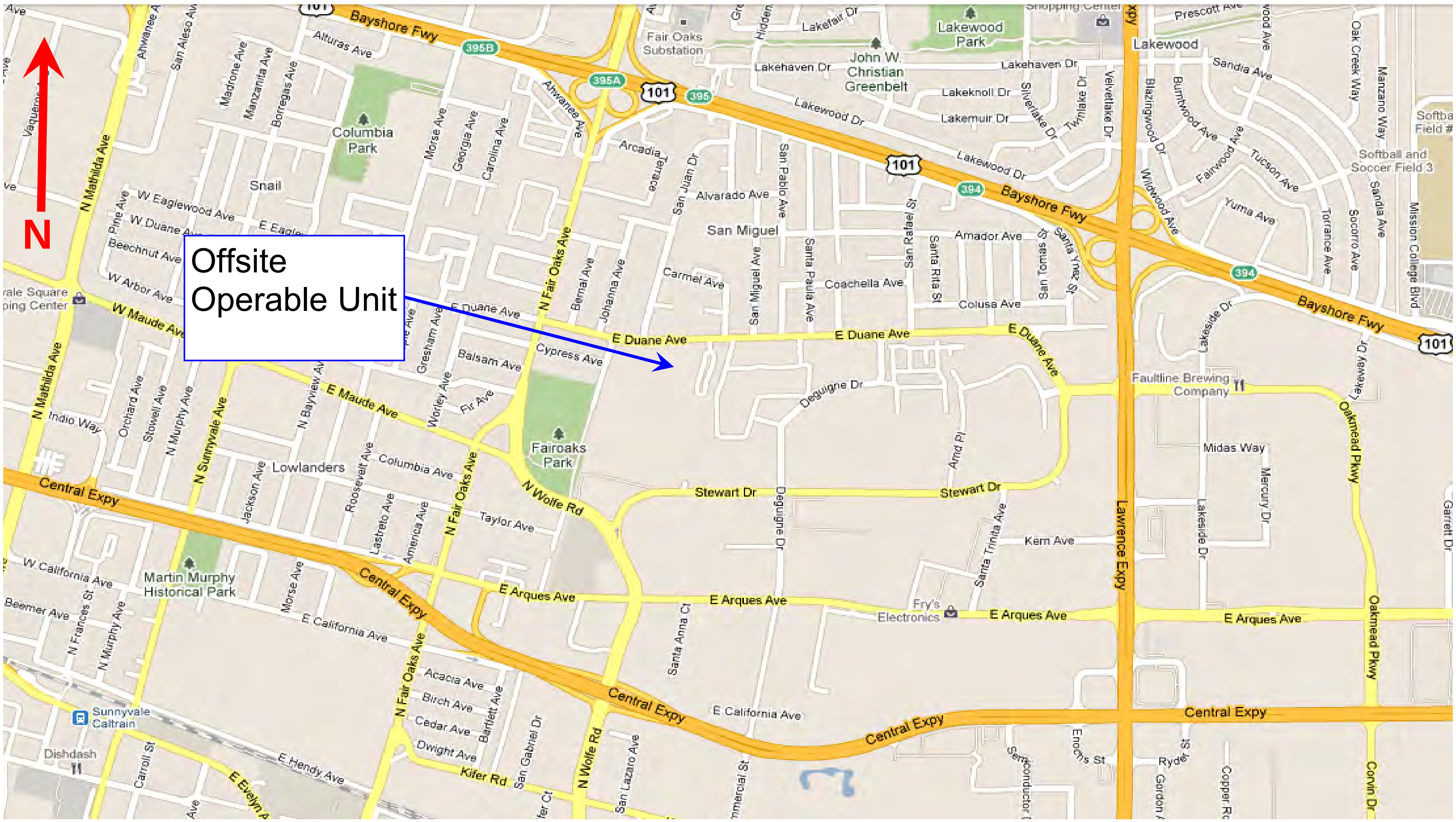
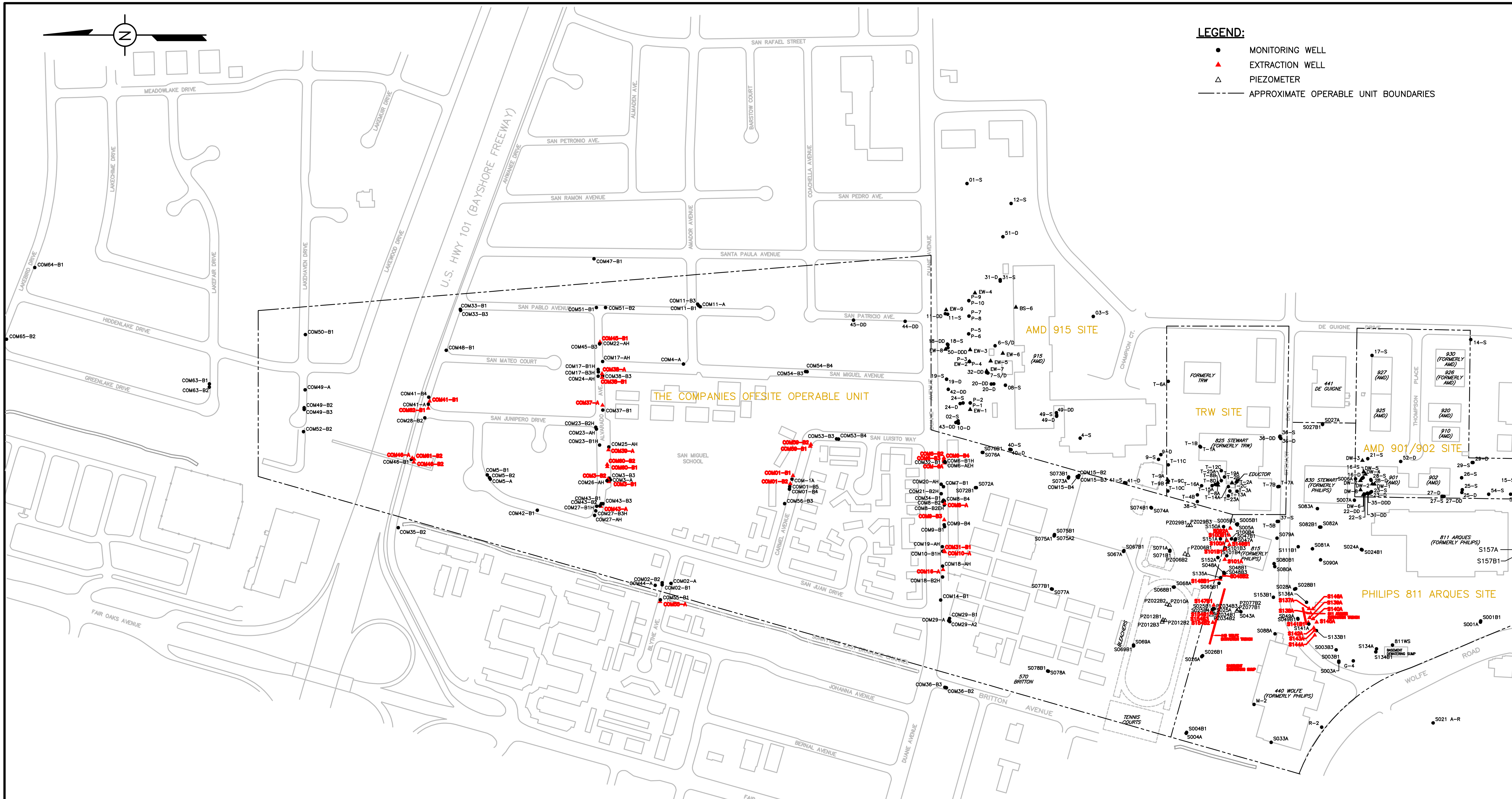


Figure 1

Site Vicinity Map
The Companies Offsite
Operable Unit
Sunnyvale, California



SITE PLAN
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

REFERENCES:
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	26 JAN 07	ADDED WELLS 157A AND S157B1. DELETED SEALED WELLS S042A AND S042B1.	VZC	MMG	JWH
2	20 JAN 03	REMOVED SEALED WELLS S085A, S086A, S091A, G-3, A-6, G-1, G-5, M-1, S065A, S070A, S087A, and S089A.	JWH	JWH	JEB
1	28 JAN 00	ISSUED FOR REPORT	VZC	MJG	JEB

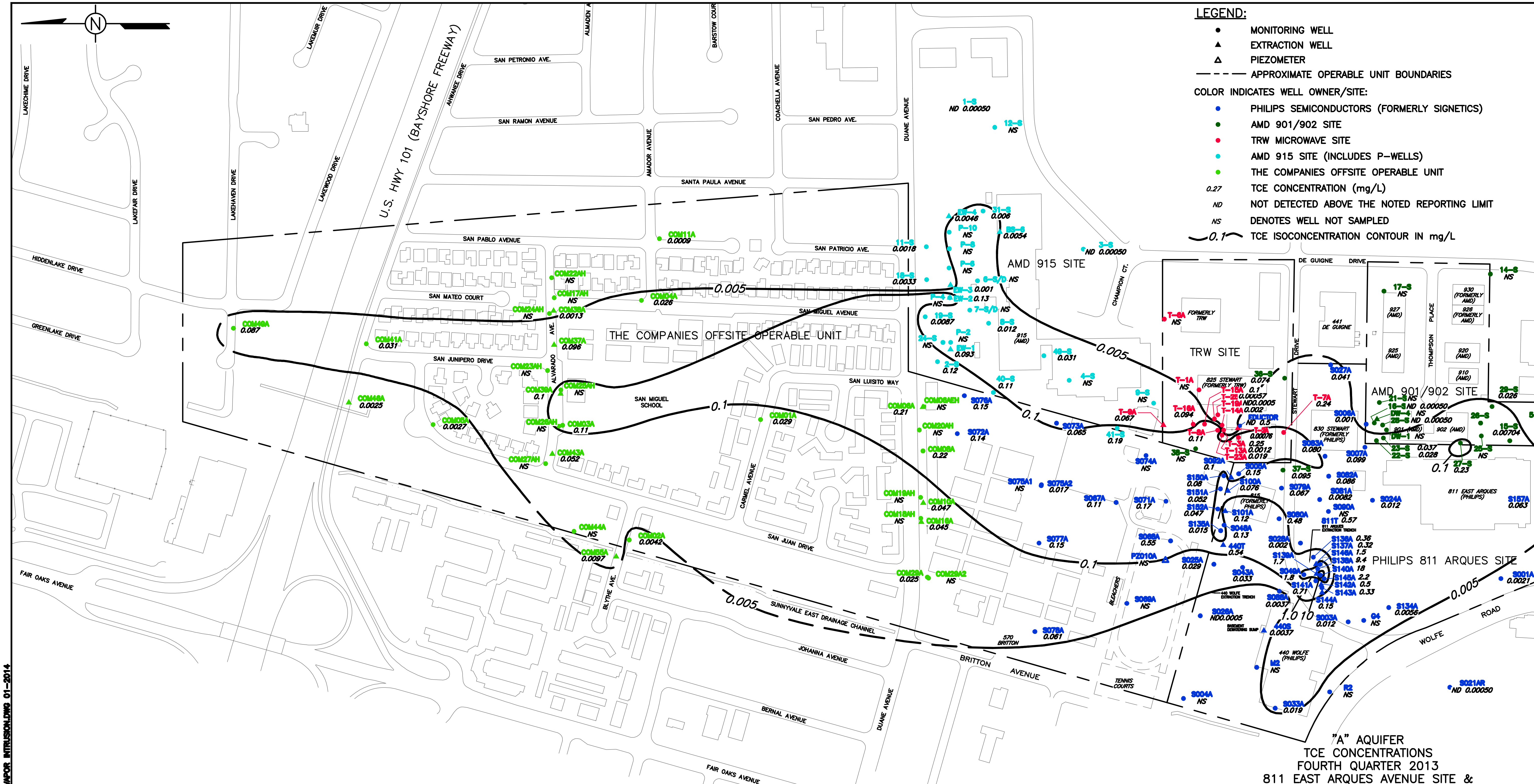
Locus TECHNOLOGIES

SCALE: 200 0 200 400 FEET

DRAWING NO. 27-006-E284

FIGURE 2

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan\figures – generic



"A" AQUIFER
TCE CONCENTRATIONS
FOURTH QUARTER 2013
811 EAST ARQUES AVENUE SITE &
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

PREPARED FOR

PHILIPS ELECTRONICS

REFERENCES:

1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
△	14 JAN 14	ISSUED FOR REPORT	TH	JWH	JWH

Locus TECHNOLOGIES

0 400 800
APPROXIMATE SCALE IN FEET

DRAWING NO. 27-005-B422

FIGURE 3

FILE NAME: K:\69-014\ARQUES 2013\OOU2012 VAPOR INTRUSION.DWG 01-2014

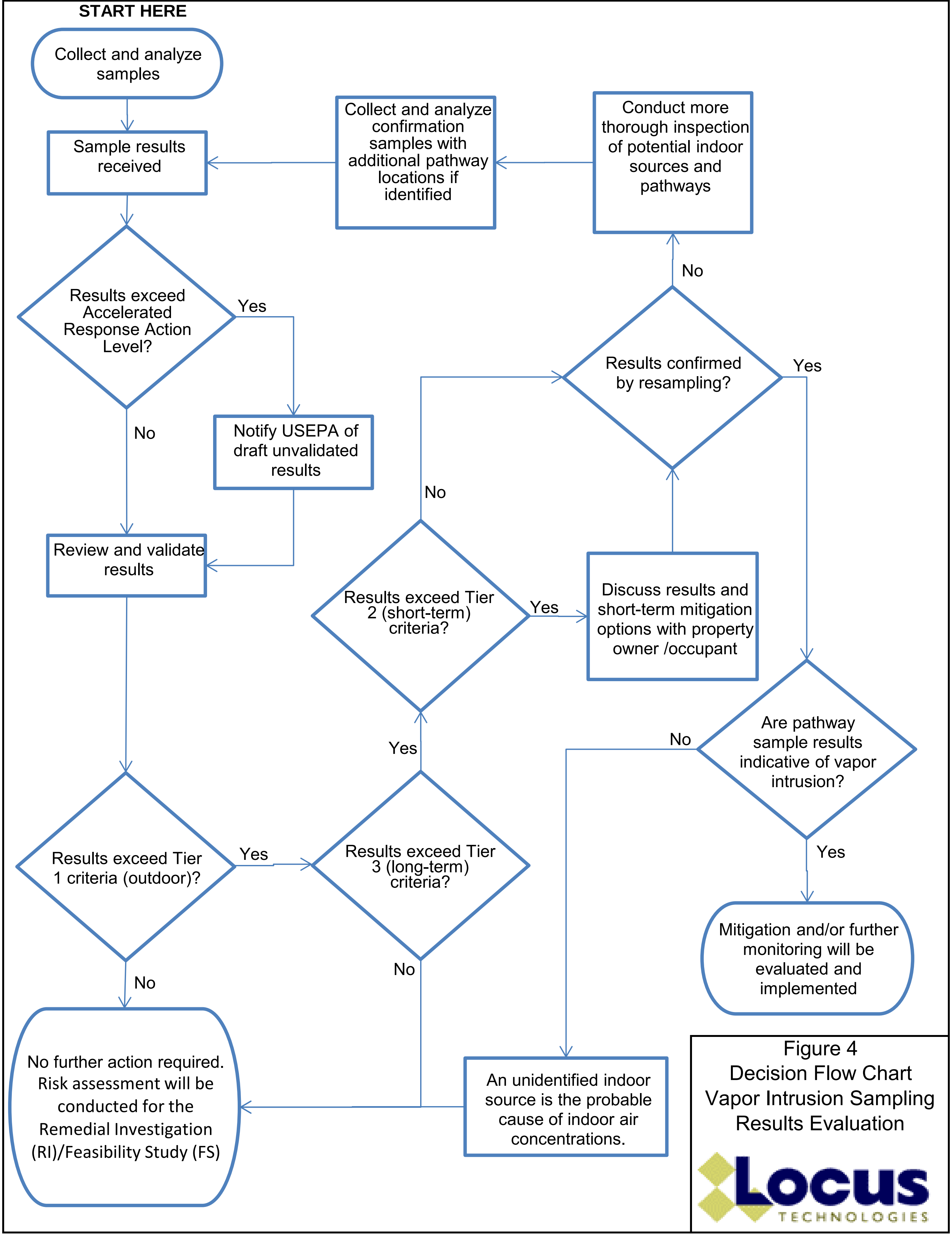


Figure 4
Decision Flow Chart
Vapor Intrusion Sampling
Results Evaluation

Locus TECHNOLOGIES

APPENDIX A

NONRESIDENTIAL SURVEY FORM

Non-Residential Survey Form

Date: ______________ **Site:** _____________________ **EPA Building Number #:** ________________

PART 1: General Information

Business Name: __________________________________

Address: ___________________________________

____

Tenant Information (if applicable)

Contact Name: ____ Interviewed: ☐ Yes ☐ No

Phone: _______________________________ Email: ____

Owner/Landlord Information **Consent Access** ☐ Yes ☐ No Date: ______________

Name: ____ Interviewed: ☐ Yes ☐ No

Phone: _______________________________ Email: ____

Building/Business Type (Check appropriate boxes)

☐ School/Day-Care ☐ Retail Store ☐ Office Space ☐ Warehouse ☐ Manufacturing

☐ Single level Office/Warehouse ☐ Multi-story ☐ Strip-mall ☐ Multi-tenant ☐ Warehouse

Other ☐ ____

Building Occupancy

Typical Days/Hours of occupancy ___________

Typical Days/Hours of ventilation system operation ___________________________________

Building Characteristics

Year/Decade Built: _________________ Number of Stories: ________________________

Approximate Building Area (square feet): Total _______________ First Floor _________________

Is there an attached warehouse/shop space? ____ describe its use:___________________________________

Foundation Type (Check appropriate boxes)

☐ Slab-on-Grade ☐ Slab-above-Grade (elevated/cap-slab on fill) ☐ Crawl Space ☐ Basement ☐ None

Describe ____

Non-Residential Survey Form

Date: _____________ **Site:** ____________________ **EPA Building Number #:** _______________

PART 2: Factors Impacting Indoor Air Quality and Sampling

Questions

Describe renovation, painting, or significant cleaning activities that have occurred over the last 6 months (what was done, what area, and when):

____

Describe any open combustion in the building. (smoking/incense/candles/cooking/burning)

____

Have site chemicals of concern been used or stored in the building or adjacent warehouse/shop?

☐ Yes ☐ No

Please list the general types of chemicals____

Have any significant amounts of volatile chemicals been used recently? ☐ Yes ☐ No

Please list the chemicals____

Describe any instance of water/groundwater present in the basement/crawlspace (including sumps):

____

Observations

What is the temperature relative to outside? ___________________________

What pathways to the subsurface were observed? ___________________________

Were windows/doors/roll-up doors kept open? ______________________________

Is there evidence of significant negative pressure? ______________________

Do parts of the indoor environment appear stagnant? _________________________

Describe any strong odors. _______________________________________

Building Construction

Building Construction Materials?

☐ Concrete ☐ Concrete Block ☐ Steel ☐ Wood ☐ Other _______________

Does the building have an at-grade or below-grade garage? ______________________

Does the building have an attached mechanical room? ________________________

Is the building slab constructed with post-tension concrete? ____________________

What are the ceiling heights? ____

Non-Residential Survey Form

Date: _____________ **Site:** ____________________ **EPA Building Number #:** _______________

Pathway Analysis

Does the building have a basement or sub-surface structures that are/have:

☐ Unfinished ☐ Exposed soil ☐ Damp or flooded ☐ Unsealed utility lines ☐ Other _______________

Are there utilities that penetrate the slab that may be conduits for soil vapor? _______________

Are these:

Connected to subsurface vaults? __________________

Connected to utilities closer to potential VI sources?__________________

In areas where pressure differential would cause air to flow through them? _____________

Is there non-ventilated space in the building (maintenance /electrical / server rooms)?___________________

Is this space occupied? _________ At what frequency/duration? ________________

Are there potential pathways in this space? _________________________ ,

Are there significant heat sources or other systems that may generate a significant negative pressure near the floor/slab? __________________________________

Are there elevators in the building? ______________________________

If the elevators are hydraulic plunger how deep does the piston penetrate below the slab? _____________

Are there significant utilities penetrating the floor/slab? ___________________________________

What is the condition of the foundation/slab? ____

Was the building constructed with a subslab system or barrier? _________________________

Are there floor drains? ______________________________________

If the foundation design specifications and/or as-built drawings are available attach.

Other Information (that may be of importance in understanding the indoor air quality)

____

____

____

Potential Sampling Locations

General notes on potential sample locations and type. Tentative sampling date(s) and preferred times.

____

____

____

On a separate page, draw/attach the general floor plan of the building and denote potential locations of sample collection. Indicate locations of doors, windows, ventilation system components, indoor air contaminant sources and field instrument readings.

Non-Residential Survey Form

Date: ______________ **Site:** _____________________ **EPA Building Number #:** ________________

PART 3: Inventory of Potential Indoor Chemical Sources:

Instructions: List items/products in the building or the attached warehouse/shop that may contain site compounds of concern. These should be removed prior to sampling. Also, list items/products that that give off significant volatiles. These may interfere with chemical analysis. Include chemicals that may be tracked into the house from an occupant. This could be chemical usage at work or in an attached workshop/garage. A portable instrument, such as a photo-ionization detector (PID) can be used to help locate volatile chemicals.

Examples of products that may contain trichloroethene (TCE): gun cleaner, rubber cement, solvent degreasers, spot removers, correction fluid, electrical motor cleaner (also be aware that older products are more likely to contain TCE).

Potential chemical source	Location of Product Source	Photograph, ingredients, PID reading?

Non-Residential Survey Form

Date: _____________ **Site:** ____________________ **EPA Building Number #:** _______________

PART 4: Building Heating/Cooling/Ventilation Systems

Systems Present

What types of systems are used for heating, cooling and ventilation? Check all that apply.

☐ Air Handler(s) ☐ Package Units ☐ Window/Wall systems ☐ Radiant heating (electric or water/steam)

☐ Evaporative Coolers ☐ Heat pump ☐ Built-up ☐ None Comments _______________________

Fresh air should be supplied in all commercial/industrial/institutional settings. ASHRAE Standard 62, *Ventilation for Acceptable Indoor Air Quality*, has guidelines on how much air should be supplied. Meeting these requirements generally helps to mitigate VI impacts.

Do the systems present provide make-up/fresh air? (Y/N) _________

Have the systems been evaluated for ASHRAE Standard 62 compliance? ______________

When was the system last tested and balanced? __________________ (attach report if available)

Is the ventilation system automated (building automation system)? _____________

If yes is the data recorded or can it be recorded? _____________________

Note that the ventilation settings should be evaluated in the automation system and verified manually where possible.

System operations

For each of the ventilation systems describe how is outdoor air supplied?

- Economizers: ______________________
  - Are economizers opening and closing properly? __________________
  - minimum and maximum settings cfm or %_______________________________
- Manual adjustable outdoor air intakes _____________________
  - Settings _____________________________________
- Fixed outdoor air intakes? ____
- Potential outdoor air intake not installed? ______________________________________
- Outdoor air intake not easily installed (e.g., split system, radiant heating) __________________

How frequently are the ventilation systems serviced? _____________________________

Are filters in good condition (*i.e.* not restricting airflow)? _____________________________

Days and hours of operation for each ventilation system _______________________________________

Do any of the ventilation systems operate during nights and weekends? _______ reduced settings? _______

Are the temperature / ventilation settings locked or routinely adjusted by the occupants? _________________

What are the temperature settings? (note if seasonally variable) Days _____________ Nights ___________ Weekends _____________

If there is an economizer, does the system control outdoor air supply using: (check all that apply)

☐ Outdoor air temperature/enthalpy ☐ CO_2 concentration ☐ Other ______________

Non-Residential Survey Form

Date: _____________ **Site:** ____________________ **EPA Building Number #:** _______________

Is there power exhaust? _______

Is the power exhaust setting dependent on ☐ economizer damper position ☐ Static pressure

Does the system use variable air volume distribution (VAV)? _________

Can airflow be detected at indoor intakes and exhausts? _________

Other Ventilation Issues impacting vapor intrusion potential.

Does the ventilation system have any underground components? __________________

Is ventilation being supplied or returned under a false floor above the building slab? ___________

Are ducting components routed through a basement, crawlspace, or utility vault area? _______________

Is a boiler or heater present in a basement or crawlspace? ______ describe_________________

Outdoor air intakes

Where are the outdoor air intakes located? ____

Are any outdoor air intakes physically obstructed? ____

Are any intakes near sources of chemicals / sewer vents? ____

Are there carbon filters present in the ventilation system? _______

What make and model of filters are present and how often are they changed? ___________________

Ventilation zones and settings

Zone/ Room	**System Type**	**Supply Air Total cfm (range if VAV)**	**Supply Air % outdoor (range)**	**Ducted y/n**	**Return Air cfm**	**Ducted y/n**

Non-Residential Survey Form

Date: ______________ Site: ______________________ EPA Building Number #: ________________

Additional Notes:

APPENDIX B

RESIDENTIAL SURVEY FORM

Residential Survey Form

Date: _____________ **Site:** ____________________ **EPA Residence Location #:** _______________

PART 1: General Information

Address: _________________________________

____

Occupant Information

Occupant Name: ____ Interviewed: ☐ Yes ☐ No

Phone: ______________________________ Email: ____

Consent Access ☐ Yes ☐ No Date: _____________

Owner/Landlord Information (if applicable)

Name: ____ Interviewed: ☐ Yes ☐ No

Phone: ______________________________ Email: ____

Building Type (Check appropriate boxes)

☐ Single-Family ☐ Duplex ☐ Condominium/Townhouse ☐ Apartment Building ☐ Mobile Home/ Trailer

Other ☐ ____

Building Occupancy

What times / days is building likely to receive ventilation _________________________________

Are the heating / cooling systems routinely operated? ☐ Yes ☐ No

If yes, what times of the day / year? ___________________

Building Characteristics

Year/Decade Built: ________________ Number of Stories: _______________________

Approximate Building Area (square feet): Total ______________ First Floor ________________

If there is an attached garage describe its use:______________________________________

Foundation Type (Check appropriate boxes)

☐ Slab-on-Grade

☐ Crawl Space – Describe Crawlspace (Access Location, Height, and Vent Locations)

____

☐ Basement - Characteristics (Check appropriate boxes)

☐ Dirt Floor ☐ Sealed ☐ Wet Surfaces ☐ Sump Pump ☐ Concrete Cracks ☐ Floor Drains

Condition of the Concrete / Floor ____

PART 2: Factors Impacting Indoor Air Quality

Questions

Describe remodeling, painting, or significant cleaning activities that have occurred over the last 6 months (what was done, what area, and when):

____

Residential Survey Form

Date: ______________ **Site:** _____________________ **EPA Residence Location #:** ________________

Describe any open combustion in the building (Smoking/Incense/Candles/Fireplace):
____
Describe any chemical-infused materials that are regularly brought into the building (including dry cleaned clothes/fabrics or those brought home from work (what/how often):
__________________ ____
Have site chemicals of concern been used or stored in building or adjacent garage?
☐ Yes ☐ No
Please list the chemicals____
Have any significant amounts of volatile chemicals been used recently? ☐ Yes ☐ No
Please list the chemicals____
Describe any instance of water/groundwater present in the basement/crawlspace (including sumps):

____

Observations

What is the temperature relative to outside? _____________________________

What pathways to the subsurface were observed? _____________________________

Are windows and door kept open? _______________________________

Is there evidence of significant negative pressure? ________________________

Do parts of the indoor environment appear stagnant? ___________________________

Describe any strong odors. ____

Other Information (that may be of importance in understanding the indoor air quality in residence):
____

____

____

Potential Sampling Locations

General notes on potential sample locations and type. Tentative sampling date(s) and preferred times.

____

____

____

Residential Survey Form

Date: _____________ Site: ____________________ EPA Residence Location #: _______________

On this page, draw the general floor plan of the building and denote potential locations of sample collection. Indicate locations of doors, windows, indoor air contaminant sources and field instrument readings.

Residential Survey Form

Date: _____________ Site: ____________________ EPA Residence Location #: _______________

PART 3: Inventory of Potential Indoor Chemical Sources:

Instructions: List items/products in the building or the attached garage that may contain site compounds of concern. These should be removed prior to sampling. List items/products that that give off significant volatiles as these may interfere with chemical analysis. Include chemicals that may be tracked into the house from an occupant. This could be chemical usage at work or in an attached workshop/garage. A portable instrument, such as a photo-ionization detector (PID) can be used to help locate volatile chemicals.

Examples of products that may contain trichloroethene (TCE) or related chemicals include gun cleaner, rubber cement, solvent degreasers, spot removers, correction fluid, and electrical motor cleaner (also be aware that older products are more likely to contain TCE).

Examples of significant volatile chemical sources include gas powered equipment, gasoline storage cans, oil-based paint, paint thinner, nail polish remover, moth balls, perfumes, scented decorative items, and insecticides.

Potential chemical source	Location of Product Source	Photograph, ingredients, PID reading?

Residential Survey Form

Date: ______________ **Site:** _____________________ **EPA Residence Location #:** ________________

PART 4: Building Ventilation Systems

Type(s) of Cooling/Heating Used (Check appropriate boxes)

☐ Central Forced Air (ducted)

☐ Natural Gas Furnace ☐ Electric Furnace

☐ Air Conditioner?

☐ Outdoor Air Intake?

☐ Floor Vents on the first floor?

Location of the Furnace _____________________________

Which rooms have air supply ___________________________

Location of air returns _____________________________

☐ Centrally located wall heater(s)
Natural Gas or Electric?

Location(s) ______________________________________

☐ Centrally located floor heater(s)
Natural Gas or Electric?

Location(s) ______________________________________

☐ Electrical Radiators
Location(s) ______________________________________

☐ Water/Steam Radiators
Location(s) ______________________________________

☐ Radiant Floor Heat
Location(s) ______________________________________

☐ Wood Stove(s)
Location(s) ______________________________________

☐ Fireplace
Location(s) ______________________________________

☐ Window / Wall Air Conditioning Units
Location(s) ______________________________________

Are the outdoor air vents opened (if equipped) ______________________________________

☐ Other (specify)____

Are fans used?

☐ No ☐ Yes, Ceiling fans ☐ Yes, Room Fans ☐ Yes, Kitchen Exhaust ☐ Yes, Bathroom Exhaust

☐ Yes, Attic/Whole house Fans CFM _____

☐ Other (specify)______________

Residential Survey Form

Date: _____________ Site: ____________________ EPA Residence Location #: _______________

Additional Notes:

APPENDIX C

SITE-SPECIFIC WORK PLAN
790 EAST DUANE AVENUE

1 INTRODUCTION

This work plan provides additional site-specific details for the vapor intrusion investigation at 790 East Duane Avenue. This document is an appendix to the Work Plan for Additional Vapor Intrusion Investigation for the Companies Offsite Operable Unit (OOU) in Sunnyvale, California, and is subject to the terms, conditions and provisions of such Work Plan. General information on this investigation, including the investigation history of the site and general sampling procedures, is provided in the main Work Plan text.

2 INVESTIGATION HISTORY

A location map for 790 East Duane Avenue is provided in Figure C-1. Building layouts are provided in Figure C-2. Historical soil-gas and indoor air analytical results are summarized in Tables C-1 and C-2. The indoor air analytes in Table C-2 include the eight COCs to be evaluated as a part of this vapor intrusion work plan, and includes additional chemicals that are part of the default SIM TO-15 analytical group.

2.1 Previous Soil-gas Sampling Results

In April 2003, a series of soil and soil-gas samples were collected to evaluate indoor air concerns within the OOU, as requested by the RWQCB. The samples were collected along Duane Avenue immediately north of Building S where the highest groundwater concentrations within the OOU are present and are evaluated using the Johnson-Ettinger model spreadsheet for soil-gas results. Results from this investigation were reported to the RWQCB in May 2003. Using the most current accepted methods, the evaluation of the soil-gas showed that volatilization from groundwater to indoor air was within the acceptable risk range (Locus, 2003). All historical soil-gas sampling locations at the OOU are shown in Figure C-3. Historical soil-gas analytical results near 790 East Duane Avenue are summarized in Table C-1.

2.2 Previous Indoor Air Sampling Results

Based on subsequent findings from EPA regarding the potential toxicity of TCE and the assessment of risks associated with indoor vapor intrusion from groundwater, the RWQCB in a letter dated 20 August 2003 requested investigation in the form of soil-gas and/or indoor air samples in the residential complex north of Duane Avenue and in the vicinity of 562 North Britton Avenue. The additional investigation was conducted in 2004 and is summarized in the site-specific work plan for that property.

The February 2004 soil-gas investigation resulted in some elevated concentrations in areas south of Duane Avenue. Though the soil-gas concentrations and associated modeling results indicated that indoor air concentrations would be below the applicable health screening criteria, the results were in the range where uncertainties in the soil characteristics and other model parameters could affect the results. Therefore, RWQCB requested indoor air sampling at 790 East Duane Avenue to evaluate these uncertainties. Multiple rounds of indoor air sampling were performed at the buildings located at 790 East Duane Avenue to evaluate the air quality during different seasons and during normal occupancy activity periods. Historical indoor air sampling locations at 790 East Duane Avenue are shown in Figure C-4. Historical indoor air analytical results are summarized in Table C-2 for the eight COCs and additional chemicals that are part of the default SIM TO-15 analytical group.

The initial round of air monitoring was conducted in May and June 2004 and the results were presented in the Indoor Air Evaluation (Locus, 2004b). Results indicated that there were no short-term or immediate health risks from the concentrations observed in the buildings. However, TCE concentrations in Building G were slightly above the long-term screening level, which warranted further evaluation. Additional sampling at Building G confirmed the elevated TCE concentrations, but also indicated that the janitor's closets and restrooms at the south end of the building were not acting as preferential pathways for vapor intrusion. After conducting an inspection of the ventilation systems in Building G, the lack of adequate ventilation was determined to be a factor causing elevated indoor air concentrations.

The recommendation of the July 2004 report was to upgrade the Heating, Ventilation and Air Conditioning (HVAC) units and/or improve the ductwork to provide adequate air flow in the building. The installation of a new Trane Precedent™ HVAC unit on the roof of Building G was completed in February 2005. The new system supplied outdoor air to each of the four rooms in the building, which is heated or cooled to maintain the temperature within the building. The new system operated concurrently with the original existing ventilation system. Locus also worked with the building owners, tenants, and ventilation maintenance staff, and provided suggestions for regular ventilation inspection and maintenance to prevent inadequate ventilation conditions at all buildings.

Additional indoor air sampling was completed in January and March 2005 to evaluate the effectiveness of the additional ventilation in Building G and confirm that concentrations in the other buildings were not exceeding the screening levels. Although the sampling results for January 2005 were impacted by quality control problems and ambient concentrations in the outdoor samples, the March 2005 results confirmed the previous findings that the chemicals in groundwater were not causing a significant vapor intrusion concern (Locus, 2005a). Also, the sampling indicated that the additional ventilation installed at Building G is effective in reducing the indoor air concentrations below the screening levels.

In response to the RWQCB request dated 13 October 2006, air samples have subsequently been collected annually since 2006 at 790 East Duane Avenue. The monitoring requirements specified by RWQCB include indoor air sampling in Buildings H and S, and ventilation system inspections in Buildings G, H, L, and S. Results from all sampling activities over the past nine years have consistently indicated that there are no short-term or immediate health risks from the concentrations observed in the buildings.

The April 2012 annual indoor air sampling event detected historically inconsistent elevated TCE concentrations in Building H, exceeding the RWQCB ESL and EPA RSL (Locus, 2012a). In response, additional sampling at Building H was conducted in September 2012. Results from the September sampling activities indicated that groundwater-related concentrations observed in Building H were consistent with historical monitoring results, which suggested that elevated TCE concentrations detected in April 2012 most likely represent an isolated incident and are not representative of long-term conditions (Locus, 2012b).

The observed concentrations in 2013 (ranging from 0.43 to 0.44 μg/m^3) were below the current risk protective range of 0.48 to 2 μg/m^3 (Locus, 2013). The observed concentrations in 2014 (ranging from 0.54 to 0.66 μg/m^3) were also within the risk protective range. These results, along with the previous sampling conducted at 790 Duane, demonstrated that indoor air concentrations in these buildings are normally below the long-term screening levels, and have always been within EPA's current risk-protective range (Locus, 2014).

3 SAMPLING LOCATIONS

3.1 Pre-Sampling Activities

Building walkthroughs have already been completed for this property prior to the sampling activities described above, and then also with EPA staff on 30 September 2013. Therefore, information on the building use, ventilation systems, and potential vapor intrusion pathways has already been reviewed. To collect more recent and complete data on chemical usage and storage in the building, the survey form in Appendix A of the Work Plan will be completed for this property prior to further sampling. Additional efforts to evaluate occupational sources may be implemented in a later phase of the project if additional sources are suspected as a result of air sampling.

3.2 Indoor/Outdoor Sample Collection

The proposed sampling locations are shown in Figure C-5. Air samples will be collected in all five buildings at 790 East Duane Avenue. Ambient air (breathing zone) samples will be collected in each building: one sample with the HVAC system on and one sample with the HVAC system off. In addition, pathway samples were identified in Building S (beneath an elevated floor, and in the restroom), Building V (in the crawlspace), and Building L (in the crawlspace and a small computer room next to the auditorium). These areas were identified as having potentially elevated risk for vapor intrusion during a walkthrough of this property conducted on 30 September 2013. In addition, selected preferential pathway locations that have been sampled previously (Figure C-4) will be resampled in this evaluation. A total of two outdoor samples will be collected from the entire site.

The air sampling will be representative of inhalation exposure point concentrations for the occupants of the buildings (primarily elementary school students). Indoor air samples will be collected at approximately 3 feet above floor level, which approximates the breathing zone elevation for occupants of these buildings. Initial sampling will be conducted with active HVAC for a 12-hour period from 6AM to 6PM, which are the normal occupancy hours for these buildings. The HVAC system will be maintained in normal weekday operating mode during sampling to most accurately reflect normal exposure conditions.

To evaluate the potential for subsurface vapor intrusion into buildings without reliance on the ventilation system, a reasonable maximum exposure scenario, a second round of sampling will be conducted with all HVAC systems shut down (assuming concurrence by property owner and occupants). For HVAC-off sampling, sample collection will begin 24 hours following shut-down of the building ventilation systems and continue while HVAC systems remain off. This HVAC-off condition represents a reasonable maximum scenario and is not representative of the normal exposure condition in the buildings. Second round samples will be collected over a 24-hour period (approximately 6PM to 6PM the next day) using passive samplers per EPA guidance.

4 SCHEDULE

The schedule for all work plan activities will be set after approval of the work plan is received from EPA. Work will proceed as follows, with estimated time of completion dependent on response from EPA and the property owners/occupants. Since sampling access has already been arranged for this property, and sample locations have already been selected, sampling can proceed on an accelerated schedule.

- Samples will be collected (estimated November 2014).
- Analysis of samples will be completed (estimated December 2014). Notification to EPA will occur within 48 hours of receipt of results that exceed the short-term screening levels.
- The final report will be submitted to the EPA within 30 days of completion of data review (estimated January 2015).

The project task schedule is contingent on EPA approval of this Work Plan at least 30 days before sampling is scheduled, so that appropriate coordination with building owners and occupants can be arranged, and sampling equipment can be procured. Detailed schedule of the sampling events will be provided through a web-based calendar, which will be accessible to EPA for updating in real time. This schedule may also be revised as needed to accommodate requests from the property owner or occupants (*e.g.* to arrange sampling when the buildings will not be in use).

TABLE C-1
HISTORICAL SOIL-GAS ANALYTICAl DATA
790 EAST DUANE AVENUE, SUNNYVALE, CALIFORNIA

	Location	SG002	SG003	SG003	SG004	SG005	SG006
	Date	4/17/2003	4/17/2003	4/17/2003	4/17/2003	4/17/2003	4/17/2003
	Sample Purpose	REG	FD	REG	REG	REG	REG
Parameter	Units						
1,1,1-Trichloroethane (TCA)	µg/m3	ND 5.4	5.0	5.0	9.9	97	ND 5.0
1,1,2-Trichlorotrifluoroethane (CFC 113)	µg/m3	ND 6.5	ND 6.2	ND 6.2	ND 12	ND 120	ND 6.0
1,1-Dichloroethane (1,1-DCA)	µg/m3	ND 3.4	ND 3.2	ND 3.2	ND 6.2	ND 61	ND 3.1
1,1-Dichloroethene (1,1-DCE)	µg/m3	ND 3.4	ND 3.2	ND 3.2	ND 6.2	ND 61	ND 3.1
1,2-Dichloroethane	µg/m3	ND 2.7	ND 2.6	ND 2.6	ND 5.0	ND 49	ND 2.5
Chloroform	µg/m3	ND 4.6	ND 4.4	ND 4.4	8.6	ND 84	ND 4.3
cis-1,2-Dichloroethene	µg/m3	ND 4.2	ND 3.9	ND 3.9	7.7	75	ND 3.8
Tetrachloroethene (PCE)	µg/m3	3.7	3.5	3.5	6.8	67	3.4
trans-1,2-Dichloroethene	µg/m3	ND 3.4	ND 3.2	ND 3.2	ND 6.4	ND 62	ND 3.2
Trichloroethene (TCE)	µg/m3	4.6	4.4	4.4	8.6	84	4.3
Vinyl Chloride	µg/m3	ND 2.2	ND 2.0	ND 2.0	ND 4.0	ND 39	ND 2.0

Notes:

ND - denotes result was below the detection limit

NT - sample not tested for the given parameter

Locus TECHNOLOGIES

TABLE C-2
HISTORICAL INDOOR AIR ANALYTICAL DATA
790 EAST DUANE AVENUE, SUNNYVALE, CA

Location	Date	Parameter Units Sample Purpose	1,1,1-TRICHLORO-ETHANE µg/m3	FREON 113 µg/m3	1,1-DICHLORO-ETHANE µg/m3	1,1-DICHLORO-ETHENE µg/m3	1,2-DICHLORO-ETHANE µg/m3	CHLORO-FORM µg/m3	CIS-1,2-DICHLORO-ETHENE µg/m3	TETRA-CHLORO-ETHENE µg/m3	TRANS-1,2-DICHLORO-ETHENE µg/m3	TRI-CHLORO-ETHENE µg/m3	VINYL CHLORIDE µg/m3
BKGD-LAKEWOOD	15-May-2004	FD	ND 0.19	0.74	ND 0.14	ND 0.068	ND 0.14	0.20	ND 0.14	1.1	ND 0.68	ND 0.18	ND 0.044
BKGD-LAKEWOOD	15-May-2004	REG	J 0.18	0.60	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
BKGD-LAKEWOOD	18-Aug-2004	FD	ND 0.19	0.64	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	0.28	ND 0.68	ND 0.18	ND 0.044
BKGD-LAKEWOOD	18-Aug-2004	REG	ND 0.19	0.63	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	0.30	ND 0.69	ND 0.19	ND 0.044
BKGD-LAKEWOOD	22-Jan-2005	REG	ND 0.19 *	0.64 *	ND 0.14 *	ND 0.068 *	ND 0.14 *	ND 0.17 *	ND 0.14 *	ND 0.23 *	ND 0.68 *	0.072 *	ND 0.044 *
BKGD-LAKEWOOD	12-Mar-2005	FD	ND 0.18	0.60	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
BKGD-LAKEWOOD	12-Mar-2005	REG	ND 0.18	0.60	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
BKGD-LAKEWOOD	1-Apr-2005	FD	ND 0.19	0.69	ND 0.14	ND 0.069	ND 0.14	0.17	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.045
BKGD-LAKEWOOD	1-Apr-2005	REG	ND 0.20	0.66	ND 0.15	ND 0.074	ND 0.15	0.20	ND 0.15	ND 0.25	ND 0.74	ND 0.20	ND 0.048
BKGD-LAKEWOOD	19-Jun-2005	FB	ND 0.20	0.63	ND 0.14	ND 0.071	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.71	ND 0.19	ND 0.046
BKGD-MURPHY	15-May-2004	REG	ND 0.19	0.60	0.23	ND 0.069	4.0	0.32	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.044
BKGD-MURPHY	18-Aug-2004	REG	3.3	0.74	ND 0.15	0.20	0.41	0.35	ND 0.15	1.1	ND 0.75	2.2	ND 0.048
BKGD-MURPHY	22-Jan-2005	REG	ND 0.18 *	0.59 *	ND 0.14 *	ND 0.067 *	ND 0.14 *	0.17 *	ND 0.13 *	0.35 *	ND 0.67 *	0.19 *	ND 0.043 *
BKGD-MURPHY	12-Mar-2005	REG	ND 0.19	0.63	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
BKGD-MURPHY	1-Apr-2005	REG	ND 0.22	0.68	ND 0.16	ND 0.080	ND 0.16	ND 0.20	ND 0.16	ND 0.27	ND 0.80	ND 0.22	ND 0.051
BKGD-MURPHY	19-Jun-2005	REG	ND 0.19	0.60	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	0.68	ND 0.044
BKGD-PONDEROSA	15-May-2004	REG	ND 0.23	0.69	ND 0.17	ND 0.083	ND 0.17	ND 0.20	ND 0.17	ND 0.28	ND 0.83	ND 0.22	ND 0.054
BKGD-PONDEROSA	18-Aug-2004	REG		0.67	ND 0.15	ND 0.072	ND 0.15	ND 0.18	ND 0.14	ND 0.25	ND 0.72	ND 0.20	ND 0.046
BKGD-PONDEROSA	22-Jan-2005	REG	ND 0.18 *	0.63 *	ND 0.14 *	ND 0.067 *	ND 0.14 *	0.18 *	ND 0.13 *	0.27 *	ND 0.67 *	0.067 *	ND 0.043 *
BKGD-PONDEROSA	12-Mar-2005	REG	ND 0.18	0.64	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
BKGD-PONDEROSA	1-Apr-2005	REG	ND 0.22	0.70	ND 0.17	ND 0.082	ND 0.17	ND 0.20	ND 0.16	ND 0.28	ND 0.82	ND 0.22	ND 0.053
BKGD-PONDEROSA	19-Jun-2005	REG	ND 0.20	0.60	ND 0.15	ND 0.072	ND 0.15	ND 0.18	ND 0.14	ND 0.25	ND 0.72	ND 0.20	ND 0.047
BLANK-G	15-May-2004	FB	ND 0.12	ND 0.16	ND 0.086	ND 0.042	ND 0.086	ND 0.10	ND 0.084	ND 0.14	ND 0.42	ND 0.11	ND 0.027
BLANK-G	12-Mar-2005	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-G	27-May-2006	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-H	15-May-2004	FB	ND 0.11	ND 0.16	ND 0.082	ND 0.040	ND 0.082	ND 0.099	ND 0.080	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-H	22-Jan-2005	FB	ND 0.11 *	ND 0.16 *	ND 0.082 *	ND 0.040 *	ND 0.082 *	ND 0.10 *	ND 0.081 *	ND 0.14 *	ND 0.40 *	ND 0.016 *	ND 0.026 *
BLANK-H	12-Mar-2005	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-L	15-May-2004	FB	ND 0.12	ND 0.16	ND 0.086	ND 0.042	ND 0.086	ND 0.10	ND 0.084	ND 0.14	ND 0.42	ND 0.11	ND 0.027
BLANK-L	22-Jan-2005	FB	ND 0.11 *	ND 0.16 *	ND 0.082 *	ND 0.040 *	ND 0.082 *	ND 0.10 *	ND 0.081 *	ND 0.14 *	ND 0.40 *	ND 0.016 *	ND 0.026 *
BLANK-L	12-Mar-2005	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-OFF	18-Aug-2004	TB	ND 0.11	ND 0.16	ND 0.083	ND 0.041	ND 0.083	ND 0.10	ND 0.081	ND 0.14	ND 0.41	ND 0.11	ND 0.026
BLANK-OFF	22-Jan-2005	FB	ND 0.11 *	ND 0.16 *	ND 0.083 *	ND 0.041 *	ND 0.083 *	ND 0.10 *	ND 0.082 *	ND 0.14 *	ND 0.41 *	ND 0.017 *	ND 0.026 *
BLANK-OFF	12-Mar-2005	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-OFF	1-Apr-2005	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-OFF	19-Jun-2005	FB	ND 0.11	ND 0.16	ND 0.084	ND 0.041	ND 0.084	ND 0.10	ND 0.082	ND 0.14	ND 0.41	ND 0.11	ND 0.026
BLANK-S	15-May-2004	FB	ND 0.11	ND 0.16	ND 0.083	ND 0.041	ND 0.083	ND 0.10	ND 0.081	ND 0.14	ND 0.41	ND 0.11	ND 0.026
BLANK-S	19-Jun-2005	FB	ND 0.12	ND 0.16	ND 0.086	ND 0.042	ND 0.086	ND 0.10	ND 0.084	ND 0.14	ND 0.42	ND 0.11	ND 0.027
BLANK-S	1-Jul-2006	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-S	21-Apr-2007	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
BLANK-S	19-Apr-2008	FB	ND 0.11	ND 0.15	ND 0.081	ND 0.040	ND 0.081	ND 0.098	ND 0.079	ND 0.14	ND 0.40	ND 0.11	ND 0.026
G-AMB-1	15-May-2004	REG	0.30	0.74	ND 0.13	ND 0.064	ND 0.13	0.22	0.64	0.71	ND 0.64	3.1	ND 0.041
G-AMB-1	12-Jun-2004	REG	0.26	0.42	ND 0.13	ND 0.066	ND 0.13	0.18	ND 0.13	1.0	ND 0.66	2.1	ND 0.043

Notes:
ND - denotes result was below the detection limit
NT - sample not tested for the given parameter
* - denotes results were impacted by quality control issues

TABLE C-2
HISTORICAL INDOOR AIR ANALYTICAL DATA
790 EAST DUANE AVENUE, SUNNYVALE, CA

Location	Date	Parameter Units Sample Purpose	1,1,1-TRICHLORO-ETHANE µg/m3	FREON 113 µg/m3	1,1-DICHLORO-ETHANE µg/m3	1,1-DICHLORO-ETHENE µg/m3	1,2-DICHLORO-ETHANE µg/m3	CHLORO-FORM µg/m3	CIS-1,2-DICHLORO-ETHENE µg/m3	TETRA-CHLORO-ETHENE µg/m3	TRANS-1,2-DICHLORO-ETHENE µg/m3	TRI-CHLORO-ETHENE µg/m3	VINYL CHLORIDE µg/m3
G-AMB-1	12-Mar-2005	REG	ND 0.19	0.64	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	0.34	ND 0.045
G-AMB-2	15-May-2004	REG	0.21	0.86	ND 0.14	ND 0.069	ND 0.14	0.22	ND 0.14	ND 0.24	ND 0.69	4.6	ND 0.044
G-AMB-2	12-Jun-2004	FD	0.24	0.40	ND 0.13	ND 0.066	ND 0.13	J 0.16	ND 0.13	0.31	ND 0.66	1.6	ND 0.043
G-AMB-2	12-Jun-2004	REG	0.23	0.65	ND 0.13	ND 0.066	ND 0.13	ND 0.16	ND 0.13	0.31	ND 0.66	1.5	ND 0.043
G-AMB-2	12-Mar-2005	FD	ND 0.19	0.64	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	0.34	ND 0.045
G-AMB-2	12-Mar-2005	REG	ND 0.17	0.62	ND 0.12	ND 0.061	ND 0.12	ND 0.15	ND 0.12	ND 0.21	ND 0.61	0.36	ND 0.040
G-AMB-2	27-May-2006	FD	ND 0.19	0.65	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
G-AMB-2	27-May-2006	REG	ND 0.19	0.72	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
G-AMB-3	15-May-2004	REG	0.19	0.80	ND 0.14	ND 0.069	ND 0.14	0.20	ND 0.14	ND 0.24	ND 0.69	2.2	ND 0.044
G-AMB-3	12-Jun-2004	REG	0.26	0.42	ND 0.13	ND 0.066	ND 0.13	0.17	ND 0.13	ND 0.23	ND 0.66	1.9	ND 0.043
G-AMB-3	12-Mar-2005	REG	ND 0.19	0.65	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	0.23	ND 0.045
G-AMB-4	15-May-2004	REG	J 0.19	0.81	ND 0.14	ND 0.070	ND 0.14	0.20	ND 0.14	ND 0.24	ND 0.70	1.9	ND 0.045
G-AMB-4	12-Jun-2004	REG	0.25	0.43	ND 0.13	ND 0.066	ND 0.13	0.17	ND 0.13	1.1	ND 0.66	1.5	ND 0.043
G-AMB-4	12-Mar-2005	REG	ND 0.19	0.62	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	0.31	ND 0.044
G-OUT-1	15-May-2004	REG	ND 0.18	0.69	ND 0.13	ND 0.065	ND 0.13	ND 0.16	ND 0.13	ND 0.22	ND 0.65	ND 0.18	ND 0.042
G-OUT-1	12-Jun-2004	REG	ND 0.18	0.42	ND 0.13	ND 0.066	ND 0.13	ND 0.16	ND 0.13	0.26	ND 0.66	ND 0.18	ND 0.043
G-OUT-1	12-Mar-2005	REG	ND 0.18	0.59	ND 0.14	ND 0.067	ND 0.14	0.27	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
G-PATH-1	12-Jun-2004	REG	0.22	0.44	ND 0.13	ND 0.066	ND 0.13	0.56	ND 0.13	0.52	ND 0.66	ND 0.18	ND 0.043
G-PATH-2	12-Jun-2004	REG	7.8	0.47	ND 0.13	0.074	ND 0.13	0.45	ND 0.13	ND 0.23	ND 0.66	0.21	ND 0.043
G-PATH-3	12-Jun-2004	REG	0.27	0.43	ND 0.14	ND 0.068	ND 0.14	0.90	ND 0.14	0.25	ND 0.68	0.31	ND 0.044
G-PATH-4	12-Jun-2004	REG	0.30	0.43	ND 0.13	ND 0.066	ND 0.13	1.7	ND 0.13	0.26	ND 0.66	0.24	ND 0.043
H-AMB-1	15-May-2004	REG	ND 0.19	0.61	ND 0.14	ND 0.070	ND 0.14	0.19	ND 0.14	ND 0.24	ND 0.70	0.58	ND 0.045
H-AMB-1	22-Jan-2005	REG	ND 0.20 *	0.65 *	ND 0.14 *	ND 0.071 *	ND 0.14 *	0.29 *	ND 0.14 *	ND 0.24 *	ND 0.71 *	1.3 *	ND 0.046 *
H-AMB-1	12-Mar-2005	REG	ND 0.20	0.65	ND 0.14	ND 0.071	ND 0.14	0.33	ND 0.14	0.48	ND 0.71	0.60	ND 0.046
H-AMB-2	15-May-2004	REG	ND 0.18	0.63	ND 0.13	ND 0.066	ND 0.13	ND 0.16	ND 0.13	ND 0.23	ND 0.66	0.47	ND 0.043
H-AMB-2	22-Jan-2005	REG	ND 0.16 *	0.63 *	ND 0.12 *	ND 0.059 *	ND 0.12 *	0.34 *	ND 0.12 *	0.27 *	ND 0.59 *	2.5 *	ND 0.038 *
H-AMB-2	12-Mar-2005	REG	ND 0.19	0.65	ND 0.14	ND 0.068	ND 0.14	0.37	ND 0.14	J 0.23	ND 0.68	0.67	ND 0.044
H-AMB-2	27-May-2006	REG	ND 0.18	0.62	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	0.31	ND 0.043
H-AMB-2	21-Apr-2007	REG	ND 0.17	ND 0.24	ND 0.12	ND 0.061	ND 0.12	0.41	ND 0.12	ND 0.21	ND 0.61	0.66	ND 0.040
H-AMB-2	19-Apr-2008	REG	ND 0.17	0.69	ND 0.13	ND 0.063	ND 0.13	ND 0.15	ND 0.12	ND 0.21	ND 0.63	0.87	ND 0.040
H-AMB-2	25-Apr-2009	FD	ND 0.19	0.56	ND 0.14	ND 0.068	0.15	ND 0.17	ND 0.14	ND 0.23	ND 0.68	0.22	ND 0.044
H-AMB-2	25-Apr-2009	REG	ND 0.16	0.60	ND 0.12	ND 0.059	0.16	ND 0.14	ND 0.12	ND 0.20	ND 0.59	0.26	ND 0.038
H-AMB-2	1-May-2010	FD	ND 0.18	0.64	ND 0.13	ND 0.064	ND 0.13	0.30	ND 0.13	ND 0.22	ND 0.64	0.89	ND 0.041
H-AMB-2	1-May-2010	REG	ND 0.18	0.65	ND 0.13	ND 0.065	ND 0.13	0.30	ND 0.13	ND 0.22	ND 0.65	0.91	ND 0.042
H-AMB-2	23-Apr-2011	FD	ND 0.18	0.54	ND 0.13	ND 0.065	0.18	0.21	ND 0.13	ND 0.22	ND 0.65	0.65	ND 0.042
H-AMB-2	23-Apr-2011	REG	ND 0.20	0.54	ND 0.14	ND 0.071	0.18	0.22	ND 0.14	ND 0.24	ND 0.71	0.66	ND 0.046
H-AMB-2	28-Apr-2012	FD	ND 0.18	ND 1.2	ND 0.13	ND 0.064	0.16	ND 0.16	ND 0.13	ND 0.22	ND 0.64	1.9	ND 0.041
H-AMB-2	28-Apr-2012	REG	ND 0.18	ND 1.3	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	1.3	ND 0.043
H-AMB-2	30-Sep-2012	FD	ND 0.19	0.60	ND 0.14	ND 0.068	0.17	0.76	ND 0.14	ND 0.23	ND 0.68	0.89	ND 0.044
H-AMB-2	30-Sep-2012	REG	ND 0.18	0.59	ND 0.14	ND 0.067	0.17	0.60	ND 0.13	0.39	ND 0.67	0.91	ND 0.043
H-AMB-2	13-Apr-2013	FD	ND 0.18	0.65	ND 0.13	ND 0.065	ND 0.13	0.38	ND 0.13	ND 0.22	ND 0.65	0.44	ND 0.042

Notes:
- ND - denotes result was below the detection limit
- NT - sample not tested for the given parameter
- * - denotes results were impacted by quality control issues

TABLE C-2
HISTORICAL INDOOR AIR ANALYTICAL DATA
790 EAST DUANE AVENUE, SUNNYVALE, CA

Location	Date	Parameter Units Sample Purpose	1,1,1-TRICHLORO-ETHANE µg/m3	FREON 113 µg/m3	1,1-DICHLORO-ETHANE µg/m3	1,1-DICHLORO-ETHENE µg/m3	1,2-DICHLORO-ETHANE µg/m3	CHLORO-FORM µg/m3	CIS-1,2-DICHLORO-ETHENE µg/m3	TETRA-CHLORO-ETHENE µg/m3	TRANS-1,2-DICHLORO-ETHENE µg/m3	TRI-CHLORO-ETHENE µg/m3	VINYL CHLORIDE µg/m3
H-AMB-2	13-Apr-2013	REG	ND 0.18	0.65	ND 0.13	ND 0.066	ND 0.13	0.37	ND 0.13	ND 0.22	ND 0.66	0.43	ND 0.042
H-AMB-3	15-May-2004	REG	ND 0.20	0.66	ND 0.15	ND 0.074	0.19	0.33	ND 0.15	ND 0.25	ND 0.74	0.56	ND 0.048
H-AMB-3	22-Jan-2005	REG	0.20*	0.64*	ND 0.14 *	ND 0.067 *	ND 0.14 *	0.26*	ND 0.13 *	0.38*	ND 0.67 *	0.99*	ND 0.043 *
H-AMB-3	12-Mar-2005	REG	ND 0.20	0.64	ND 0.14	ND 0.071	ND 0.14	0.28	ND 0.14	ND 0.24	ND 0.71	0.50	ND 0.046
H-AMB-4	15-May-2004	REG	ND 0.19	0.65	ND 0.14	ND 0.069	ND 0.14	0.20	ND 0.14	ND 0.24	ND 0.69	0.52	ND 0.044
H-AMB-4	22-Jan-2005	REG	ND 0.19 *	0.62 *	ND 0.14 *	ND 0.068 *	ND 0.14 *	0.25 *	ND 0.14 *	ND 0.23 *	ND 0.68 *	1.4 *	ND 0.044 *
H-AMB-4	12-Mar-2005	REG	ND 0.19	0.60	ND 0.14	ND 0.069	ND 0.14	0.46	ND 0.14	ND 0.24	ND 0.69	0.38	ND 0.045
H-OUT-1	15-May-2004	REG	ND 0.19	0.66	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.044
H-OUT-1	22-Jan-2005	REG	ND 0.20 *	0.60 *	ND 0.15 *	ND 0.072 *	ND 0.15 *	ND 0.18 *	ND 0.14 *	ND 0.25 *	ND 0.72 *	0.073 *	ND 0.047 *
H-OUT-1	12-Mar-2005	REG	ND 0.19	0.64	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
H-PATH-1	15-May-2004	REG	ND 0.19	0.72	ND 0.14	ND 0.070	ND 0.14	0.65	ND 0.14	ND 0.24	ND 0.70	0.73	ND 0.045
H-PATH-1	22-Jan-2005	REG	ND 0.19 *	0.66 *	ND 0.14 *	ND 0.068 *	ND 0.14 *	0.51 *	ND 0.14 *	ND 0.23 *	ND 0.68 *	2.5 *	ND 0.044 *
H-PATH-1	12-Mar-2005	REG	ND 0.21	0.63	ND 0.15	ND 0.076	ND 0.15	0.84	ND 0.15	ND 0.26	ND 0.76	0.86	ND 0.049
L-AMB-1	15-May-2004	REG	ND 0.19	0.78	ND 0.14	ND 0.070	ND 0.14	0.23	ND 0.14	0.28	ND 0.70	0.19	ND 0.045
L-AMB-1	22-Jan-2005	REG	ND 0.22 *	0.69 *	ND 0.16 *	ND 0.080 *	ND 0.16 *	0.31 *	ND 0.16 *	0.29 *	ND 0.80 *	1.6 *	ND 0.051 *
L-AMB-1	12-Mar-2005	REG	ND 0.19	0.63	ND 0.14	ND 0.069	ND 0.14	0.28	ND 0.14	0.24	ND 0.69	0.22	ND 0.045
L-AMB-2	15-May-2004	REG	ND 0.19	0.98	ND 0.14	ND 0.068	ND 0.14	1.1	ND 0.14	0.34	ND 0.68	0.38	ND 0.044
L-AMB-2	22-Jan-2005	REG	ND 0.20 *	0.69 *	ND 0.14 *	ND 0.071 *	ND 0.14 *	0.39 *	ND 0.14 *	0.31 *	ND 0.71 *	1.3 *	ND 0.046 *
L-AMB-2	12-Mar-2005	REG	ND 0.20	0.62	ND 0.14	ND 0.071	ND 0.14	0.33	ND 0.14	0.28	ND 0.71	0.25	ND 0.046
L-AMB-2	27-May-2006	REG	ND 0.19	0.66	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.045
L-AMB-3	15-May-2004	FD	ND 0.19	0.80	ND 0.14	ND 0.069	ND 0.14	0.64	ND 0.14	0.77	ND 0.69	0.22	ND 0.044
L-AMB-3	15-May-2004	REG	ND 0.19	0.81	ND 0.14	ND 0.070	ND 0.14	0.63	ND 0.14	ND 0.24	ND 0.70	0.22	ND 0.045
L-AMB-3	22-Jan-2005	FD	ND 0.19 *	0.65 *	ND 0.14 *	ND 0.069 *	ND 0.14 *	0.20 *	ND 0.14 *	0.28 *	ND 0.69 *	0.71 *	ND 0.045 *
L-AMB-3	22-Jan-2005	REG	ND 0.19 *	0.63 *	ND 0.14 *	ND 0.068 *	ND 0.14 *	0.20 *	ND 0.14 *	0.29 *	ND 0.68 *	0.71 *	ND 0.044 *
L-AMB-3	12-Mar-2005	REG	ND 0.26	0.61	ND 0.19	ND 0.094	ND 0.19	0.34	ND 0.19	0.35	ND 0.94	0.57	ND 0.060
L-AMB-4	15-May-2004	REG	ND 0.19	0.86	ND 0.14	ND 0.069	ND 0.14	0.36	ND 0.14	ND 0.24	ND 0.69	0.40	ND 0.044
L-AMB-4	22-Jan-2005	REG	ND 0.19 *	0.67 *	ND 0.14 *	ND 0.068 *	ND 0.14 *	0.22 *	ND 0.14 *	0.25 *	ND 0.68 *	1.1 *	ND 0.044 *
L-AMB-4	12-Mar-2005	REG	ND 0.19	0.64	ND 0.14	ND 0.068	ND 0.14	0.25	ND 0.14	0.24	ND 0.68	0.22	ND 0.044
L-OUT-1	15-May-2004	REG	ND 0.19	0.83	ND 0.14	ND 0.070	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.70	ND 0.19	ND 0.045
L-OUT-1	22-Jan-2005	REG	ND 0.18 *	0.64 *	ND 0.13 *	ND 0.064 *	ND 0.13 *	0.35 *	ND 0.13 *	ND 0.22 *	ND 0.64 *	0.079 *	ND 0.041 *
L-OUT-1	12-Mar-2005	REG	ND 0.19	0.63	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.045
L-PATH-1	15-May-2004	REG	ND 0.19	0.73	ND 0.14	ND 0.070	ND 0.14	1.7	ND 0.14	ND 0.24	ND 0.70	0.44	ND 0.045
L-PATH-1	22-Jan-2005	REG	ND 0.19 *	0.68 *	ND 0.14 *	ND 0.068 *	ND 0.14 *	67 *	ND 0.14 *	0.27 *	ND 0.68 *	2.9 *	ND 0.044 *
L-PATH-1	12-Mar-2005	REG	ND 0.20	0.63	ND 0.14	ND 0.071	ND 0.14	1.2	ND 0.14	ND 0.24	ND 0.71	0.31	ND 0.046
S-AMB-1	15-May-2004	REG	0.20	0.73	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	0.71	ND 0.044
S-AMB-1	19-Jun-2005	REG	ND 0.20	0.61	ND 0.14	ND 0.071	ND 0.14	0.18	ND 0.14	ND 0.24	ND 0.71	0.20	ND 0.046
S-AMB-2	15-May-2004	REG	0.48	0.62	ND 0.14	ND 0.068	0.17	0.23	ND 0.14	0.43	ND 0.68	1.0	ND 0.044
S-AMB-2	19-Jun-2005	REG	0.39	0.63	ND 0.14	ND 0.069	ND 0.14	0.30	ND 0.14	ND 0.24	ND 0.69	0.89	ND 0.045
S-AMB-2	27-May-2006	REG	ND 0.18	0.70	ND 0.14	ND 0.067	ND 0.14	0.23	ND 0.13	ND 0.23	ND 0.67	2.2	ND 0.043

Notes:

ND - denotes result was below the detection limit

NT - sample not tested for the given parameter

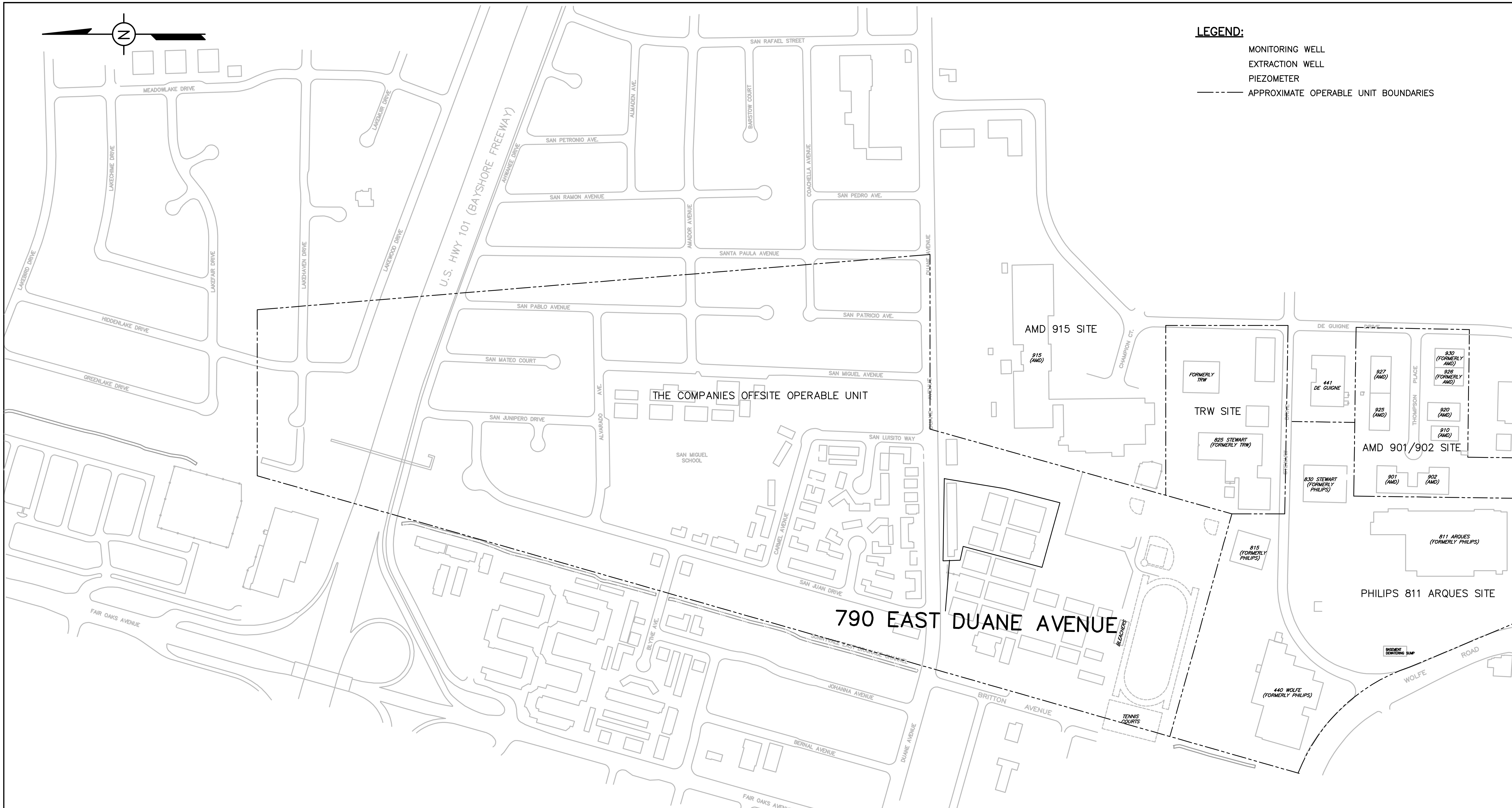
* - denotes results were impacted by quality control issues

TABLE C-2
HISTORICAL INDOOR AIR ANALYTICAL DATA
790 EAST DUANE AVENUE, SUNNYVALE, CA

Location	Date	Parameter Units Sample Purpose	1,1,1-TRICHLORO-ETHANE µg/m3	FREON 113 µg/m3	1,1-DICHLORO-ETHANE µg/m3	1,1-DICHLORO-ETHENE µg/m3	1,2-DICHLORO-ETHANE µg/m3	CHLORO-FORM µg/m3	CIS-1,2-DICHLORO-ETHENE µg/m3	TETRA-CHLORO-ETHENE µg/m3	TRANS-1,2-DICHLORO-ETHENE µg/m3	TRI-CHLORO-ETHENE µg/m3	VINYL CHLORIDE µg/m3
S-AMB-2	1-Jul-2006	FD	ND 0.16	0.61	ND 0.12	ND 0.060	ND 0.12	0.15	ND 0.12	ND 0.21	ND 0.60	ND 0.16	ND 0.039
S-AMB-2	1-Jul-2006	REG	ND 0.16	0.60	ND 0.12	ND 0.060	ND 0.12	ND 0.15	ND 0.12	ND 0.21	ND 0.60	ND 0.16	ND 0.039
S-AMB-2	21-Apr-2007	REG	ND 0.18	ND 0.25	ND 0.13	ND 0.065	ND 0.13	ND 0.16	ND 0.13	0.50	ND 0.65	0.59	ND 0.042
S-AMB-2	19-Apr-2008	FD	ND 0.19	0.65	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	0.51	ND 0.045
S-AMB-2	19-Apr-2008	REG	ND 0.17	0.66	ND 0.12	ND 0.061	ND 0.12	ND 0.15	ND 0.12	ND 0.21	ND 0.61	0.32	ND 0.040
S-AMB-2	25-Apr-2009	REG	ND 0.17	0.59	ND 0.12	ND 0.061	ND 0.12	0.27	ND 0.12	0.36	ND 0.61	0.42	ND 0.040
S-AMB-3	15-May-2004	REG	0.86	0.64	ND 0.14	ND 0.068	ND 0.14	0.19	ND 0.14	ND 0.23	ND 0.68	0.93	ND 0.044
S-AMB-3	19-Jun-2005	REG	1.4	0.63	ND 0.14	ND 0.071	ND 0.14	0.21	ND 0.14	ND 0.24	ND 0.71	1.8	ND 0.046
S-AMB-4	15-May-2004	FD	0.28	0.70	ND 0.14	ND 0.069	ND 0.14	0.20	ND 0.14	0.46	ND 0.69	0.41	ND 0.044
S-AMB-4	15-May-2004	REG	0.27	0.64	ND 0.14	ND 0.069	ND 0.14	0.19	ND 0.14	ND 0.24	ND 0.69	0.27	ND 0.044
S-AMB-4	19-Jun-2005	FD	ND 0.20	0.63	ND 0.15	ND 0.072	ND 0.15	0.21	ND 0.14	ND 0.25	ND 0.72	0.21	ND 0.047
S-AMB-4	19-Jun-2005	REG	ND 0.20	0.63	ND 0.15	ND 0.072	ND 0.15	0.20	ND 0.14	ND 0.25	ND 0.72	0.21	ND 0.047
S-AMB-4	1-May-2010	REG	ND 0.18	ND 0.62	ND 0.13	ND 0.064	ND 0.13	0.20	ND 0.13	ND 0.22	ND 0.64	0.18	ND 0.041
S-AMB-4	28-Apr-2012	REG	ND 0.19	ND 1.3	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
S-AMB-4	13-Apr-2013	REG	ND 0.18	0.62	ND 0.14	ND 0.067	ND 0.14	2.2	ND 0.13	ND 0.23	ND 0.67	0.27	ND 0.043
S-OUT-1	15-May-2004	REG	ND 0.19	0.72	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.044
S-OUT-1	19-Jun-2005	REG	ND 0.19	0.62	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	0.24	ND 0.045
S-OUT-1	27-May-2006	REG	ND 0.18	0.66	ND 0.13	ND 0.064	ND 0.13	ND 0.16	ND 0.13	ND 0.22	ND 0.64	ND 0.17	ND 0.041
S-OUT-1	1-Jul-2006	REG	ND 0.16	0.62	ND 0.12	ND 0.060	ND 0.12	ND 0.15	ND 0.12	ND 0.21	ND 0.60	ND 0.16	ND 0.039
S-OUT-1	21-Apr-2007	REG	ND 0.17	ND 0.24	ND 0.13	ND 0.063	ND 0.13	ND 0.15	ND 0.12	ND 0.21	ND 0.63	ND 0.17	ND 0.040
S-OUT-1	19-Apr-2008	REG	ND 0.19	0.70	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
S-OUT-1	25-Apr-2009	REG	u ND 0.18	0.58	u ND 0.14	u ND 0.067	u ND 0.14	u ND 0.16	u ND 0.13	u ND 0.23	u ND 0.67	u ND 0.18	u ND 0.043
S-OUT-1	1-May-2010	REG	ND 0.18	ND 0.64	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
S-OUT-1	23-Apr-2011	REG	ND 0.18	0.54	ND 0.13	ND 0.065	ND 0.13	ND 0.16	ND 0.13	ND 0.22	ND 0.65	ND 0.18	ND 0.042
S-OUT-1	28-Apr-2012	REG	ND 0.18	ND 1.3	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
S-OUT-1	30-Sep-2012	REG	ND 0.19	0.52	ND 0.14	ND 0.069	ND 0.14	0.31	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.045
S-OUT-1	13-Apr-2013	REG	ND 0.19	0.67	ND 0.14	ND 0.069	ND 0.14	0.24	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.044
V-AMB-1	15-May-2004	REG	0.21	0.83	ND 0.14	ND 0.070	ND 0.14	1.7	ND 0.14	0.28	ND 0.70	0.49	ND 0.045
V-AMB-1	12-Mar-2005	REG	ND 0.32	0.63	ND 0.24	ND 0.12	ND 0.24	1.3	ND 0.24	ND 0.40	ND 1.2	ND 0.32	ND 0.076
V-AMB-2	15-May-2004	FD	0.22	0.79	ND 0.14	ND 0.068	ND 0.14	2.1	ND 0.14	J 0.23	ND 0.68	0.56	ND 0.044
V-AMB-2	15-May-2004	REG	0.22	0.81	ND 0.14	ND 0.068	ND 0.14	2.1	ND 0.14	0.26	ND 0.68	0.60	ND 0.044
V-AMB-2	12-Mar-2005	FD	ND 0.20	0.64	ND 0.14	ND 0.071	ND 0.14	1.5	ND 0.14	0.26	ND 0.71	ND 0.19	ND 0.046
V-AMB-2	12-Mar-2005	REG	ND 0.20	0.34	ND 0.14	ND 0.071	ND 0.14	1.5	ND 0.14	0.25	ND 0.71	ND 0.19	ND 0.046
V-AMB-3	15-May-2004	REG	0.21	0.92	ND 0.14	ND 0.070	ND 0.14	1.6	ND 0.14	0.27	ND 0.70	0.53	ND 0.045
V-AMB-3	12-Mar-2005	REG	ND 0.21	0.62	ND 0.15	ND 0.076	ND 0.15	1.2	ND 0.15	ND 0.26	ND 0.76	ND 0.20	ND 0.049
V-AMB-4	15-May-2004	REG	0.21	0.76	ND 0.13	ND 0.066	ND 0.13	1.6	ND 0.13	0.26	ND 0.66	0.57	ND 0.043
V-AMB-4	12-Mar-2005	REG	ND 0.19	0.65	ND 0.14	ND 0.069	ND 0.14	1.6	ND 0.14	0.29	ND 0.69	ND 0.19	ND 0.045
V-OUT-1	15-May-2004	REG	ND 0.18	0.65	ND 0.13	ND 0.066	ND 0.13	ND 0.16	ND 0.13	ND 0.23	ND 0.66	ND 0.18	ND 0.043
V-OUT-1	12-Mar-2005	REG	ND 0.19	0.65	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	1.9	ND 0.68	ND 0.18	ND 0.044
V-PATH-1	15-May-2004	REG	0.23	0.80	ND 0.14	ND 0.069	ND 0.14	1.9	ND 0.14	0.24	ND 0.69	0.54	ND 0.044
V-PATH-1	12-Mar-2005	REG	ND 0.19	0.61	ND 0.14	ND 0.069	ND 0.14	1.2	ND 0.14	0.24	ND 0.69	ND 0.19	ND 0.045

Notes:
ND - denotes result was below the detection limit
NT - sample not tested for the given parameter
* - denotes results were impacted by quality control issues

Locus TECHNOLOGIES



SITE PLAN
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

REFERENCES:
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	26 JAN 07	ADDED WELLS 157A AND S157B1. DELETED SEALED WELLS S042A AND S042B1.	VZC	MMG	JWH
2	20 JAN 03	REMOVED SEALED WELLS S085A, S086A, S091A, G-3, A-6, G-1, G-5, M-1, S065A, S070A, S087A, and S089A.	JWH	JWH	JEB
1	28 JAN 00	ISSUED FOR REPORT	VZC	MJG	JEB

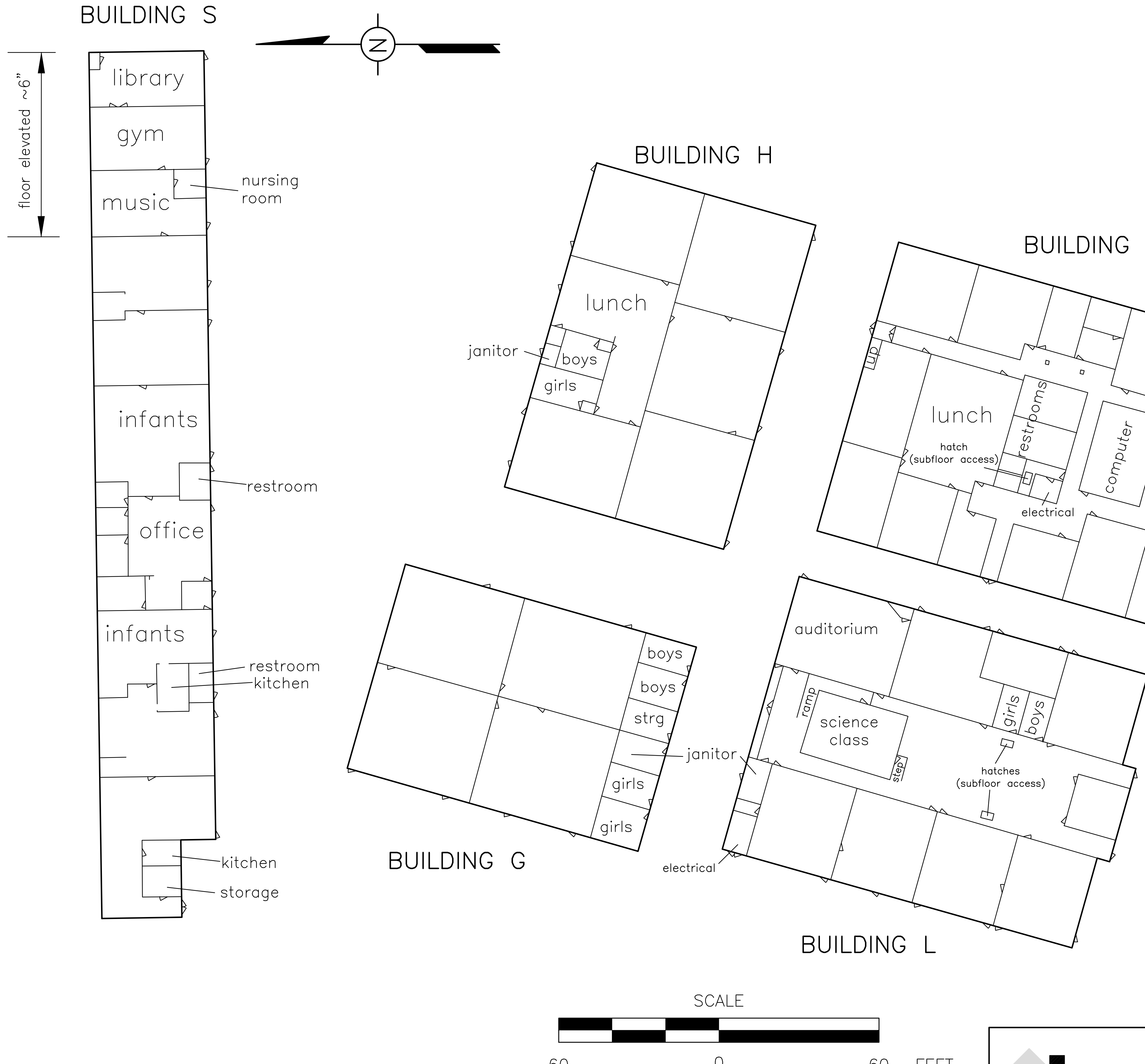
LOCUS TECHNOLOGIES

SCALE: 200 0 200 400 FEET

DRAWING NO. 27-006-C1

FIGURE C-1

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan\figures – generic\VI 2014



SITE PLAN
790 EAST DUANE AVENUE
SUNNYVALE, CALIFORNIA

PHILIPS

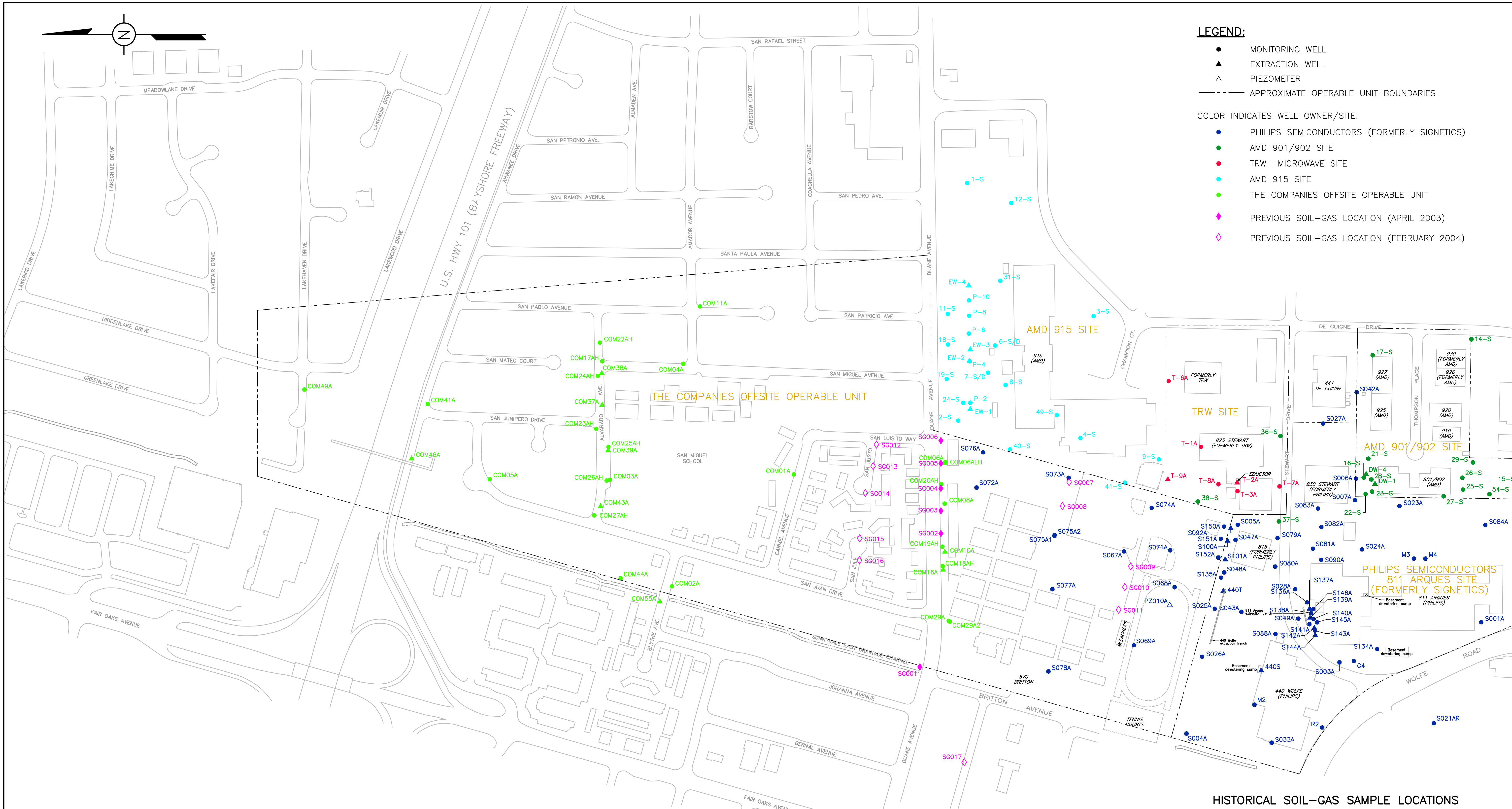
No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR REPORT	VZC	JWH	JWH

Locus TECHNOLOGIES

SCALE: AS SHOWN

DRAWING NO. 27–006–C2

FIGURE C–2



HISTORICAL SOIL-GAS SAMPLE LOCATIONS

THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

REFERENCES:
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
△	2-OCT-03	ISSUED FOR REPORT	JWH	JWH	JEB

Locus TECHNOLOGIES

SCALE IN FEET: 0, 150, 450

DRAWING NO. 27-006-C3

FIGURE C-3

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LEGEND:

▽ V-AMB-1 AIR SAMPLING LOCATION

790 EAST DUANE AVENUE
HISTORICAL AIR MONITORING LOCATIONS
SUNNYVALE, CALIFORNIA

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR REPORT	VZC	JWH	JWH

SCALE

60 0 60 FEET

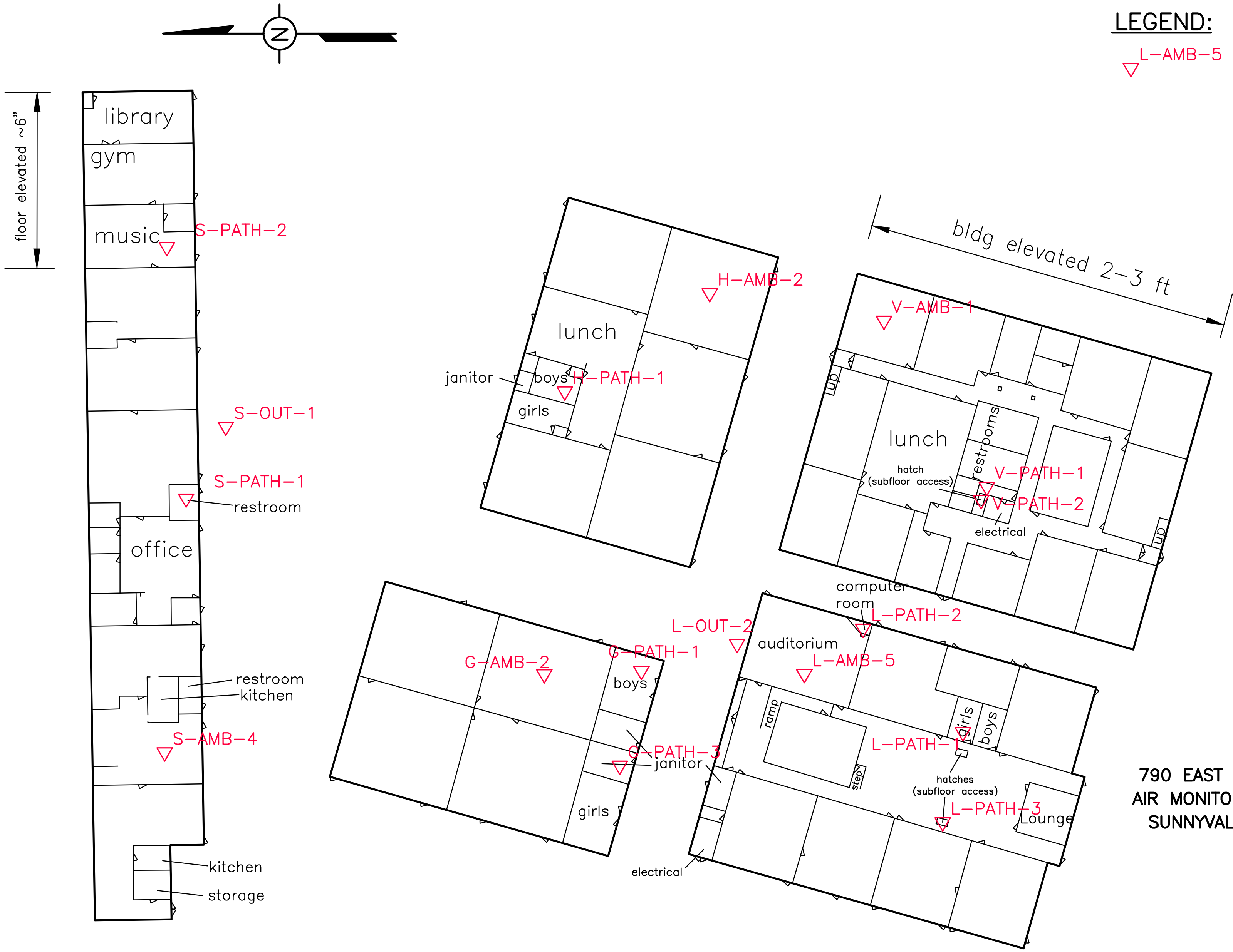
Locus TECHNOLOGIES

SCALE: AS SHOWN

DRAWING NO. 27-006-C4

FIGURE C-4

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan\Appendix C Site-specific work plan-790 Duane



LEGEND:

L-AMB-5 ▽ AIR SAMPLING LOCATION

790 EAST DUANE AVENUE
AIR MONITORING LOCATIONS
SUNNYVALE, CALIFORNIA

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR REPORT	ND	JWH	JWH

SCALE

60 0 60 FEET

Locus TECHNOLOGIES

SCALE: AS SHOWN

DRAWING NO. 27-006-C5

FIGURE C-5

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APPENDIX D

SITE-SPECIFIC WORK PLAN
562 NORTH BRITTON AVENUE

1 INTRODUCTION

This work plan provides additional site-specific details for the vapor intrusion investigation at 562 North Britton Avenue. This document is an appendix to the Work Plan for Additional Vapor Intrusion Investigation for the Companies Offsite Operable Unit (OOU) in Sunnyvale, California, and is subject to the terms, conditions and provisions of such Work Plan. General information on this investigation, including the investigation history of the site and general sampling procedures, is provided in the main Work Plan text.

2 INVESTIGATION HISTORY

A location map for 562 North Britton Avenue is provided in Figure D-1. Building layouts are provided in Figure D-2. Historical soil-gas and indoor air analytical results are summarized in Tables D-1 and D-2. The indoor air analytes in Table D-2 include the eight COCs to be evaluated as a part of this vapor intrusion work plan, and includes additional chemicals that are part of the standard SIM TO-15 analytical group.

2.1 Previous Soil-gas Sampling Results

On 20 August 2003, RWQCB requested an investigation in the form of soil-gas and/or indoor air samples in the residential complex north of Duane Avenue and in the vicinity of 562 North Britton Avenue. As a result, one round of soil-gas sampling and two rounds of indoor air sampling were conducted between 2004 and 2005 to evaluate the potential for vapor intrusion at the property. All historical soil-gas sampling locations at the OOU are shown in Figure D-3. Historical soil-gas analytical results near 562 North Britton Avenue are summarized in Table D-1.

2.2 Previous Indoor Air Sampling Results

The results of the February 2004 soil-gas investigation concluded that indoor air concentrations at the site are likely below all applicable health criteria (Locus, 2004c). However, since the soil-gas concentrations were elevated in some areas south of Duane Avenue, the modeled indoor air concentrations were in the range where uncertainties in the soil consistency and other model parameters could affect the results. Indoor air sampling was conducted to evaluate these uncertainties. Historical indoor air sampling locations at 562 North Britton Avenue are shown in Figure D-4. Historical indoor air analytical results are summarized in Table D-2 for the eight COCs and additional chemicals that are part of the standard SIM TO-15 analytical group.

Elevated concentrations of TCE were observed at Building K during the August 2004 sampling and appeared inconsistent with other observed concentrations at the site (Locus, 2004b). It was suspected that significant remodeling activities during the sampling of Building K caused interference with the sampling results because all other factors observed were similar across the site (i.e. groundwater concentrations, building design, and building ventilation). With the exception of the results affected by remodeling activities, all observed concentrations were below the screening levels at 562 Britton Avenue.

To assess potential seasonal variability and Building K inconsistencies in the indoor air concentrations, a second round of indoor air sampling was conducted in April 2005. Results indicated that there were no short-term or immediate health risks from the concentrations observed in the buildings (Locus, 2005b). Resampling of Building K indicated that the elevated results observed in August 2004 were related to the temporary remodeling activities. Additionally, groundwater related concentrations observed in all the buildings at the property were below all applicable long-term risk based criteria.

Results from all sampling activities in August 2004 and April 2005 indicate that there were no short-term or immediate health risks from the concentrations observed in the buildings. Additionally, concentrations observed in all the buildings at the property that could be attributed to groundwater were below all applicable long-term risk-based criteria. This investigation concluded that existing groundwater conditions did not pose unacceptable health risks and no further investigation or mitigation actions were recommended for the property.

3 SAMPLING LOCATIONS

3.1 Pre-Sampling Activities

Building walkthroughs have already been completed for this property prior to the sampling activities described above, and then also with EPA staff on 30 September 2013. Therefore, information on the building use, ventilation systems, and potential vapor intrusion pathways has already been reviewed. To collect more recent and complete data on chemical usage and storage in the building, the survey form in Appendix A of the Work Plan will be completed for this property prior to further sampling. Additional efforts to evaluate occupational sources may be implemented in a later phase of the project if additional sources are suspected as a result of air sampling.

3.2 Indoor/Outdoor Sample Collection

The proposed sample locations are provided in Figure D-5. Air samples will be collected in the 13 occupied structures. Ambient air (breathing zone) samples will be collected in each building: one sample with the HVAC system on and one sample with the HVAC system off. In addition, all preferential pathways will be evaluated, and then a representative subset of locations will be selected for sampling. One pathway sample location has already been identified in Building P (restroom). Layouts need to be obtained from the property owner for the Auditorium and Building W to show exact sample locations within those buildings. A total of three outdoor samples will be collected from the entire site.

The air sampling will be representative of inhalation exposure point concentrations for the occupants of the buildings (primarily high school students). Indoor air samples will be collected at the approximate breathing zone elevation (5 feet). Initial sampling will be conducted with active HVAC for a 8-hour period from 8AM to 4PM, which are the normal occupancy hours for these buildings. The HVAC system will be maintained in normal weekday operating mode to most accurately reflect normal exposure conditions.

To evaluate the potential for subsurface vapor intrusion into buildings without reliance on the ventilation system, a reasonable maximum exposure scenario, a second round of sampling will be conducted with all HVAC systems shut down (assuming concurrence by property owner and occupants). For HVAC-off sampling, sample collection will begin 24 hours following shut-down of the building ventilation systems and continue while HVAC systems remain off. This HVAC-off condition represents a reasonable maximum scenario and is not representative of the normal exposure condition in the buildings. Second round samples will be collected over a 24-hour period (approximately 6PM to 6PM the next day) using passive samplers per EPA guidance.

4 SCHEDULE

The schedule for all work plan activities will be set after approval of the work plan is received from EPA. Work will proceed as follows, with estimated time of completion dependent on response from EPA and the property owners/occupants. Since sampling access has already been arranged for this property, and sample locations have already been selected, sampling can proceed on an accelerated schedule.

- Samples will be collected (estimated November 2014).
- Analysis of samples will be completed (estimated December 2015). Notification to EPA will occur within 48 hours of receipt of results that exceed the short-term screening levels.
- The final report will be submitted to the EPA within 30 days of completion of data review (estimated January 2015).

The project task schedule is contingent on EPA approval of this Work Plan at least 30 days before sampling is scheduled, so that appropriate coordination with building owners and occupants can be arranged, and sampling equipment can be procured. Detailed schedule of the sampling events will be provided through a web-based calendar, which will be accessible to EPA for updating in real time. This schedule may also be revised as needed to accommodate requests from the property owner or occupants (e.g. to arrange sampling when the buildings will not be in use).

TABLE D-1
HISTORICAL SOIL-GAS ANALYTICAl DATA
562 BRITTON AVENUE, SUNNYVALE, CALIFORNIA

Parameter	Location Date Sample Purpose Units	SG007 2/5/2004 REG	SG008 2/5/2004 REG	SG009 2/5/2004 FD	SG009 2/5/2004 REG	SG010 2/5/2004 REG	SG011 2/5/2004 REG
1,1,1-Trichloroethane (TCA)	µg/m3	ND 4.2	ND 4.6	ND 4.5	ND 4.4	19	94
1,1,2-Trichlorotrifluoroethane (CFC 113)	µg/m3	ND 5.9	ND 6.5	ND 6.3	ND 6.2	48	410
1,1-Dichloroethane (1,1-DCA)	µg/m3	ND 3.1	ND 3.4	ND 3.3	ND 3.2	ND 6.4	ND 62
1,1-Dichloroethene (1,1-DCE)	µg/m3	ND 3.1	ND 3.4	ND 3.2	ND 3.2	ND 6.2	ND 61
1,2-Dichloroethane	µg/m3	ND 3.1	ND 3.4	ND 3.3	ND 3.2	ND 6.4	ND 62
Chloroform	µg/m3	ND 3.8	ND 4.2	ND 4.0	ND 3.9	ND 7.7	ND 75
cis-1,2-Dichloroethene	µg/m3	ND 3.1	ND 3.4	ND 3.2	ND 3.2	ND 6.2	ND 61
Tetrachloroethene (PCE)	µg/m3	ND 5.2	ND 5.8	ND 5.6	ND 5.4	27	120
trans-1,2-Dichloroethene	µg/m3	ND 12	ND 14	ND 13	ND 13	ND 25	ND 240
Trichloroethene (TCE)	µg/m3	5.6	17	ND 4.4	41	2900	13000
Vinyl Chloride	µg/m3	ND 2.0	ND 2.2	ND 2.1	ND 2.0	ND 4.0	ND 39

Notes:

ND - denotes result was below the detection limit

NT - sample not tested for the given parameter

LOCUS TECHNOLOGIES

TABLE D-2
HISTORICAL INDOOR AIR ANALYTICAL DATA
562 NORTH BRITTON AVENUE, SUNNYVALE, CA

Location	Date	Parameter Units Sample Purpose	1,1,1-TRICHLORO-ETHANE µg/m3	FREON 113 µg/m3	1,1-DICHLORO-ETHANE µg/m3	1,1-DICHLORO-ETHENE µg/m3	1,2-DICHLORO-ETHANE µg/m3	CHLORO-FORM µg/m3	CIS-1,2-DICHLORO-ETHENE µg/m3	TETRA-CHLORO-ETHENE µg/m3	TRANS-1,2-DICHLORO-ETHENE µg/m3	TRI-CHLORO-ETHENE µg/m3	VINYL CHLORIDE µg/m3
A-AMB-1	18-Aug-2004	REG	ND 0.19	0.66	ND 0.14	ND 0.069	ND 0.14	ND 0.17	0.58	0.55	ND 0.69	0.34	ND 0.044
A-AMB-2	18-Aug-2004	REG	ND 0.19	0.68	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	0.62	ND 0.69	0.49	ND 0.044
A-AMB-3	18-Aug-2004	REG	ND 0.18	0.66	ND 0.13	ND 0.065	ND 0.13	3.0	ND 0.13	0.30	ND 0.65	1.2	ND 0.042
A-AMB-3	24-Nov-2004	REG	ND 0.19	0.61	ND 0.14	ND 0.069	ND 0.14	2.9	ND 0.14	0.61	ND 0.69	0.34	ND 0.045
BKGD-LAKEWOOD	15-May-2004	FD	ND 0.19	0.74	ND 0.14	ND 0.068	ND 0.14	0.20	ND 0.14	1.1	ND 0.68	ND 0.18	ND 0.044
BKGD-LAKEWOOD	15-May-2004	REG	J 0.18	0.60	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
BKGD-LAKEWOOD	18-Aug-2004	FD	ND 0.19	0.64	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	0.28	ND 0.68	ND 0.18	ND 0.044
BKGD-LAKEWOOD	18-Aug-2004	REG	ND 0.19	0.63	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	0.30	ND 0.69	ND 0.19	ND 0.044
BKGD-LAKEWOOD	22-Jan-2005	REG	ND 0.19 *	0.64 *	ND 0.14 *	ND 0.068 *	ND 0.14 *	ND 0.17 *	ND 0.14 *	ND 0.23 *	ND 0.68 *	0.072 *	ND 0.044 *
BKGD-LAKEWOOD	12-Mar-2005	FD	ND 0.18	0.60	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
BKGD-LAKEWOOD	12-Mar-2005	REG	ND 0.18	0.60	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
BKGD-LAKEWOOD	1-Apr-2005	FD	ND 0.19	0.69	ND 0.14	ND 0.069	ND 0.14	0.17	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.045
BKGD-LAKEWOOD	1-Apr-2005	REG	ND 0.20	0.66	ND 0.15	ND 0.074	ND 0.15	0.20	ND 0.15	ND 0.25	ND 0.74	ND 0.20	ND 0.048
BKGD-LAKEWOOD	19-Jun-2005	FB	ND 0.20	0.63	ND 0.14	ND 0.071	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.71	ND 0.19	ND 0.046
BKGD-MURPHY	15-May-2004	REG	ND 0.19	0.60	0.23	ND 0.069	4.0	0.32	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.044
BKGD-MURPHY	18-Aug-2004	REG	3.3	0.74	ND 0.15	0.20	0.41	0.35	ND 0.15	1.1	ND 0.75	2.2	ND 0.048
BKGD-MURPHY	22-Jan-2005	REG	ND 0.18 *	0.59 *	ND 0.14 *	ND 0.067 *	ND 0.14 *	0.17 *	ND 0.13 *	0.35 *	ND 0.67 *	0.19 *	ND 0.043 *
BKGD-MURPHY	12-Mar-2005	REG	ND 0.19	0.63	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
BKGD-MURPHY	1-Apr-2005	REG	ND 0.22	0.68	ND 0.16	ND 0.080	ND 0.16	ND 0.20	ND 0.16	ND 0.27	ND 0.80	ND 0.22	ND 0.051
BKGD-MURPHY	19-Jun-2005	REG	ND 0.19	0.60	ND 0.14	ND 0.068	ND 0.14	ND 0.17	ND 0.14	ND 0.23	ND 0.68	0.68	ND 0.044
BKGD-PONDEROSA	15-May-2004	REG	ND 0.23	0.69	ND 0.17	ND 0.083	ND 0.17	ND 0.20	ND 0.17	ND 0.28	ND 0.83	ND 0.22	ND 0.054
BKGD-PONDEROSA	18-Aug-2004	REG	ND 0.20	0.67	ND 0.15	ND 0.072	ND 0.15	ND 0.18	ND 0.14	ND 0.25	ND 0.72	ND 0.20	ND 0.046
BKGD-PONDEROSA	22-Jan-2005	REG	ND 0.18 *	0.63 *	ND 0.14 *	ND 0.067 *	ND 0.14 *	0.18 *	ND 0.13 *	0.27 *	ND 0.67 *	0.067 *	ND 0.043 *
BKGD-PONDEROSA	12-Mar-2005	REG	ND 0.18	0.64	ND 0.14	ND 0.067	ND 0.14	ND 0.16	ND 0.13	ND 0.23	ND 0.67	ND 0.18	ND 0.043
BKGD-PONDEROSA	1-Apr-2005	REG	ND 0.22	0.70	ND 0.17	ND 0.082	ND 0.17	ND 0.20	ND 0.16	ND 0.28	ND 0.82	ND 0.22	ND 0.053
BKGD-PONDEROSA	19-Jun-2005	REG	ND 0.20	0.60	ND 0.15	ND 0.072	ND 0.15	ND 0.18	ND 0.14	ND 0.25	ND 0.72	ND 0.20	ND 0.047
C-AMB-1	18-Aug-2004	REG	0.29	0.65	ND 0.14	ND 0.070	ND 0.14	0.18	ND 0.14	0.60	ND 0.70	0.26	ND 0.045
C-AMB-2	18-Aug-2004	REG	ND 0.20	0.68	ND 0.15	ND 0.072	ND 0.15	0.18	ND 0.14	ND 0.25	ND 0.72	ND 0.20	ND 0.046
C-AMB-3	18-Aug-2004	REG	ND 0.19	0.69	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.044
C-OUT-1	18-Aug-2004	REG	ND 0.20	0.70	ND 0.15	ND 0.074	ND 0.15	ND 0.18	ND 0.15	ND 0.25	ND 0.74	ND 0.20	ND 0.048
E-AMB-1	18-Aug-2004	REG	ND 0.20	0.71	ND 0.15	ND 0.072	ND 0.15	0.24	ND 0.14	ND 0.25	ND 0.72	ND 0.20	ND 0.046
E-AMB-1	1-Apr-2005	REG	ND 0.19	0.62	ND 0.14	ND 0.069	ND 0.14	0.32	ND 0.14	J 0.23	ND 0.69	ND 0.19	ND 0.045
E-AMB-2	18-Aug-2004	REG	0.21	0.76	ND 0.14	ND 0.070	ND 0.14	ND 0.17	ND 0.14	0.58	ND 0.70	ND 0.19	ND 0.045
E-AMB-2	1-Apr-2005	REG	ND 0.19	0.64	ND 0.14	ND 0.069	ND 0.14	0.18	ND 0.14	ND 0.24	ND 0.69	ND 0.19	ND 0.045
E-AMB-3	18-Aug-2004	FD	0.20	0.72	ND 0.15	ND 0.072	ND 0.15	ND 0.18	ND 0.14	0.26	ND 0.72	ND 0.20	ND 0.046
E-AMB-3	18-Aug-2004	REG	0.19	0.71	ND 0.12	ND 0.059	ND 0.12	ND 0.14	ND 0.12	0.23	ND 0.59	ND 0.16	ND 0.038
E-AMB-3	1-Apr-2005	FD	ND 0.18	0.68	ND 0.13	ND 0.065	ND 0.13	0.19	ND 0.13	0.23	ND 0.65	ND 0.18	ND 0.042
E-AMB-3	1-Apr-2005	REG	ND 0.19	0.69	ND 0.14	ND 0.068	ND 0.14	0.20	ND 0.14	0.25	ND 0.68	ND 0.18	ND 0.044
E-AMB-3	26-Oct-2012	REG	ND 500	ND 500	ND 500	ND 2000	NT	NT	ND 500	ND 500	ND 500	ND 500	ND 500
E-AMB-4	18-Aug-2004	REG	0.24	0.79	ND 0.15	ND 0.075	ND 0.15	0.19	ND 0.15	1.2	ND 0.75	ND 0.20	ND 0.048
E-AMB-4	1-Apr-2005	REG	ND 0.19	0.68	ND 0.14	ND 0.068	ND 0.14	0.17	ND 0.14	ND 0.23	ND 0.68	ND 0.18	ND 0.044
K-AMB-1	18-Aug-2004	REG	ND 0.32	0.69	ND 0.24	ND 0.12	ND 0.24	ND 0.29	ND 0.24	ND 0.40	ND 1.2	260	ND 0.076
K-AMB-1	24-Nov-2004	FD	ND 0.18	0.61	ND 0.13	ND 0.064	ND 0.13	0.20	ND 0.13	0.60	ND 0.64	0.36	ND 0.041
K-AMB-1	24-Nov-2004	REG	ND 0.18	0.63	ND 0.13	ND 0.065	ND 0.13	0.19	ND 0.13	0.66	ND 0.65	0.38	ND 0.042
K-AMB-2	18-Aug-2004	REG	ND 0.19	0.73	ND 0.14	ND 0.070	ND 0.14	ND 0.17	J 0.14	ND 0.24	ND 0.70	40	ND 0.045
K-AMB-2	24-Nov-2004	REG	0.18	0.66	ND 0.13	ND 0.065	ND 0.13	0.22	ND 0.13	0.84	ND 0.65	0.49	ND 0.042
K-AMB-3	18-Aug-2004	REG	ND 0.19	0.67	ND 0.14	ND 0.069	ND 0.14	ND 0.17	ND 0.14	ND 0.24	ND 0.69	20	ND 0.044
K-AMB-3	24-Nov-2004	REG	ND 0.18	0.60	ND 0.13	ND 0.065	ND 0.13	0.22	ND 0.13	0.70	ND 0.65	0.36	ND 0.042
K-AMB-4	24-Nov-2004	REG	0.23	0.65	ND 0.13	ND 0.065	ND 0.13	0.26	0.19	2.2	ND 0.65	0.65	ND 0.042
K-OUT-1	18-Aug-2004	REG	ND 0.20	0.67	ND 0.15	ND 0.074	ND 0.15	ND 0.18	ND 0.15	ND 0.25	ND 0.74	1.9	ND 0.048
K-OUT-1	24-Nov-2004	REG	ND 0.18	0.59	ND 0.13	ND 0.065	ND 0.13	0.17	ND 0.13	0.55	ND 0.65	0.21	ND 0.042

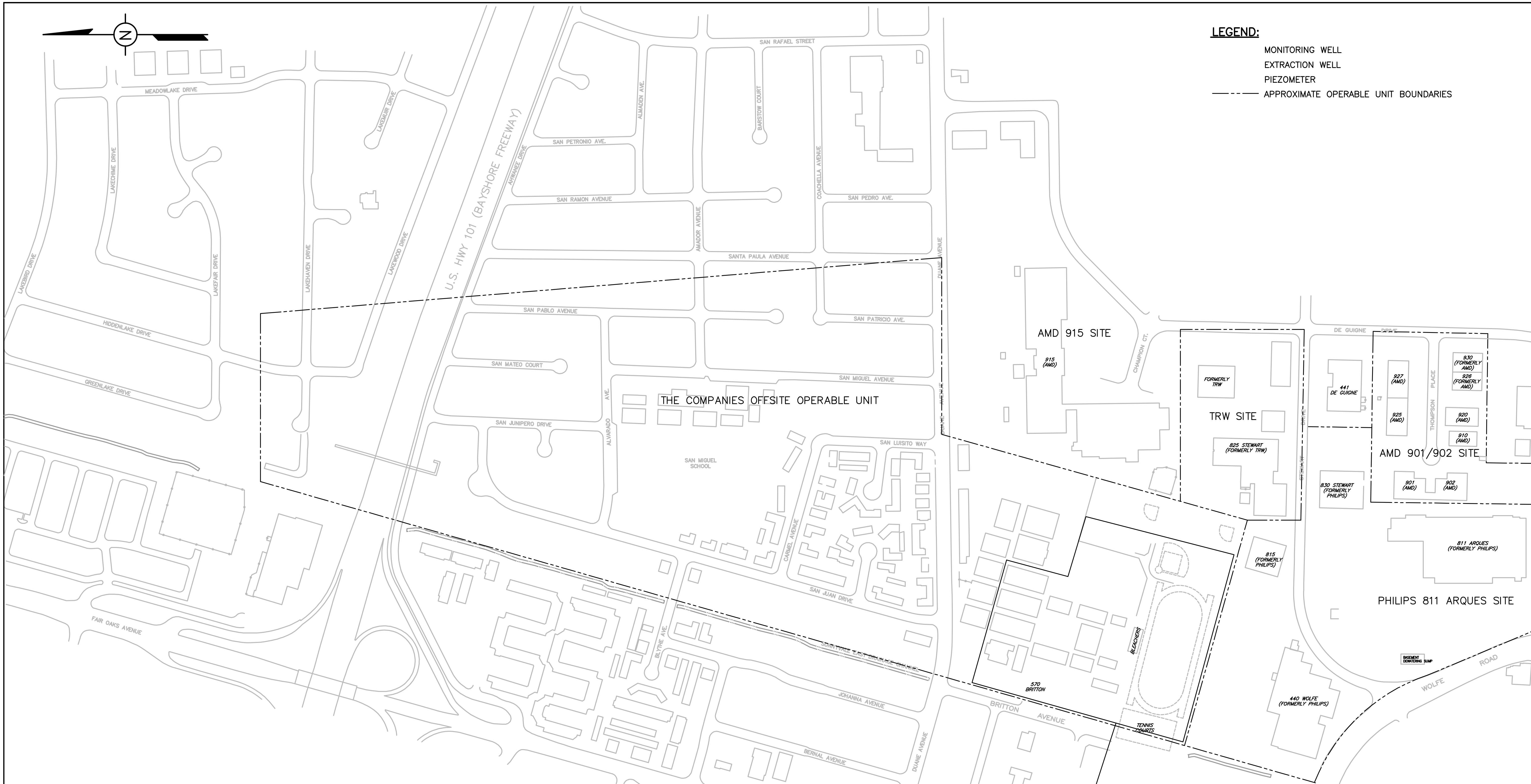
Notes:
ND - denotes result was below the detection limit
NT - sample not tested for the given parameter
* - denotes results were impacted by quality control issues

TABLE D-2
HISTORICAL INDOOR AIR ANALYTICAL DATA
562 NORTH BRITTON AVENUE, SUNNYVALE, CA

Location	Date	Parameter Units Sample Purpose	1,1,1-TRICHLORO-ETHANE µg/m3	FREON 113 µg/m3	1,1-DICHLORO-ETHANE µg/m3	1,1-DICHLORO-ETHENE µg/m3	1,2-DICHLORO-ETHANE µg/m3	CHLORO-FORM µg/m3	CIS-1,2-DICHLORO-ETHENE µg/m3	TETRA-CHLORO-ETHENE µg/m3	TRANS-1,2-DICHLORO-ETHENE µg/m3	TRI-CHLORO-ETHENE µg/m3	VINYL CHLORIDE µg/m3
M-AMB-1	18-Aug-2004	REG	ND 0.18	0.72	ND 0.13	ND 0.066	ND 0.13	0.19	ND 0.13	0.27	ND 0.66	0.30	ND 0.043
M-AMB-2	18-Aug-2004	REG	ND 0.20	0.75	ND 0.15	ND 0.072	ND 0.15	J 0.17	ND 0.14	ND 0.25	ND 0.72	0.22	ND 0.046
P-AMB-1	18-Aug-2004	REG	ND 0.18	0.73	ND 0.14	ND 0.068	ND 0.14	0.28	ND 0.14	0.23	ND 0.68	0.95	ND 0.044
P-AMB-2	18-Aug-2004	REG	ND 0.19	0.68	ND 0.14	ND 0.070	ND 0.14	0.40	ND 0.14	ND 0.24	ND 0.70	1.0	ND 0.045
Q-AMB-1	18-Aug-2004	REG	5.7	0.66	ND 0.14	ND 0.070	ND 0.14	0.25	ND 0.14	ND 0.24	ND 0.70	0.30	ND 0.045
Q-AMB-2	18-Aug-2004	REG	ND 0.20	0.69	ND 0.15	ND 0.072	ND 0.15	0.20	ND 0.14	ND 0.25	ND 0.72	0.45	ND 0.046
Q-AMB-3	18-Aug-2004	FD	0.53	0.67	ND 0.14	ND 0.069	ND 0.14	0.29	ND 0.14	0.30	ND 0.69	0.44	ND 0.044
Q-AMB-3	18-Aug-2004	REG	0.56	0.74	ND 0.14	ND 0.069	ND 0.14	0.33	ND 0.14	ND 0.24	ND 0.69	0.45	ND 0.044
Q-OUT-1	18-Aug-2004	REG	ND 0.20	0.71	ND 0.15	ND 0.072	ND 0.15	0.24	ND 0.14	ND 0.25	ND 0.72	0.52	ND 0.046

Notes:
ND - denotes result was below the detection limit
NT - sample not tested for the given parameter
* - denotes results were impacted by quality control issues

Locus TECHNOLOGIES



562 NORTH BRITTON AVENUE

SITE PLAN
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

REFERENCES:
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	26 JAN 07	ADDED WELLS 157A AND S157B1. DELETED SEALED WELLS S042A AND S042B1.	VZC	MMG	JWH
2	20 JAN 03	REMOVED SEALED WELLS S085A, S086A, S091A, G-3, A-6, G-1, G-5, M-1, S065A, S070A, S087A, and S089A.	JWH	JWH	JEB
1	28 JAN 00	ISSUED FOR REPORT	VZC	MJG	JEB

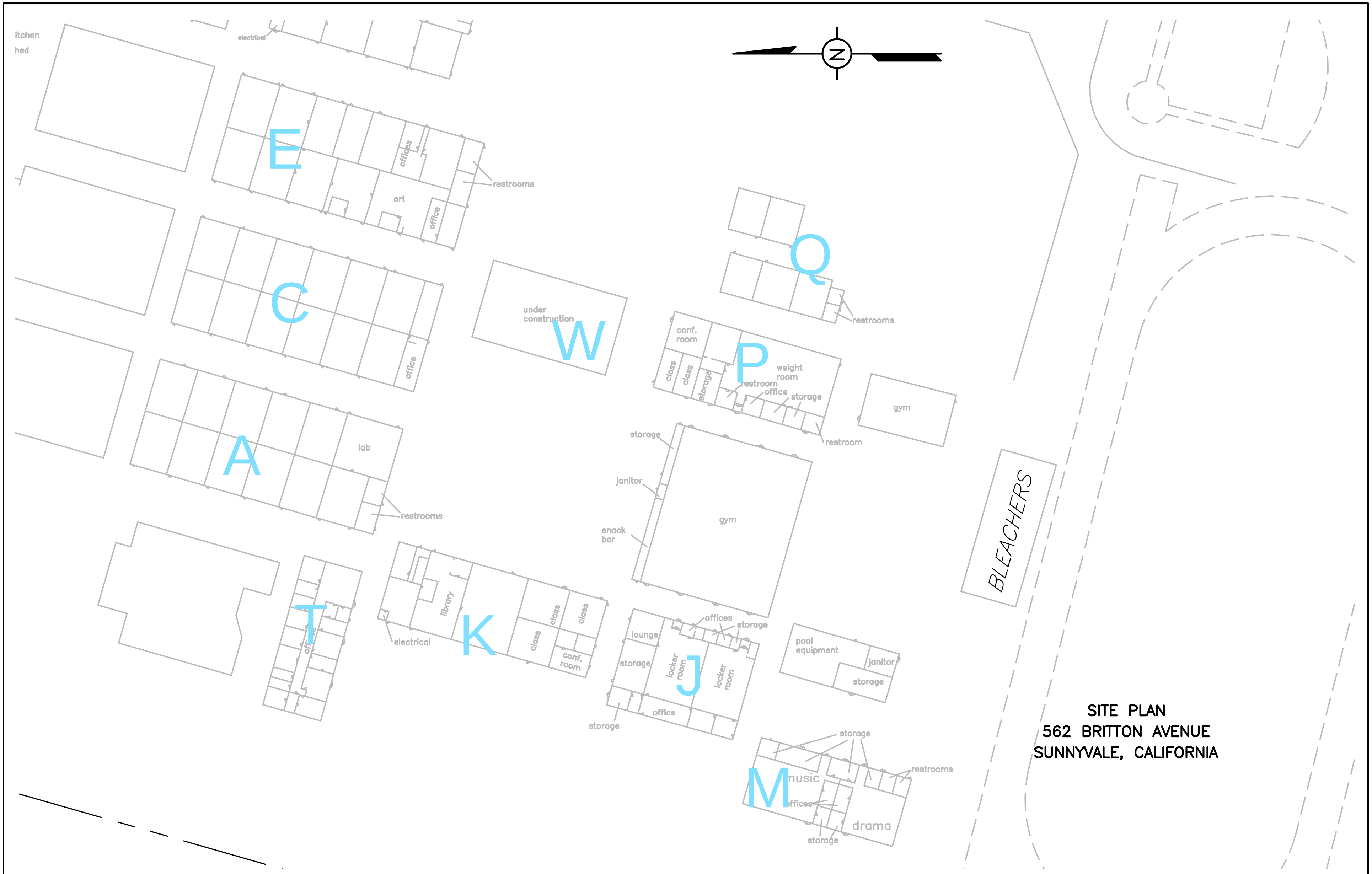
LOCUS TECHNOLOGIES

SCALE
200 0 200 400 FEET

DRAWING NO. 27-006-D1

FIGURE D-1

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan\Appendix D Site-specific work plan-562 Britton



No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR REPORT	VZC	JWH	JWH

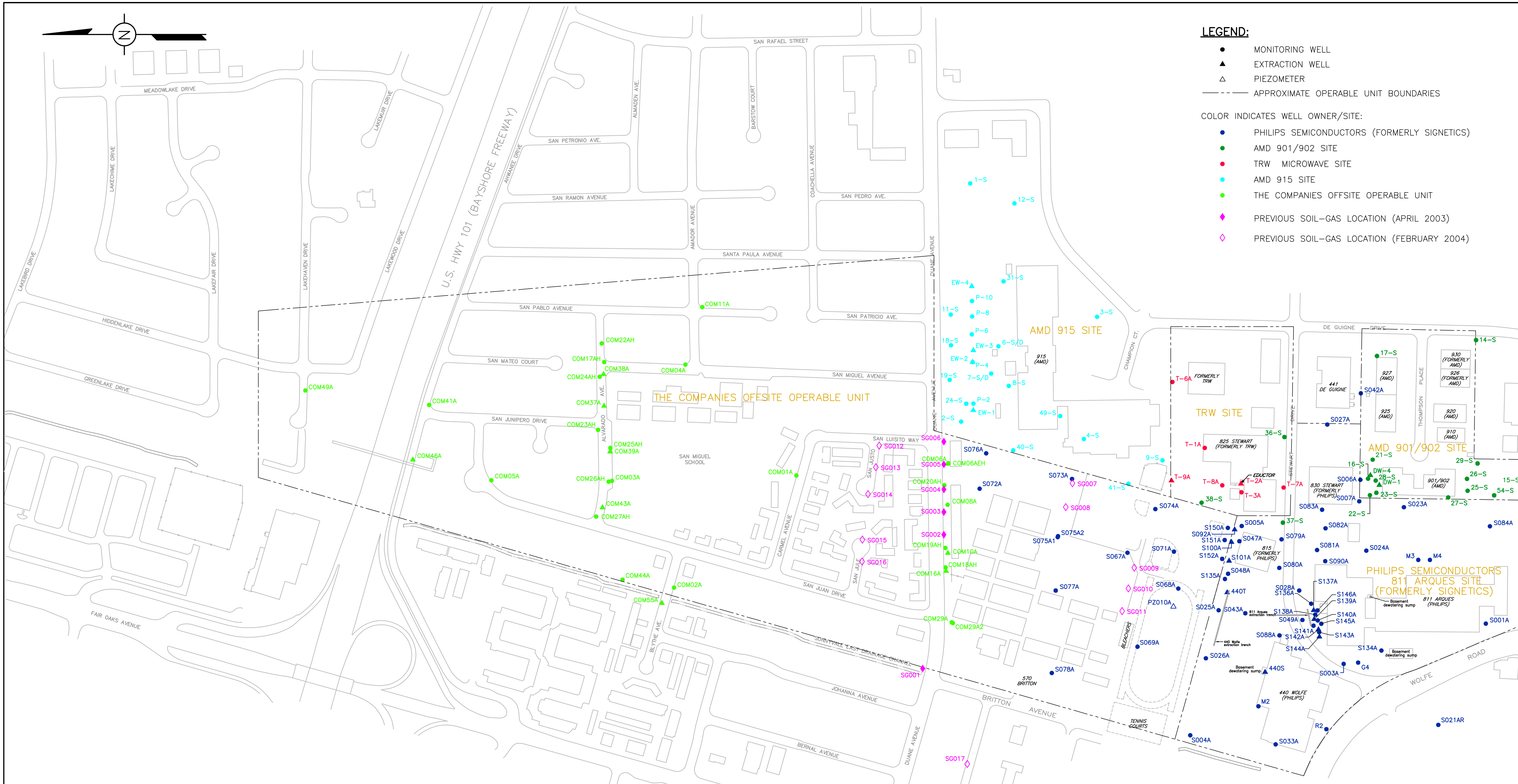
SCALE

100 0 100 FEET

DRAWING NO. 27–006–D2

FIGURE D–2

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan\Appendix D Site–specific work plan–562 Britton



HISTORICAL SOIL-GAS SAMPLE LOCATIONS

THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

REFERENCES:

1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
△	2-OCT-03	ISSUED FOR REPORT	JWH	JWH	JEB

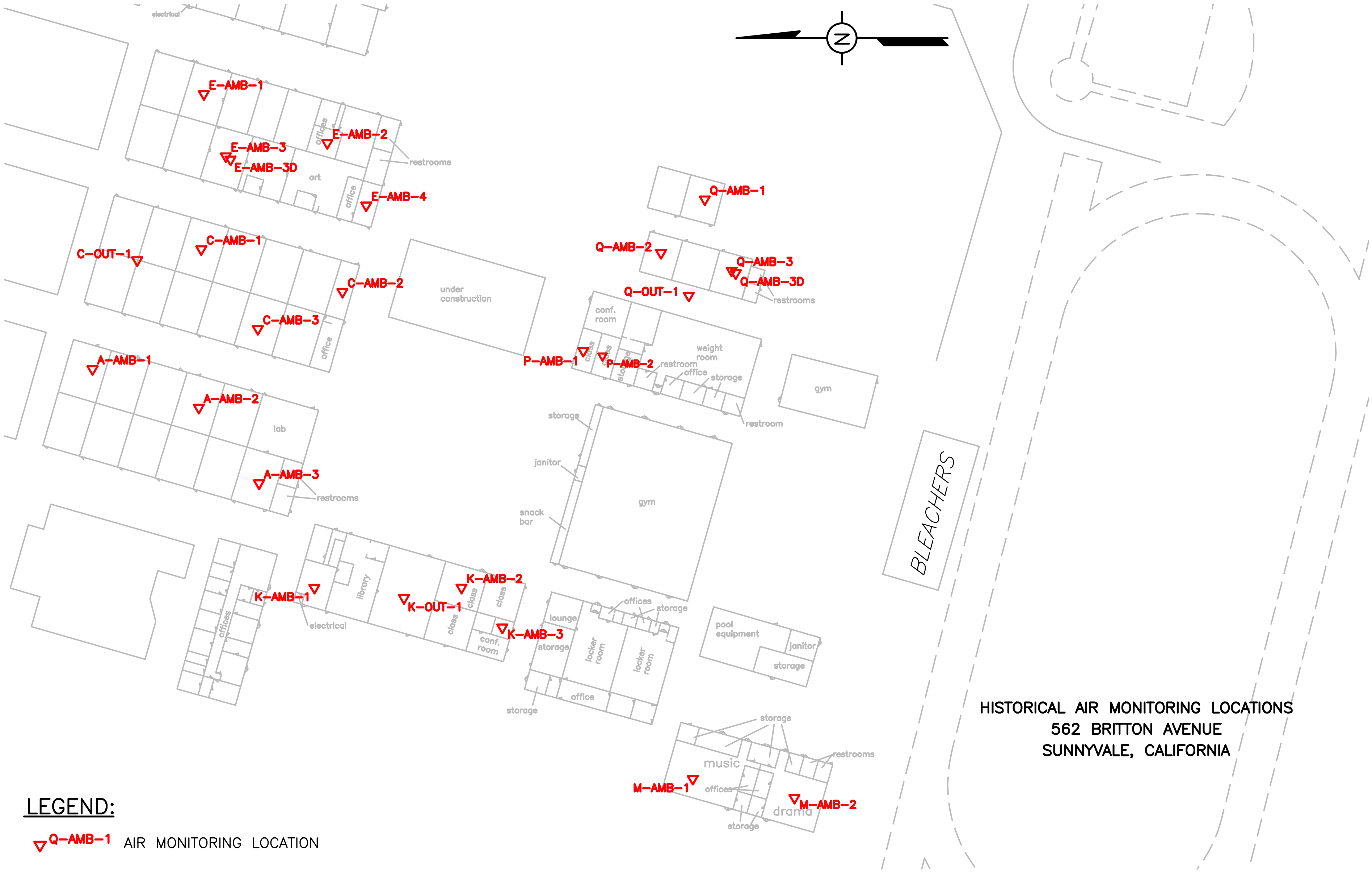
Locus TECHNOLOGIES

SCALE IN FEET
0 150 450

DRAWING NO. 27-006-C3

FIGURE D-3

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan



HISTORICAL AIR MONITORING LOCATIONS
562 BRITTON AVENUE
SUNNYVALE, CALIFORNIA

LEGEND:

▽ Q-AMB-1 AIR MONITORING LOCATION

SCALE

100 0 100 FEET

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR REPORT	VZC	JWH	JWH

Locus TECHNOLOGIES

DRAWING NO. 27-006-D4

FIGURE D-4

AIR MONITORING LOCATIONS
562 BRITTON AVENUE
SUNNYVALE, CALIFORNIA

LEGEND:

▽ PROPOSED AIR MONITORING LOCATION

* SAMPLE LOCATIONS MAY BE REVISED BASED ON BUILDING LAYOUTS OBTAINED FROM THE PROPERTY OWNER/TENANT

SCALE

100 0 100 FEET

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR REPORT	ND	JWH	JWH

Locus TECHNOLOGIES

DRAWING NO. 27-006-D5

FIGURE D-5

APPENDIX E

SITE-SPECIFIC WORK PLAN
794 EAST DUANE AVENUE

1 INTRODUCTION

This work plan provides additional site-specific details for the vapor intrusion investigation at 794 East Duane Avenue. This document is an appendix to the Work Plan for Additional Vapor Intrusion Investigation for the Companies Offsite Operable Unit (OOU) in Sunnyvale, California, and is subject to the terms, conditions and provisions of such Work Plan. General information on this investigation, including the investigation history of the site and general sampling procedures, is provided in the main Work Plan text.

2 INVESTIGATION HISTORY

A location map for 794 East Duane Avenue is provided in Figure E-1. Building layouts are not yet available for this property and will be obtained from the property owner so that sample locations can be selected. Historical soil-gas results are summarized in Table E-1.

In April 2003, a series of soil and soil-gas samples were collected to evaluate indoor air concerns within the OOU, as requested by the RWQCB. The samples were collected along Duane Avenue where the highest groundwater concentrations within the OOU are present and are evaluated using the Johnson-Ettinger model spreadsheet for soil-gas results. Results from this investigation were reported to the RWQCB in May 2003. Using the most current accepted methods, the evaluation of the soil-gas showed that volatilization from groundwater to indoor air was within the acceptable risk range (Locus, 2003). Additionally, the spatial trends in both soil-gas and groundwater concentrations indicated that there was minimal potential for vapor intrusion concerns at the 794 East Duane Avenue property. Concentrations of soil-gas and groundwater were much lower on this property compared to elsewhere at the OOU. All historical soil-gas sampling locations at the OOU are shown in Figure E-2. Historical soil-gas analytical results near 794 East Duane Avenue are summarized in Table E-1.

3 SAMPLING LOCATIONS

3.1 Pre-sampling Tasks

Indoor air at 794 East Duane Avenue was previously determined to be low risk for vapor intrusion concerns due to the level of contaminants in the groundwater below and therefore has not been previously sampled. The property includes three buildings. A building walkthrough will be conducted prior to indoor air sampling to collect information on building construction/design, building use, and building ventilation, if available, from the tenants and/or building owners. The survey form in Appendix A of the Work Plan will be used for this property. As a preliminary evaluation of other occupational sources, information on chemical usage and storage in the building, including material safety data sheets (MSDS), will also be obtained, if available. However, the MSDS forms may not be definitive as to the presence or absence of VOCs. Additional efforts to evaluate occupational sources may be implemented in a later phase of the project if additional sources are suspected as a result of air sampling. A building walkthrough will be scheduled with the tenants and/or owners as part of this information collection. The following items will be obtained during the walkthrough and other communication with the tenants and/or owners:

- Detailed building site plan.
- Identification of areas where the chemicals of interest were used or are present.
- Information on the foundation and base slab construction, where available, and ventilation systems' design and operation.

- Location of plumbing or piping systems, power conduits, communication conduits, sumps, or floor drains that penetrate the base slab.
- Detailed plans for any foundation treatments such as vapor barriers, lime treatment of sub-soils, fiber cement, additional reinforcing bars, or other measures that were incorporated into the base slab design and that might act as barriers to vapor intrusion or to minimize slab cracking.
- Locations of areas where the slab is accessible, and if possible, locate areas where the floor is cracked or seamed.
- Determination of where, if anywhere, elevated VOC levels are detected in the ground floor air through the use of an organic vapor analyzer or photo ionization detector.

Based on the building survey results, potential sample locations will be identified. A site map displaying all buildings at the property will be assembled. Proposed locations will then be submitted to EPA prior to sampling.

3.2 Indoor/Outdoor Sample Collection

Air samples will be collected in three buildings at the 794 East Duane Avenue in Buildings B, D and F (refer to Figure E-1). Using the results of the building survey, and emphasizing the areas near base slab penetrations, floor cracks or seams, and areas where VOCs may have been present from past use, locations will be selected for the collection of a minimum of one indoor air sample at each building selected for sampling. In addition, all preferential pathways will be evaluated, and then a representative subset of locations will be selected for sampling.

The air sampling will be representative of inhalation exposure point concentrations for the occupants of the buildings (primarily preschoolers). Indoor air samples will be collected at approximately 2 feet above floor level, which approximates breathing zone elevation for occupants of these buildings. Initial sampling will be conducted with active HVAC for a 12-hour period from 6AM to 6PM, which are the normal occupancy hours for these buildings. The HVAC system will be maintained in normal weekday operating mode during sampling to most accurately reflect normal exposure conditions.

To evaluate the potential for subsurface vapor intrusion into buildings without reliance on the ventilation system, a second round of sampling will be conducted with all HVAC systems shut down (assuming concurrence by property owner and occupants). For HVAC-off sampling, sample collection will begin 24 hours following shut-down of the building ventilation systems and continue while HVAC systems remain off. This HVAC-off condition represents a reasonable maximum exposure scenario and is not representative of the normal exposure condition in the buildings. Second round samples will be collected over a 24-hour period (approximately 6PM to 6PM the next day) using passive samplers per EPA guidance.

4 SCHEDULE

The schedule for all work plan activities will be set after approval of the work plan is received from EPA. Work will proceed as follows, with estimated time of completion dependent on response from EPA and the property owners/occupants. Since sampling access has already been arranged for this property, sampling can proceed on an accelerated schedule.

- Contact will be established with building occupants to arrange access and pre-sampling walkthroughs (estimated November 2014).
- Proposed sample locations will be submitted to EPA (estimated December 2014).
- Samples will be collected (estimated December 2014).
- Analysis of samples will be completed (estimated January 2015). Notification to EPA will occur within 48 hours of receipt of results that exceed the short-term screening levels.
- The final report will be submitted to the EPA within 30 days of completion of data review (estimated February 2015).

The project task schedule is contingent on EPA approval of this Work Plan and the proposed sample locations at least 30 days before sampling is scheduled, so that appropriate coordination with building owners and occupants can be arranged, and sampling equipment can be procured. Detailed schedule of the sampling events will be provided through a web-based calendar, which will be accessible to EPA for updating in real time. This schedule may also be revised as needed to accommodate requests from the property owner or occupants (*e.g.* to arrange sampling when the building will not be in use).

TABLE E-1
HISTORICAL SOIL-GAS ANALYTICAl DATA
790 EAST DUANE AVENUE, SUNNYVALE, CALIFORNIA

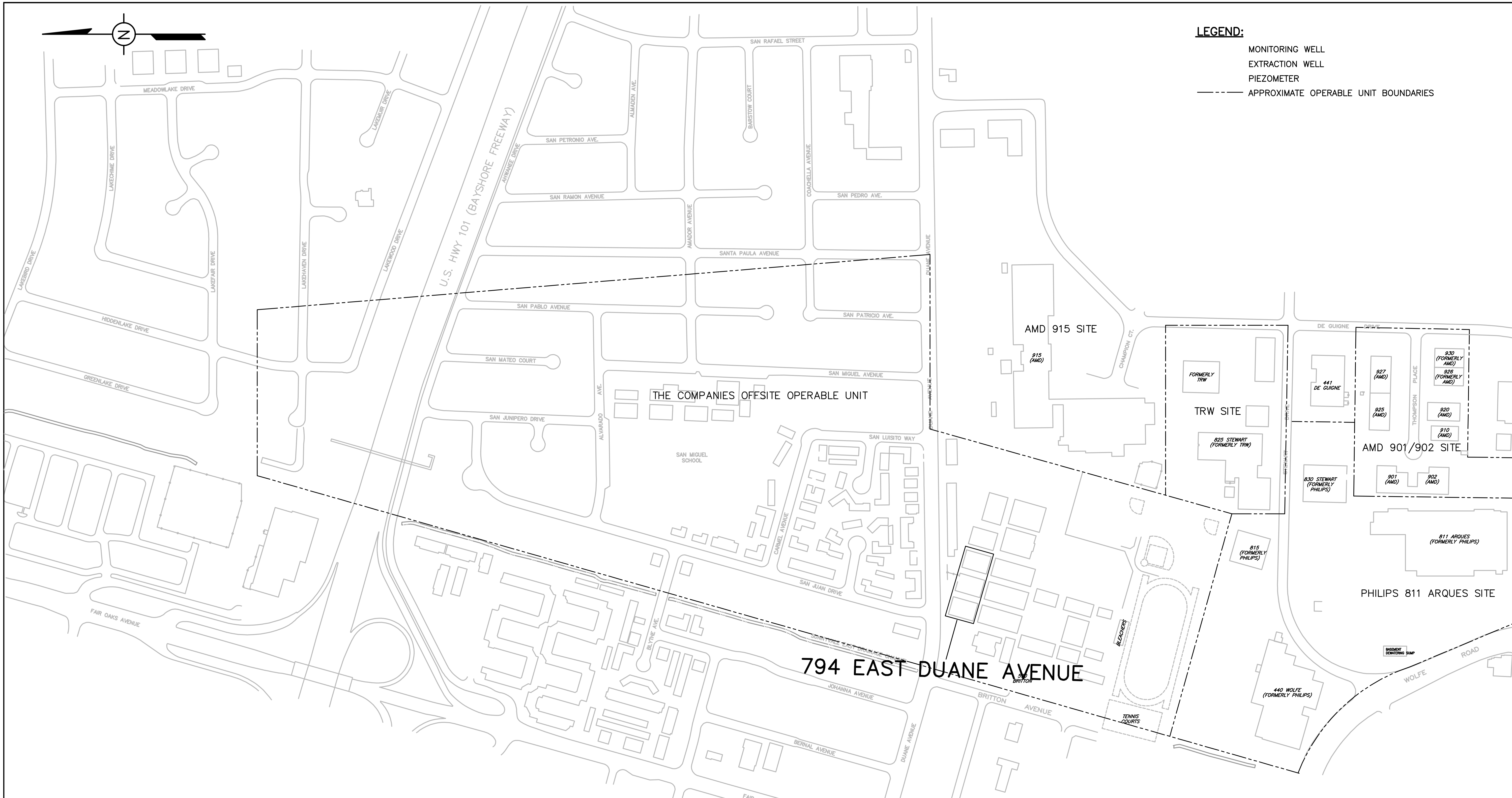
Parameter	Location Date Sample Purpose Units	SG001 4/17/2003 REG	SG002 4/17/2003 REG	SG003 4/17/2003 FD	SG003 4/17/2003 REG	SG004 4/17/2003 REG	SG005 4/17/2003 REG	SG006 4/17/2003 REG
1,1,1-Trichloroethane (TCA)	µg/m3	ND 4.9	ND 5.4	5.0	5.0	9.9	97	ND 5.0
1,1,2-Trichlorotrifluoroethane (CFC 113)	µg/m3	5.9	ND 6.5	ND 6.2	ND 6.2	ND 12	ND 120	ND 6.0
1,1-Dichloroethane (1,1-DCA)	µg/m3	ND 3.1	ND 3.4	ND 3.2	ND 3.2	ND 6.2	ND 61	ND 3.1
1,1-Dichloroethene (1,1-DCE)	µg/m3	ND 3.1	ND 3.4	ND 3.2	ND 3.2	ND 6.2	ND 61	ND 3.1
1,2-Dichloroethane	µg/m3	ND 2.5	ND 2.7	ND 2.6	ND 2.6	ND 5.0	ND 49	ND 2.5
Chloroform	µg/m3	ND 4.2	ND 4.6	ND 4.4	ND 4.4	8.6	ND 84	ND 4.3
cis-1,2-Dichloroethene	µg/m3	ND 3.8	ND 4.2	ND 3.9	ND 3.9	7.7	75	ND 3.8
Tetrachloroethene (PCE)	µg/m3	ND 3.4	3.7	3.5	3.5	6.8	67	3.4
trans-1,2-Dichloroethene	µg/m3	ND 3.1	ND 3.4	ND 3.2	ND 3.2	ND 6.4	ND 62	ND 3.2
Trichloroethene (TCE)	µg/m3	4.2	4.6	4.4	4.4	8.6	84	4.3
Vinyl Chloride	µg/m3	ND 2.0	ND 2.2	ND 2.0	ND 2.0	ND 4.0	ND 39	ND 2.0

Notes:

ND - denotes result was below the detection limit

NT - sample not tested for the given parameter

Locus TECHNOLOGIES



SITE PLAN
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

REFERENCES:
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	26 JAN 07	ADDED WELLS 157A AND S157B1. DELETED SEALED WELLS S042A AND S042B1.	VZC	MMG	JWH
2	20 JAN 03	REMOVED SEALED WELLS S085A, S086A, S091A, G-3, A-6, G-1, G-5, M-1, S065A, S070A, S087A, and S089A.	JWH	JWH	JEB
1	28 JAN 00	ISSUED FOR REPORT	VZC	MJG	JEB

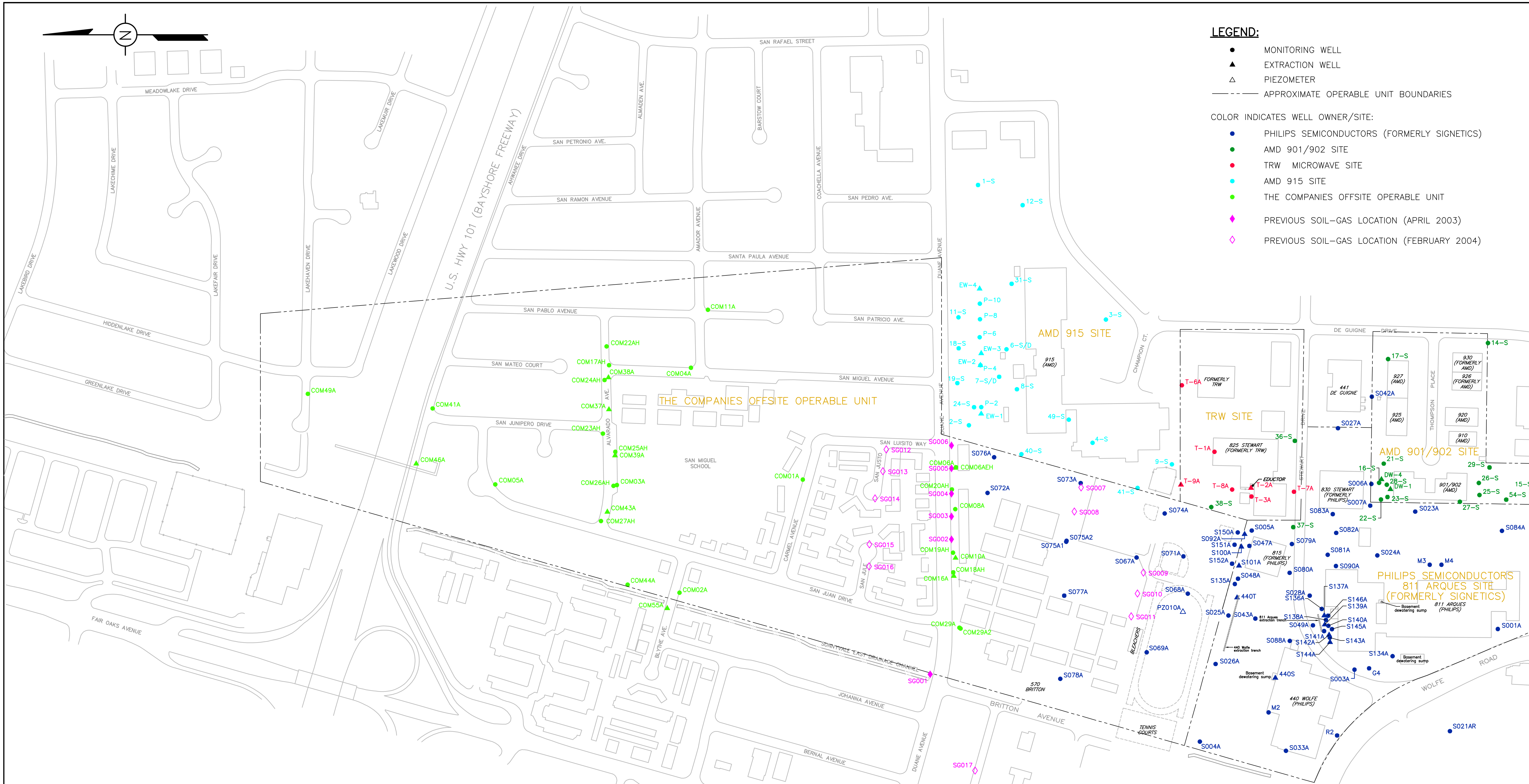
LOCUS TECHNOLOGIES

SCALE
200 0 200 400 FEET

DRAWING NO. 27-006-E1

FIGURE E-1

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan\Appendix E Site-specific work plan-794 Duane



HISTORICAL SOIL-GAS SAMPLE LOCATIONS

THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

REFERENCES:
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
△	2-OCT-03	ISSUED FOR REPORT	JWH	JWH	JEB

Locus TECHNOLOGIES

SCALE IN FEET
0 150 450

DRAWING NO. 27-006-C3

FIGURE E-2

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan

APPENDIX F

SITE-SPECIFIC WORK PLAN
777 SAN MIGUEL AVENUE

1 INTRODUCTION

This work plan provides additional site-specific details for the vapor intrusion investigation at 777 San Miguel Avenue. This document is an appendix to the Work Plan for Additional Vapor Intrusion Investigation for the Companies Offsite Operable Unit (OOU) in Sunnyvale, California, and is subject to the terms, conditions and provisions of such Work Plan. General information on this investigation, including the investigation history of the site and general sampling procedures, is provided in the main Work Plan text.

A location map for San Miguel Elementary School is provided in Figure F-1. Building layouts are not yet available for this property and will be obtained from the property owner so that sample locations can be selected. Indoor air has not been sampled at this property.

2 SAMPLING LOCATIONS

2.1 Pre-sampling Tasks

Indoor air at777 San Miguel Avenue was previously determined to be low risk for vapor intrusion concerns due to the level of contaminants in the groundwater below and therefore has not been previously sampled. The property includes ten buildings. A building walkthrough will be conducted prior to indoor air sampling to collect information on building construction/design, building use, and building ventilation, if available, from the tenants and/or building owners. The survey form in Appendix A of the Work Plan will be used for this property. As a preliminary evaluation of other occupational sources, information on chemical usage and storage in the building, including material safety data sheets (MSDS), will also be obtained, if available. However, the MSDS forms may not be definitive as to the presence or absence of VOCs. Additional efforts to evaluate occupational sources may be implemented in a later phase of the project if additional sources are suspected as a result of air sampling. A building walkthrough will be scheduled with the tenants and/or owners as part of this information collection. The following items will be obtained during the walkthrough and other communication with the tenants and/or owners:

- Detailed building site plan.
- Identification of areas where the chemicals of interest were used or are present.
- Information on the foundation and base slab construction, where available, and ventilation systems' design and operation.

- Location of plumbing or piping systems, power conduits, communication conduits, sumps, or floor drains that penetrate the base slab.
- Detailed plans for any foundation treatments such as vapor barriers, lime treatment of sub-soils, fiber cement, additional reinforcing bars, or other measures that were incorporated into the base slab design and that might act as barriers to vapor intrusion or to minimize slab cracking.
- Locations of areas where the slab is accessible, and if possible, locate areas where the floor is cracked or seamed.
- Determination of where, if anywhere, elevated VOC levels are detected in the ground floor air through the use of an organic vapor analyzer or photo ionization detector.

Based on the building survey results, potential sample locations will be identified. A site map displaying all buildings at the property will be assembled. Proposed locations will then be submitted to EPA prior to sampling.

2.2 Indoor/Outdoor Sample Collection

Air samples will be collected in ten buildings at 777 San Miguel Avenue (refer to Figure F-1). Using the results of the building survey, and emphasizing the areas near base slab penetrations, floor cracks or seams, and areas where VOCs may have been present from past use, locations will be selected for the collection of a minimum of one indoor air sample at each building selected for sampling. In addition, all preferential pathways will be evaluated, and then a representative subset of locations will be selected for sampling.

The air sampling will be representative of inhalation exposure point concentrations for the occupants of the buildings (primarily elementary school students). Indoor air samples will be collected at approximately 3 feet above floor level, which approximates breathing zone elevation for occupants of these buildings. Initial sampling will be conducted with active HVAC for an 8-hour period from 7:30AM to 3:30PM, which are the normal occupancy hours for these buildings. The HVAC system will be maintained in normal weekday operating mode during sampling to most accurately reflect normal exposure conditions.

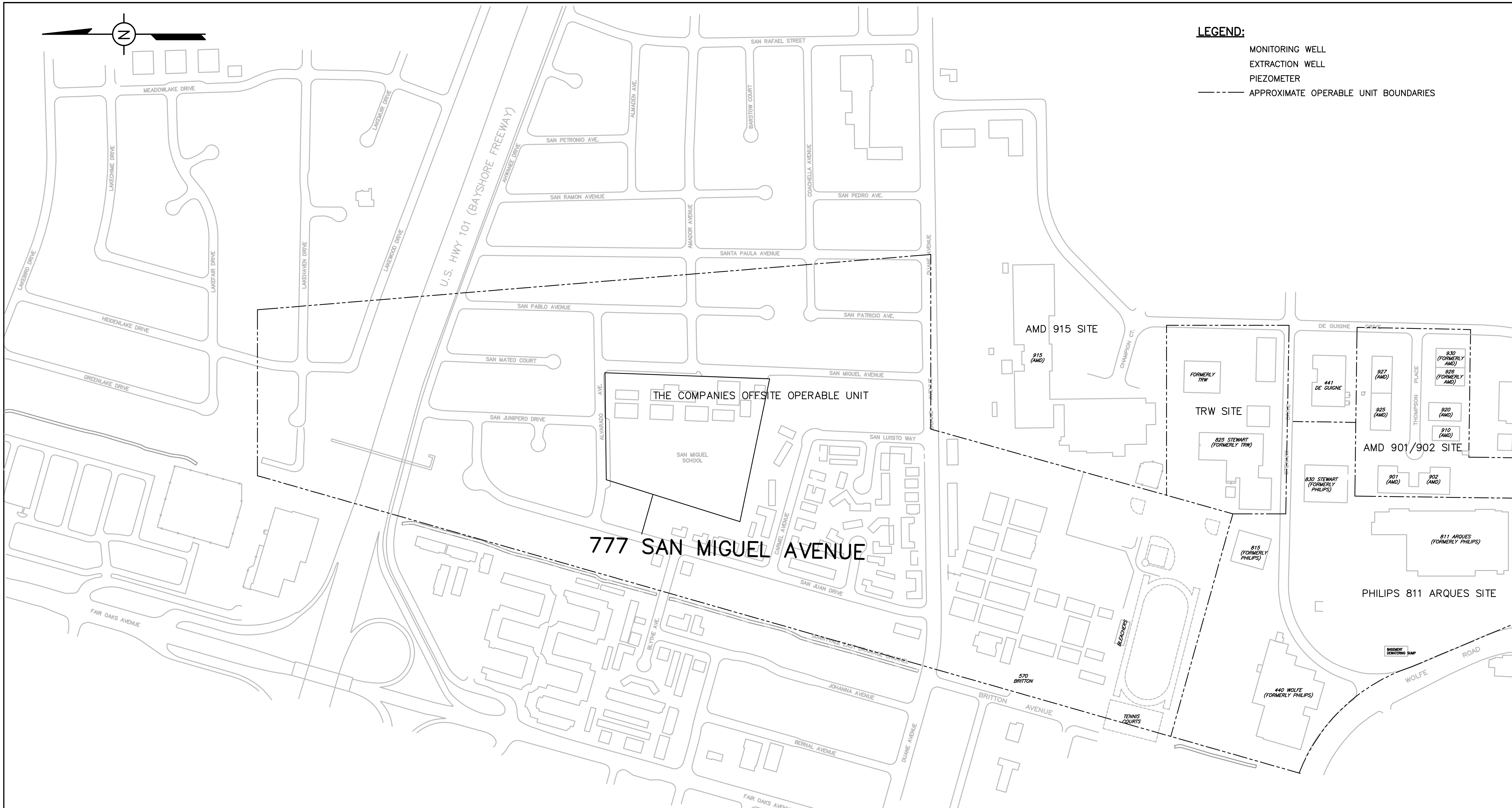
To evaluate the potential for subsurface vapor intrusion into buildings without reliance on the ventilation system, a reasonable maximum exposure scenario, a second round of sampling will be conducted with all HVAC systems shut down (assuming concurrence by property owner and occupants). For HVAC-off sampling, sample collection will begin 24 hours following shut-down of the building ventilation systems and continue while HVAC systems remain off. This HVAC-off condition represents a reasonable maximum scenario and is not representative of the normal exposure condition in the buildings. Second round samples will be collected over a 24-hour period (approximately 6PM to 6PM the next day) using passive samplers per EPA guidance.

3 SCHEDULE

The schedule for all work plan activities will be set after approval of the work plan is received from EPA. Work will proceed as follows, with estimated time of completion dependent on response from EPA and the property owners/occupants.

- Contact will be established with building occupants to arrange access and pre-sampling walkthroughs (estimated November 2014).
- Proposed sample locations will be submitted to EPA (estimated December 2014).
- Samples will be collected (estimated December 2014).
- Analysis of samples will be completed (estimated January 2015). Notification to EPA will occur within 48 hours of receipt of results that exceed the short-term screening levels.
- The final report will be submitted to the EPA within 30 days of completion of data review (estimated February 2015).

The project task schedule is contingent on EPA approval of this Work Plan and the proposed sample locations at least 30 days before sampling is scheduled, so that appropriate coordination with building owners and occupants can be arranged, and sampling equipment can be procured. Detailed schedule of the sampling events will be provided through a web-based calendar, which will be accessible to EPA for real-time updates. This schedule may also be revised as needed to accommodate requests from the property owner or occupants (*e.g.* to arrange sampling when the building will not be in use).



SITE PLAN
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

REFERENCES:
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	26 JAN 07	ADDED WELLS 157A AND S157B1. DELETED SEALED WELLS S042A AND S042B1.	VZC	MMG	JWH
2	20 JAN 03	REMOVED SEALED WELLS S085A, S086A, S091A, G-3, A-6, G-1, G-5, M-1, S065A, S070A, S087A, and S089A.	JWH	JWH	JEB
1	28 JAN 00	ISSUED FOR REPORT	VZC	MJG	JEB

Locus TECHNOLOGIES

SCALE 200 0 200 400 FEET

DRAWING NO. 27-006-F1

FIGURE F-1

I:\Projects\P\Philips\OOU\Indoor Air\Work Plan\Sep 2014 Work Plan\Appendix F Site-specific work plan-777 San Miguel

APPENDIX G

SITE-SPECIFIC WORK PLAN
RESIDENTIAL BUILDINGS

1 INTRODUCTION

This document is an appendix to the Work Plan for Additional Vapor Intrusion Investigation for the Companies Offsite Operable Unit (OOU) in Sunnyvale, California, and is subject to the terms, conditions and provisions of such Work Plan. This work plan provides additional site-specific details for the vapor intrusion investigation at residential structures within the OOU. General information on this investigation, including the investigation history of the site and general sampling procedures for the entire OOU, is provided in the main Work Plan text.

2 INVESTIGATION HISTORY

A location map that identifies all residential buildings within the OOU is included in Figure G-1. Previous investigations have been conducted in this area to address vapor intrusion concerns. In April 2003, a series of soil and soil-gas samples were collected, as requested by the RWQCB (SG001 to SG006 on Figure G-2). The samples were collected along Duane Avenue where the highest groundwater concentrations within the OOU are present and were evaluated using the Johnson-Ettinger model spreadsheet for soil-gas results. Results from this investigation were reported to the RWQCB in May 2003. The evaluation of the soil-gas showed that volatilization from groundwater to indoor air was within the acceptable risk range (Locus, 2003). Additionally, the spatial trends in both soil-gas and groundwater concentrations indicated that there was minimal potential for vapor intrusion concerns within the residential area of OOU.

In February 2004, another set of five soil-gas samples were collected from within the residential area of OOU (SG012 to SG016 on Figure G-2), along with an additional location in the residential area outside the groundwater plume for comparison (SG017). These samples were collected beneath paved areas in order to best represent the concentrations that could accumulate underneath buildings. Soil-gas concentrations at these locations were very low, with TCE only detected at one location (SG016) at 6.2 µg/m^3. TCE was below detection at all other locations. Through comparison to screening levels and evaluation of the data using the Johnson-Ettinger model, these soil-gas concentrations were found to not present a significant vapor intrusion concern.

All historical soil-gas sampling locations at the OOU are shown in Figure G-2. Historical soil-gas analytical results within the residential area of OOU are provided in Table G-1.

3 SAMPLING LOCATIONS

3.1 Pre-sampling Tasks

Indoor air within the residential area of OOU was previously determined to be low risk for vapor intrusion concerns due to the very low concentrations in soil-gas in this area. Therefore, indoor air in these buildings has not been previously sampled. The area includes 88 residential buildings located within the 5 µg/L groundwater contour in the "A" aquifer as of the fourth quarter 2013 groundwater sampling event. The area includes apartment buildings, townhomes, duplexes, and single-family homes. San Miguel Elementary School is also located within this area, but is addressed in a separate work plan. A map of this area with current usage of the structures is provided as Figure G-1. Building layouts are not yet available for these properties and will be obtained from the property owners, if available. If not available, a sketch of the building layout will be prepared so that sample locations can be selected.

For each residential building being evaluated, a building walkthrough will be conducted prior to indoor air sampling to collect information on building construction/design, building use, and building ventilation (if available), from the tenants and/or building owners. The survey form in Appendix B of the Work Plan will be used for these properties. As a preliminary evaluation of other occupational sources, information on chemical usage and storage in the building will also be obtained, if available. Additional efforts to evaluate occupational sources may be implemented in a later phase of the project if additional sources are suspected as a result of air sampling. A building walkthrough will be scheduled with the tenants and/or owners as part of this information collection. The following items will be requested during the walkthrough and other communication with the tenants and/or owners:

- Building site plan, if available.
- Identification of areas where the chemicals of interest were used or are present.
- Information on the foundation and base slab construction, where available, and ventilation systems' design and operation.
- Location of plumbing or piping systems, power conduits, communication conduits, sumps, or floor drains that penetrate the base slab.
- Locations of areas where the slab is accessible, and if possible, locate areas where the floor is cracked or seamed.
- Determination of where, if anywhere, elevated VOC levels are detected in the ground floor air through the use of an organic vapor analyzer or photo ionization detector.

3.1.1 Sample Location Selection

Based on the building survey results, potential sample locations will be identified. In order to accelerate the start of sampling, a tiered approach will be used to selecting buildings for sampling, based on the most recent groundwater TCE contours in the "A" aquifer (Figure 3 of the work plan). Structures that fall within the 100 µg/L contour will be approached first, as these are expected to have the highest potential for vapor intrusion concerns. Other structures located outside the 100 µg/L contour but within the 5 µg/L contour will also be evaluated for sampling, but priority will be given to the structures located above higher groundwater concentrations.

Air samples will be collected in buildings that meet the following criteria:

- Groundwater concentrations of TCE from the latest sampling event are greater than 5 micrograms per liter. This is the defined vapor intrusion study area.
- Access is granted to complete all tasks specified in the work plan, including pre-sampling inspections, sample collection, and mitigation options if needed. These access rights are required in order to properly interpret the data and take appropriate follow-up actions.
- Based on pre-sampling survey results, there are no sources of chemicals of concern within the building. If possible, chemical sources can be temporarily removed from the building a minimum of two weeks before sampling. However, if this is not possible, sampling of indoor air would not yield useful results. Pathway sampling may be possible, but only if it can be determined that the indoor sources would not affect the pathway sample results.
- The building has enclosed and occupied areas directly above the slab or crawlspace. Buildings with carports on the first floor are not expected to have vapor intrusion concerns.

For buildings that meet these criteria, sample locations will be selected and submitted to EPA prior to sampling. Sample locations will generally be selected using the results of the building survey, and emphasizing the areas near base slab penetrations, floor cracks or seams, and areas where VOCs may have been present from past use. A minimum of one indoor air sample will be selected for each building identified for sampling. If the building has a crawlspace or other subfloor area where a sample could be collected, a pathway sample will be collected from that area.

3.2 Sample Collection

A minimum of one indoor air sample will be collected from each residence, while one outdoor air sample will be collected per five residences. The indoor air sampling will be representative of inhalation exposure point concentrations for the occupants of the buildings (primarily adults). Indoor air samples will be collected at approximately 5 feet above floor level. Samples will be collected over a 24-hour period (approximately 6PM to 6PM the next day) using passive samplers per EPA guidance. If an active ventilation system is installed in the building, it will remain in normal operation during the first sampling event. If the ventilation system can be disabled without adversely affecting the occupant (and subject to approval by the owner/occupant), a second round of samples will be collected without active ventilation, after the system has been off for a minimum of 24 hours.

4 SCHEDULE

The schedule for all work plan activities will be set after approval of the work plan is received from EPA. Work will proceed as follows, with estimated time of completion dependent on response from EPA and the property owners/occupants:

- Contact will be established with building owners and occupants to arrange access and pre-sampling walkthroughs for buildings within 100 µg/L groundwater contour (estimated November 2014).
- Proposed sample locations will be submitted to EPA (estimated December 2014).
- Contact will be established with building owners and occupants to arrange access and pre-sampling walkthroughs for buildings within 5 µg/L groundwater contour (estimated December 2014). EPA will participate in residence walkthroughs.
- Samples will be collected (estimated December 2014-January 2015).
- Analysis of samples will be completed (estimated February 2015). Notification to EPA will occur within 48 hours of receipt of results that exceed the short-term screening levels.
- The final report will be submitted to the EPA within 30 days of completion of data review (estimated March 2015).

The project task schedule is contingent on EPA approval of this Work Plan and the proposed sample locations at least 30 days before sampling is scheduled, so that appropriate coordination with building owners and occupants can be arranged, and sampling equipment can be procured. Detailed schedule of the sampling events will be provided through a web-based calendar, which will be accessible to EPA for real-time updates. This schedule may also be revised as needed to accommodate requests from the property owner or occupants (*e.g.* to arrange sampling when the building will not be in use).

TABLE G-1
HISTORICAL SOIL GAS ANALYTICAL DATA
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

Parameter	Location Sample Date Sample Purpose Units	SG001 4/17/2003 REG	SG002 4/17/2003 REG	SG003 4/17/2003 FD	SG003 4/17/2003 REG	SG004 4/17/2003 REG	SG005 4/17/2003 REG	SG006 4/17/2003 REG
1,1,1-Trichloroethane (TCA)	µg/m3	16	17	25	22	0.13	26	16
1,1,2-Trichlorotrifluoroethane (CFC 113)	µg/m3	279	234	223	220	0.92	226	224
1,1-Dichloroethane (1,1-DCA)	µg/m3	50	53	50	49	0.054	51	50
1,1-Dichloroethene (1,1-DCE)	µg/m3	26	27	26	26	0.060	26	26
1,2-Dichloroethane	µg/m3	27	28	27	26	0.082	27	27
Chloroform	µg/m3	81	86	81	80	0.12	83	82
cis-1,2-Dichloroethene	µg/m3	40	42	40	40	0.15	70	41
Tetrachloroethene (PCE)	µg/m3	44	52	121	44	0.90	48	49
trans-1,2-Dichloroethene	µg/m3	130	136	130	128	0.075	132	131
Trichloroethene (TCE)	µg/m3	1923	1565	2414	2262	7.1	3515	1191
Vinyl Chloride	µg/m3	9.3	9.8	9.3	9.2	0.058	9.4	9.4

Notes:

ND - denotes result was below the detection limit

NT - sample not tested for the given parameter

Locus TECHNOLOGIES

TABLE G-1
HISTORICAL SOIL GAS ANALYTICAL DATA
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

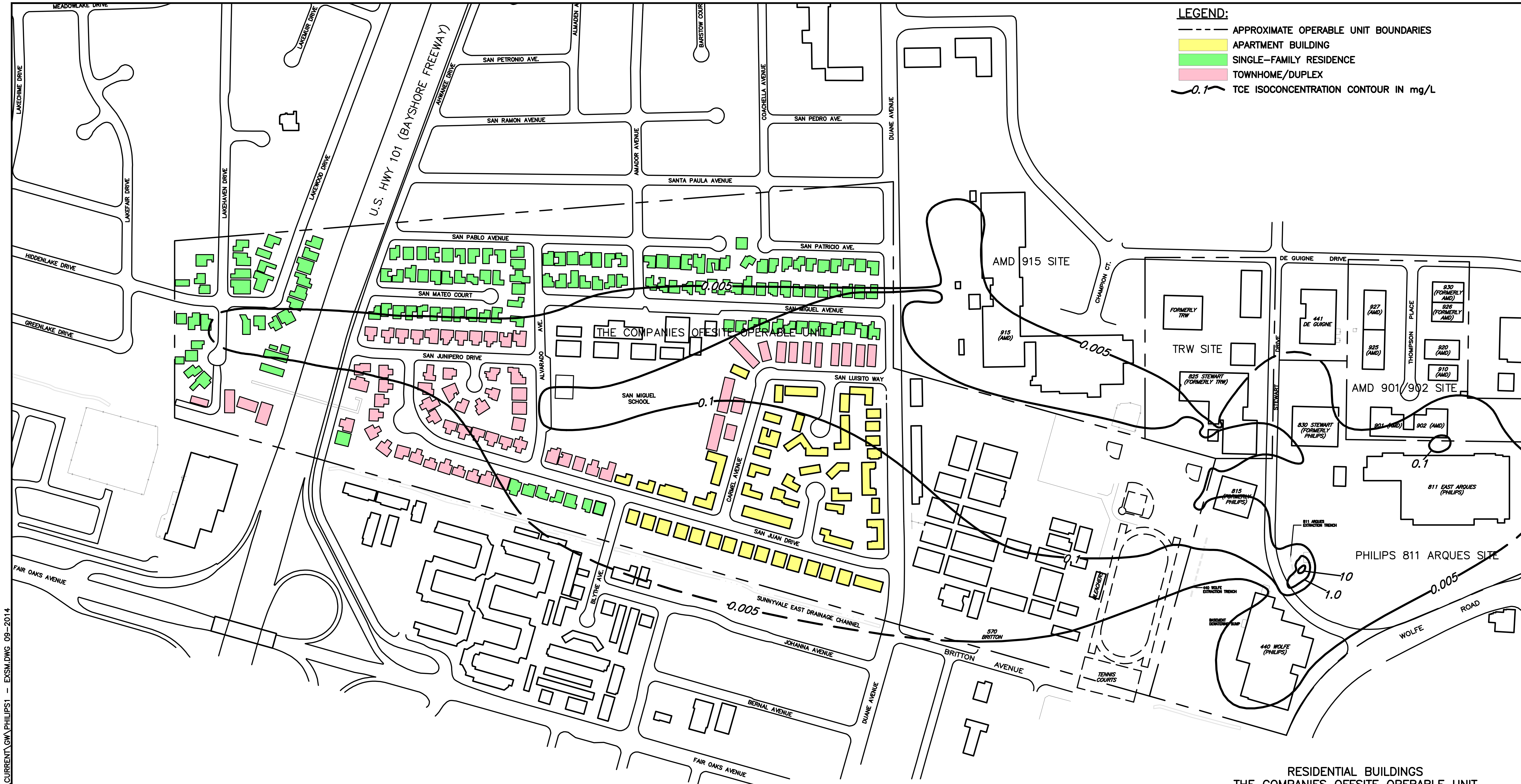
Parameter	Location / Date / Sample Purpose / Units	SG012	SG013	SG014	SG015	SG016	SG017	SG017
	Date	2/4/2004	2/4/2004	2/4/2004	2/4/2004	2/4/2004	2/4/2004	2/4/2004
	Sample Purpose	REG	REG	REG	REG	REG	FD	REG
	Units							
1,1,1-Trichloroethane (TCA)	µg/m3	4.3	4.5	4.5	4.5	4.9	4.5	4.5
1,1,2-Trichlorotrifluoroethane (CFC 113)	µg/m3	6.0	6.4	6.4	6.3	6.3	6.3	6.3
1,1-Dichloroethane (1,1-DCA)	µg/m3	3.2	3.4	3.4	3.3	3.3	3.3	3.3
1,1-Dichloroethene (1,1-DCE)	µg/m3	3.1	3.3	3.3	3.2	3.2	3.2	3.2
1,2-Dichloroethane	µg/m3	3.2	3.4	3.4	3.3	3.3	3.3	3.3
Chloroform	µg/m3	3.8	4.1	4.1	4.0	4.0	4.0	4.0
cis-1,2-Dichloroethene	µg/m3	3.1	3.3	3.3	3.2	3.2	3.2	3.2
Tetrachloroethene (PCE)	µg/m3	5.3	5.6	5.6	5.6	5.6	5.6	5.6
trans-1,2-Dichloroethene	µg/m3	12	13	13	13	13	13	13
Trichloroethene (TCE)	µg/m3	4.2	4.5	4.5	4.4	6.2	4.4	4.4
Vinyl Chloride	µg/m3	2.0	2.1	2.1	2.1	2.1	2.1	2.1

Notes:

ND - denotes result was below the detection limit

NT - sample not tested for the given parameter

Locus TECHNOLOGIES



RESIDENTIAL BUILDINGS
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
2	09/14	ADDITIONAL BLDGS ADDED TO PLAN	AJK	WJH	WJH
1	09/13	ADDITIONAL BLDGS ADDED TO PLAN	AJK	ND	ND

Locus TECHNOLOGIES

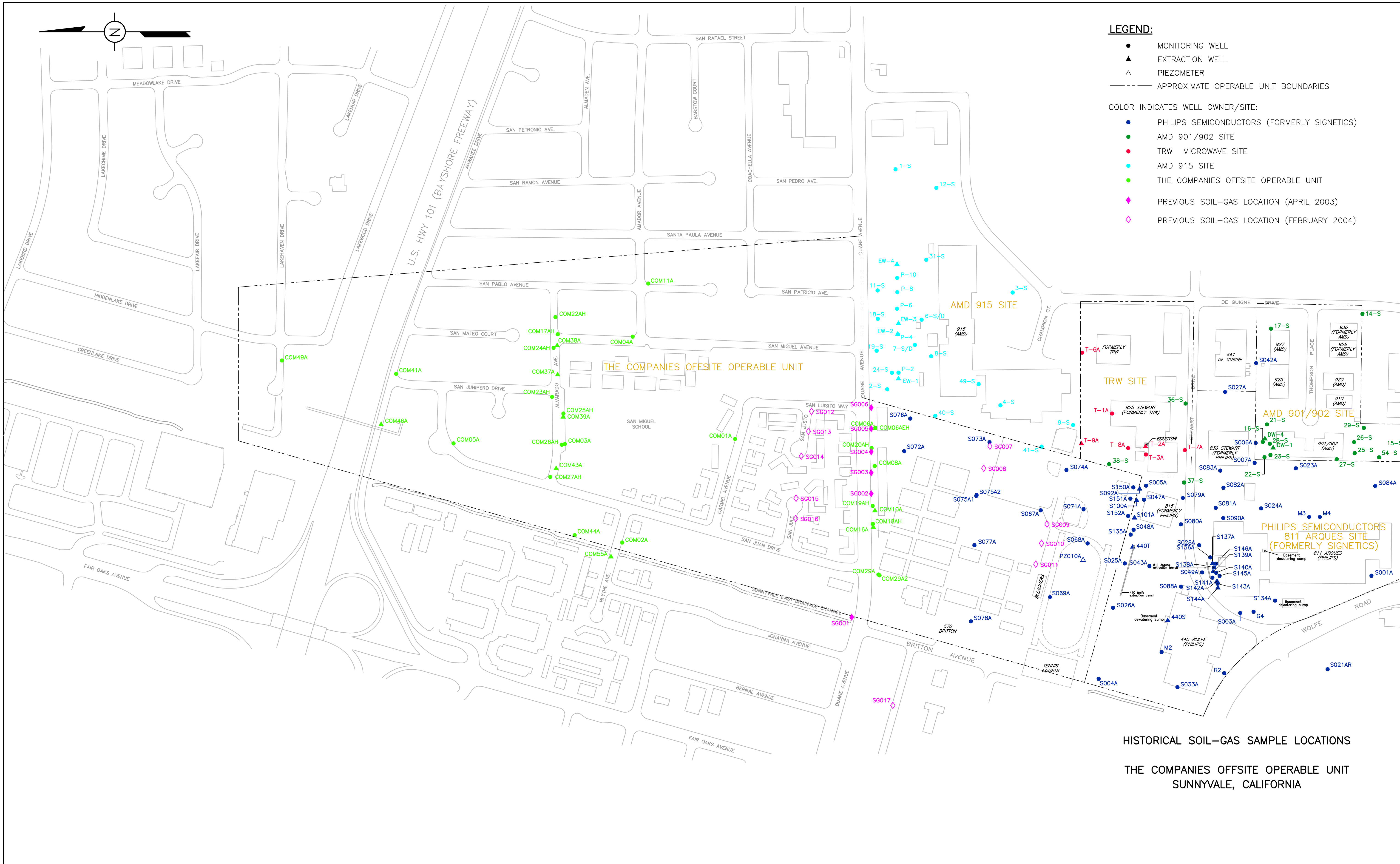
DRAWING NO. 27–006–B378

FIGURE G–1

REFERENCES:

1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE–A, FEBRUARY 1998.

FILE NAME: Z:\LOCUS.TEC\PHILLIPS SUNNYVALE\CURRENT\GW\PHILIPS1 – EXSM.DWG 09–2014



REFERENCES:

1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
△	2-OCT-03	ISSUED FOR REPORT	JWH	JWH	JEB

Locus TECHNOLOGIES

DRAWING NO. 27-006-C3

FIGURE G-2

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APPENDIX H

QUALITY ASSURANCE PROJECT PLAN FOR ADDITIONAL VAPOR INTRUSION EVALUATION THE COMPANIES OFFSITE OPERABLE UNIT SUNNYVALE, CALIFORNIA

Quality Assurance Project Plan
Additional Vapor Intrusion Evaluation
The Companies Offsite Operable Unit
Sunnyvale, California

J. Wesley Hawthorne, P.E., P.G.
Project Manager

Sean Sandborgh, PhD
Project Quality Assurance Officer

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Fax: 415.360.5889

SAN FRANCISCO

LOS ANGELES

ARIZONA

MASSACHUSETTS

FLORIDA

EUROPE

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LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
LQAP	Laboratory Quality Assurance Plan
MDL	Method Detection Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
PDF	Portable Document Format
PM	Project Manager
QA	Quality assurance
QA/QC	Quality assurance/quality control
QAO	The Quality Assurance Officer
QAPP	Quality Assurance Project Plan
EPA	United States Environmental Protection Agency
VOC	Volatile organic compound
Work Plan	Work Plan for Additional Vapor Intrusion Evaluation, 1 May 2014 (revised 19 September 2014)

LIST OF ATTACHMENTS

QUALITY ASSURANCE PROJECT PLAN ADDITIONAL VAPOR INTRUSION EVALUATION THE COMPANIES OFFSITE OPERABLE UNIT SUNNYVALE, CALIFORNIA

1. INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared by Locus Technologies (Locus) for the Additional Vapor Intrusion Evaluation at The Companies Offsite Operable Unit (OOU) in Sunnyvale, California. This vapor intrusion evaluation will be conducted in response to the RWQCB letter dated 10 January 2014 and subsequent comments from EPA in letters dated 11 August 2014 and 7 October 2014. A work plan dated 1 May 2014 (last revised 19 September 2014) was prepared by Locus and submitted to EPA: Work Plan for Additional Vapor Intrusion Evaluation (Work Plan). The structure of this document follows EPA requirements and guidelines for the Quality Assurance Project Plans (EPA, 2001; EPA, 2002).

2. PROJECT MANAGEMENT

2.1. Distribution List

Parties that will receive electronic copy of documents resulting from this project are listed below. All stakeholders will be provided the opportunity to comment on the methods for data collection, analysis, and data interpretation.

Table 1. Distribution List

Title:	Name (Affiliation):	Tel. No.:
EPA Project Manager	Melanie Morash, EPA	913-538-2357
Philips Project Manager	Shau-Luen Barker, Philips	913-538-2124
Locus Project Manager	J. Wesley Hawthorne, Locus	415-663-4702
Project Quality Assurance Officer	Sean Sandborgh, Locus	415-692-5435

2.2. Project Organization

Individuals involved in this project are listed below, along with their project roles and contact information. This list may be modified as additional parties (laboratories, additional agency personnel, etc.) are added or substituted. An Organizational Chart is provided in Figure 1.

Table 2. Personnel Responsibilities

Name	Organizational Affiliation	Title and Responsibilities	Contact Information (Telephone number, fax number, email address.)
Melanie Morash	EPA	EPA Project Manager Oversee all aspects of data collection, analysis, interpretation, and reporting; lead community outreach	415-972-3050 fax 415-947-3528 morash.melanie@epa.gov
Shau-Luen Barker	Philips Electronics North America Corporation	Philips Project Manager Oversee and coordinate all aspects of contractor data collection, analysis, interpretation, and reporting; maintain communication with EPA Project Manager	main 913-538-2357 direct 913-538-2124 shauluen.barker@philips.com

Name	Organizational Affiliation	Title and Responsibilities	Contact Information (Telephone number, fax number, email address.)
J. Wesley Hawthorne, P.E., P.G.	Locus Technologies	Locus Project Manager Maintain project schedule, budget, and communication with Philips project manager; Prepare sampling design; Provide QA/QC	415-663-4702 hawthornej@locustec.com
Nancy-Jeanne LeFevre, P.E.	Locus Technologies	Sampling Coordinator Arrange property access in concert with EPA-led community outreach, and execute the sampling program	415-992-5360 lefevren@locustec.com
Ning Du, E.I.T.	Locus Technologies	Data Evaluation Manager Data validation, evaluation, and reporting	415-390-2446 dun@locustec.com
Sean Sandborgh, PhD	Locus Technologies	Project Quality Assurance Officer Confirm contractor data verification, data validation, and confirming data integrity, updating QAPP, error tracking, use G-8 process	415-692-5435 sandborghs@locustec.com

Name	Organizational Affiliation	Title and Responsibilities	Contact Information (Telephone number, fax number, email address.)
Kelly Buettner	Eurofins Air Toxics, Inc	Lab Project Manager Receive, record, prepare, extract, analyze samples; report results	916-605-3378 fax 916-985-1020 kellybuettner@eurofinsus.com
Melanie Levesque	Eurofins Air Toxics, Inc	Lab QA Manager QA/QC, data validation documentation and reporting	916-985-1000 melanielevesque@eurofinsus.com

2.2.1. Quality Assurance Officer

The Project Quality Assurance Officer (PQAO) will be responsible for validating laboratory analytical data. The PQAO will be responsible for accepting or rejecting submittals from contract laboratories or field teams based on acceptability of work from a quality assurance perspective. The PQAO will furnish the Project Manager (PM) with data to begin analysis and interpretation of the data once the data have been properly validated.

The PQAO will not be involved in the supervision or execution of data collection in the field or laboratory. Contract laboratory data will be furnished directly to the PQAO. The PQAO will serve as a data flow control point to ensure that only validated data are used for the purposes of analysis, interpretation, testing hypotheses, and drawing conclusions. Data will not be disseminated among stakeholders before the PQAO has signed off on the data validation steps.

The PQAO will contact laboratory quality assurance/quality control (QA/QC) personnel on matters of data acceptability. The Sampling Coordinator will manage field data collection contractors and communicate with the laboratory's client services managers for the purpose of coordinating sample receipt and analysis. Once samples are submitted, the Data Evaluation Manager will await the PQAO's completion of data validation before beginning data analysis, hypothesis testing, and report preparation. The PQAO will remain independent of those generating the data.

2.2.2. QAPP Update and Maintenance

This QAPP may be changed, as warranted by problems or other needs identified by field or laboratory personnel, by the PQAO or by the PM. Each modification of the QAPP shall be accompanied by documentation of the change. Documentation shall record the date, nature of the revision, deletion, addition, or other change, reason for the change, and date that the QAPP users notified of the change. Changes to the QAPP will be disseminated to the QAPP users by electronic mail as soon as they are made. An appendix to the QAPP will document QAPP revisions.

2.3. Problem Definition and Background

This project seeks to address additional groundwater-to-indoor air vapor intrusion concerns within selected portions of the Companies Offsite Operable Unit (OOU) as requested by EPA. The goal is to determine typical volatile organic compound (VOC) exposure (ambient air) for the building occupants and evaluation of exposure pathways at the evaluation study area. The evaluation will need to identify the potential source or sources of any VOCs measured in the study area. Location and site maps of the study area are shown in Figures 1 and 2. Applicable evaluation criteria for the vapor intrusion evaluation are provided in Table 2 of the Work Plan.

The groundwater beneath the site is impacted with trichloroethene (TCE). The OOU consists of the commingled plumes of the Philips Semiconductors site at 811 East Arques Avenue, the AMD site at 901/902 Thompson Place, and the TRW site at 825 Stewart Drive. An extensive groundwater extraction and monitoring program has been in operation since 1988 to monitor and control the migration of TCE in the groundwater beneath the site. Because TCE is the chemical most commonly present within the OOU and the neighboring operable units, it serves as the indicator chemical for the site, although there are eight chemicals of concern established on the Orders for the OOU: 1,1-dichloroethane (1,1-DCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (cis-1,2-DCE); trans-1,2-dichloroethene (trans-1,2-DCE); Freon 113; 1,1,1-trichloroethane (1,1,1-TCA); TCE; and tetrachloroethene (PCE). Additional detail on the hydrogeology and nature and extent of chemicals at the site is available in Sections 2.3 and 2.4 of the Work Plan for Additional Vapor Intrusion Evaluation (Work Plan). In addition, a summary of previous vapor intrusion investigations is provided in Section 2.5 of the Work Plan.

2.4. Project/Task Description

This document is an appendix to the Work Plan for Additional Vapor Intrusion Investigation for the Companies Offsite Operable Unit (OOU) in Sunnyvale, California (Work Plan). The project description is provided in the Work Plan. Refer to Section 6 of the main Work Plan for a description of project scheduling.

2.5. Quality Objectives and Criteria

The following data quality objectives for each monitoring parameter will be used in this evaluation:

- Accuracy: Measures the overall agreement of a result or the mean of a set of results to the true or accepted value. Analytical accuracy is achieved with the laboratory control samples (see Section 5.6.3 of the main Work Plan). A known amount of standard is added to the sample and the amount recovered determines the accuracy of the method. For each analyte, there are acceptable accuracy limits expressed as percent recovery. For project analytes, the acceptable percent recovery limits are 70-130% for EPA Method TO-15 SIM and TO-17.

- Precision: Measures the agreement between repeat measurements or observations made under the same conditions, such as the reproducibility of a set of duplicate results. Analytical precision measures the variability associated with duplicate analyses. As discussed in the Sampling Protocol (Section 5 of the main Work Plan, in particular, Section 5.6.3), laboratory control samples will be used to determine the precision of the analytical method used. Total precision is measurement of variability associated with the entire process of sample collection and analysis, and is determined by the analysis of duplicate field and laboratory samples. The precision measurement will be determined using the relative percent difference (RPD) between results. RPD is calculated as follows:

  RPD = (100)*(2)*(result - duplicate result) / (result + duplicate result)

Using laboratory control spikes and laboratory control spike duplicates, the acceptable RPD limit for each project analyte is 25% for EPA Method TO-15 SIM and 20% for EPA Method TO-17. Using field duplicates, the acceptable RPD limit for the project is 25%.

- Recovery: A measure of how much of the parameter in the sample is included in the analysis. Surrogate compound recoveries in the method blank sample are also an accuracy measurement. However, in blank samples, matrix effect interference (such as moisture and hydrocarbons) can skew the accuracy of surrogate recovery. Surrogate recovery is generally only used to determine how well the compounds were extracted from the containers. Acceptable percent recovery limits were determined as a measurement of accuracy, discussed above.

- Representativeness: The extent to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is qualitative and is predominantly concerned with proper sampling program design.

- Completeness: Measures the amount of valid data that are collected during a project phase and is usually expressed as a percentage. The completeness goal is to generate enough valid data to meet project needs. The completeness of a data set is calculated by dividing the number of valid results by the number of possible individual analyte results. The completeness requirement is 90% for air sampling.

  % Completeness = 100*(number of valid results/ total number of results)

- Comparability: A qualitative term that expresses the measure of confidence that one data set can be compared to another and potentially combined with the other data set for decision-making purposes. Comparability is achieved by using standard sampling and analysis methods (including sample collection, transport and analytical procedures) and reporting data in appropriate units.

2.6. Specialized Training or Certifications

The investigators and decision makers involved in this project should have experience and training in indoor air sampling and data analysis. In addition, staff implementing this plan should be familiar with the work plan, QAPP, and associated procedures. However, no specialized training or certifications are required.

The sampling and analysis team has many years of experience in indoor air sampling and data validation and analysis. Therefore, training of laboratory and data review personnel on indoor air sampling will not be a requirement for this project; however, training and review for field personnel using sampling equipment is recommended. If new staff join the project, on the job training and evaluation will be conducted for the individual(s).

2.7. Documentation and Records

This project will generate many data records and several reports in the course of the investigation. The methods of report and data management are described below.

2.7.1. Documents

All documents prepared for this project will either be produced directly as electronic documents or scanned into electronic format. Files will be maintained in Adobe Acrobat Portable Document Format (Adobe PDF). The Locus Project Manager will be responsible for maintaining records for this project.

Table 3. Document and Record Retention

	Identify Type Needed	Retention	Archival	Disposition
Sample Collection Records	Hard Copy	5 year	20 years	On file with Locus
	PDF	5 years	20 years	On file with Locus
Field Records	Hard Copy	5 year	20 years	On file with Locus
	PDF	5 years	20 years	On file with Locus
Analytical Records	PDF	5 years	20 years	On file with Locus
	Relational Database	5 years	20 years	On file with Locus
Final Report	PDF	5 years	20 years	On file with Locus

2.7.2. Records

Data from both laboratory analyses and field measurements will be imported to and maintained in an electronic database. For the duration of the project, the database will be updated and maintained by Locus Technologies; thereafter, copies of data subsets or access to the entire database will be available from Philips as requested.

3. DATA GENERATION AND ACQUISITION

3.1. Sampling Process Design (Experimental Design)

This project seeks to evaluate potential volatile organic compound (VOC) exposure (ambient air) for building occupants due to underlying groundwater VOCs within selected portions of the Companies Offsite Operable Unit (OOU) as requested by EPA. The project also seeks to evaluate potential exposure pathways from underlying groundwater VOCs. Once samples are collected and analyzed, the potential public health impacts associated with measured levels of site-related chemicals in air will be evaluated.

In addition, mitigation measures will be determined based on the data evaluation. Details regarding interim mitigation measures and long-term mitigation measures (and associated plans for verification and monitoring) are discussed in detail in Section 5.7.5 of the main Work Plan.

3.1.1. Study Boundaries

The vapor intrusion study area is defined by EPA as areas overlying shallow groundwater concentrations of 5 micrograms per liter (µg/L) or higher (see Figure 3 in the main Work Plan). Existing data collected from outside the study area (background samples) may be valuable in evaluating potential VOC sources.

3.1.2. Property Access

This vapor intrusion evaluation involves sampling within commercial buildings and residences that are not owned or operated by the individuals or organizations executing this study. Samples can only be obtained with the permission of the property owners and occupants. To address this constraint with a minimal impact on the project schedule, the EPA is leading the community outreach effort to gain property access. In cases where the property occupant is not the same as the property owner, access arrangements will be made with both parties. If the owner (and occupant if applicable) is willing to participate, an access agreement will be secured by EPA prior to sampling. Properties for which access cannot be obtained will not be sampled in this study.

3.1.3. Field Sampling

Sampling activities will entail air sampling in buildings (indoor air and pathway samples) and adjacent outdoor locations within the study area. Buildings to be sampled will be selected based on EPA directive and community outreach. Sampling locations within buildings will be determined based on site inspections and building walk-throughs as described in Sections 5.1 and 5.2 and property-specific appendices of the Work Plan. The final list of sampling locations to be mapped on floor plans in buildings and residences in the study area will depend on cooperation of property owners/occupants to provide access for sampling. Sampling conditions are described in detail in Section 5.4 of the main Work Plan, including HVAC settings, time of year, and weather.

3.2. Sampling Methods

Sections 5.3 to 5.5 of the Work Plan list the sampling tools, methods, and protocols (passive samplers and Summa canisters; indoor air, pathway samples, and outdoor air; HVAC-on and HVAC-off) that will be used to achieve the goals of this study. Equipment will be inspected prior to use, as described in Section 5.3 of the main Work Plan. Equipment that fails inspection will be replaced prior to use. Samplers that fail during sample collection will be omitted from laboratory analysis.

3.3. Sampling Handling and Custody

The ability to trace samples from the time they are collected to receipt of final data is essential to the sampling program. The sampling handling and custody is described in Section 5.5 of the main Work Plan. In particular, prior to sampling, summa canisters and sorbent samplers will be inspected to verify that all equipment components are present. Summa canisters will be checked to be sure the canister valve is closed and the initial vacuum pressure is >25 inches of mercury (" Hg). After sample collection, summa canisters will be handled at ambient temperature, avoiding temperature extremes and direct sunlight. Sorbent samples will be transported and stored at 4°C or less to help minimize diffusion off of the sorbent material. Additional details regarding sample delivery and chain-of-custody documentation are discussed here.

All information relevant to field sampling will be documented on field logs and on chain-of-custody (COC) forms, and samples will be labeled in the field to ensure location mix-ups do not occur. All samples will be shipped to the laboratory for arrival before expiration of the sample holding time (30 days). Samples will be delivered to the laboratory person authorized to receive samples, who will inspect and note the condition of the equipment and enter the samples into laboratory record for analysis. If there are any discrepancies between the received samples and the COC documentation, the sender will be immediately notified. As with corrections made in the field, any changes made to the COCs will be made by striking the item and initialing and dating the correction in ink.

3.4. Analytical Methods

Sampling technicians will submit samples to a California-certified laboratory for analysis by EPA Method TO-15 SIM for Summa passivated canisters and by EPA Method TO-17 for passive air samplers (EPA, 1999a; EPA, 1999b). Samples will be analyzed for all chemicals of concern in groundwater at the site (refer to Table 2 of the main Work Plan). The contract laboratory will carry out pre-determined quality assurance measures as described in their respective quality assurance plans. Eurofins Air Toxics, Inc. SOP numbers and method performance criteria are provided in Appendix H-1. Standard laboratory turnaround times (15 days for an EDD and validation package) will be used. Samples will be disposed of in accordance with all applicable local, state, and federal regulations.

3.4.1. Performance Criteria

Quality control limits for laboratory analyses, which meet DQOs, are documented in Appendix H-1 for EPA Method TO-15 SIM and TO-17.

3.4.2. Corrective Actions

The laboratory will have a corrective action program to address any unacceptable data or conditions. After completion of analyses, the laboratory will verify compliance with the laboratory QAPP. If any parameters are outside of the control limits, corrective action will be implemented. Initial corrective action is to verify that calculation errors have not occurred. If appropriate and holding time permits, reanalysis will be performed. If it is confirmed that the parameters are outside of the control limits, the corrective action process will be initiated. Corrective actions may include:

- Verification of dilution factors
- Verification of sample preparation and instrument performance
- Verification of procedure by monitoring method performance; If necessary, amending sampling and analytical procedures
- Re-sampling and analysis

The laboratory will maintain records of corrective action reports and submit them to the contractor with the electronic copies of the laboratory reports. Corrective actions will also be included in the project report.

3.5. Quality Control

Quantitative performance criteria should be established at a level which will reduce the potential for false data to an acceptable probability. However, they should also not be set at such a high standard that the data set is limited, and uncertainty in the derived conclusion is high.

It is critical that any laboratory quality control issues associated with data collected as part of the investigation be quantified and minimized. This plan provides detailed descriptions of the measures that will be taken to guard against false-positives and false-negatives. False-positives can occur due sample contamination. The primary strategy for preventing false-positives will be the use of quality control samples in the field and laboratory.

3.5.1. Quality Control Samples

Quality control samples are added to the sampling program to ensure an appropriate level of data quality and to identify any potential sampling or analytical errors that could impact the sampling results. If any results for quality control samples fall outside the acceptable range, the results of any associated samples will only be used if the Project Quality Assurance Officer confirms that the problem did not affect integrity of the rest of the samples. Quality control samples for this project entail field quality control samples and laboratory quality control samples. Field quality control samples are collected in the field and provide quality information regarding sampling methods in the field as well as the transport of samples from the field to the laboratory. Laboratory quality control samples are prepared and analyzed in the laboratory and check the quality of the analytical procedures. Laboratory blanks, laboratory control spikes, and analytical surrogates will be provided and analyzed by the laboratory per the analytical method protocol. The laboratory control samples are independent source reference standards used to validate the accuracy of the initial calibration of the instrument used to analyze the samples.

Field duplicates, field blanks, and laboratory control samples included as a part of this project are described in greater detail in Section 5.6 of the main Work Plan.

3.5.2. Quality Control Limits

Contract laboratory personnel will document accuracy, precision, and recovery for laboratory analyses by following established quality assurance procedures defined by EPA Method guidance, and in-house quality assurance project plans for laboratory procedures. Quality control limits for laboratory analyses, which meet quality objectives and criteria in Section 2.5, are documented in Appendix H-1 for EPA Method TO-15 SIM and TO-17. Refer to Section 5.2 for a discussion of action to be taken when control limits are exceeded and how control actions will be documented.

3.6. Instrument/Equipment Testing, Inspection, and Maintenance

The laboratory will have written standard operating procedures (SOPs) defining the instrumentation, maintenance, calibration, method detection limits, QC analysis, acceptance criteria and any other requirements for the analytical methods used. The SOPs must be available to the laboratory chemists performing the work, and they must meet or exceed the requirements of the methods to be used for analysis. The laboratory must maintain records of all activities that have an impact on the quality of the results. The laboratory must maintain instrumentation required for analysis; any method substitution due to instrument failure will not be permitted without prior approval. Instrumentation deficiencies found will be evaluated by the laboratory and contractor to determine if analytical results were affected. Deficiencies affecting analytical results will be addressed through re-analysis, if possible, and re-sampling, if necessary.

3.7. Instrument/Equipment Calibration and Frequency

The laboratory will calibrate all instruments and equipment in accordance with the method specifications. Calibrations are conducted when the method is initially set up and whenever the calibrations fail to meet the acceptance criteria. If instrumentation undergoes significant repairs or maintenance, a valid initial calibration will be conducted. Instrumentation deficiencies found will be evaluated by the laboratory and contractor to determine if analytical results were affected. Deficiencies affecting analytical results will be addressed through re-analysis, if possible, and re-sampling, if necessary.

3.8. Inspection/Acceptance of Supplies and Consumables

All passivated Summa canisters must be checked for proper vacuum prior to sampling. Initial vacuum will be documented on field logs. In addition, passive air samplers must be checked for packaging integrity upon receipt, especially with respect to the sorbent cartridge. Equipment that fails inspection will be replaced prior to use. The Sampling Coordinator will be responsible for inspection and acceptance of supplies and consumables.

3.9. Non-Direct Measurements (Existing Data)

As discussed in the main Work Plan and Appendices A through G, some indoor air and soil gas data is available within the study area and from affiliated outdoor air background sampling. In addition, groundwater data is available from throughout the study area. Data quality of all three data types (indoor air, soil gas, and groundwater) is documented in the analytical database and in previously reports provided to EPA and RWQCB. These data may be used in combination with new data in supporting interpretations for background levels and source analysis. In addition, groundwater data will be used to define the vapor intrusion study area, which is defined as areas overlying shallow groundwater concentrations of 5 micrograms per liter (µg/L) or higher (see Figure 3 in the main Work Plan). Use of existing data will be limited based on the comparability of the new and existing datasets, including the age and sampling conditions of the samples.

3.10. Data Management

Data received from the laboratory, and verified and validated by the PQAO, will be managed by the Data Evaluation Manager for storage, retrieval, and transmittal. Sample information (location, date, time, etc.) will be entered into the electronic database from field logs and chain of custody documentation. Wherever possible, laboratory data will be received in an Electronic Data Deliverable (EDD) format directly from the laboratory to avoid potential transcription errors. Once received, the EDD will be uploaded into a holding table where it is checked for formatting and general data validation (quality control limits, consistency with chain of custody information, etc.). If the EDD fails any of the checks at this point, the error or discrepancy will be identified and either corrected or qualified depending on the severity of the error. No changes or corrections will be made to the EDD file itself without being reissued from the laboratory. Any validation qualifiers tagged onto the data set will identify the rationale for the qualifier and the person adding the qualifier. Wherever possible, re-analysis options should be examined to avoid applying qualifiers to the data set, since qualifiers may limit the usability of the data.

4. ASSESSMENT AND OVERSIGHT

4.1. Assessment and Response Actions

The Locus Project Manager will monitor, and if necessary, audit field activities. System audits involve the inspection of equipment for sampling and data gathering, and are usually conducted early in the initial stages of a field activity. Performance audits involve the inspection of field and laboratory activities to verify that standard procedures are completed to provide accurate data generation and to conform to specifications. Performance audits, if necessary, will also be completed by the Locus Project Manager and at the same time field audits are completed. Audit results would be reported to the Philips Project Manager and, upon request, to the EPA Project Manager. The Philips Project Manager and EPA Project Manager are also authorized to conduct audits and have the authority to issue stop work orders, if necessary.

4.1.1. Field and Performance Audits

Field audits may include evaluation of sample collection and identification in the field, observations of COC procedures, field documentation and measurements, and instrument calibrations. Field documents and COC forms will be reviewed to ensure that they are signed and dated, and that all entries are legible and in ink. Samples may be randomly checked for proper labeling.

Performance audits may be completed to ensure that work is completed in a controlled manner and that data quality requirements are met.

4.1.2. *Laboratory Audits*

The laboratories selected for analysis will have their own system of routine performance and system audits. As such, the contractor will not perform audits of the laboratory unless deemed necessary.

4.1.3. *Corrective Actions*

Corrective actions for laboratories are described in Section 3.4.2. Corrective actions necessary for adverse findings from field and performance audits will entail conforming activities to standard procedures as outlined in the Work Plan, including this QAPP.

4.2. Reports to Management

Refer to Section 6 of the main Work Plan for a description of reporting and notifications to EPA.

5. DATA VALIDATION AND USABILITY

5.1. Data Review, Verification, and Validation

Data review will be performed by the contractor ensuring that:

- The COC is properly completed,
- Samples are analyzed before the holding time limit expires,
- Calculations and units are performed and reported correctly,
- Results obtained are within the working calibration range of instrument used, and
- Complete and correct sample information is available.

Data verification will be performed by the contractor ensuring that:

- Correct sampling procedures are followed,
- Samples are analyzed in accordance with the analytical method, and
- QC results meet the acceptance criteria for quality control limits identified in Section 3.5.2.

Data validation will be performed by the PQAO ensuring that QC results meet the quality objectives and criteria identified in Section 2.5. Further levels of validation on the laboratory data are available (e.g. EPA Level IV), but given the current understanding of the quality control requirements of this project, these measures are not expected to be necessary for this project. The quality control limits identified in Section 3.5.2 are sufficient to ensure an appropriate level of data quality to meet the project's quality objectives.

5.2. Verification and Validation Methods

The laboratory will conduct the initial review and verification of data. As part of the process, if necessary, data are flagged with qualifiers, which may include the following:

- J = Estimated result
- U = Compound analyzed for, but not detected at or above the reporting limit.
- UJ = Non-detected compound associated with low bias in the CCV (continuous calibration)
- Q = Exceeds quality control limits.
- E = Exceeds instrument calibration range
- B = Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

All data generated for this project will be screened by the contractor in accordance with Section 5.1 prior to incorporation into the site database and prior to any use of the data to derive conclusions. Wherever possible, the comparison to numeric quality control limits should be done electronically to avoid potential errors. If any results fall out of the quality control limits and quality objectives, the results will be further investigated. Data falling outside of these limits and objectives may be allowed into the database with the addition of a qualifier for each affected data record.

5.3. Reconciliation with User Requirements

The PQAO will validate data to confirm that user objectives have been satisfied per established criteria presented in Section 5.1 and that data are suitable for inclusion in data analysis. The Data Evaluation Manager will await the PQAO's completion of data validation before beginning data analysis, hypothesis testing, and report preparation. Based on preliminary evaluation of data and data use, the PQAO may select all or a portion of the data for full, independent (third party) validation consistent with the latest version of the *National Functional Guidelines for Superfund Organic Methods Data Review* by EPA.

The project report will present data analysis and data interpretations. The report narrative will provide an explanation for the means by which conclusions and recommendations were reached. Ultimately, data will be evaluated against the risk assessment and mitigation criteria described in Section 5.7 of the main Work Plan. The report will explain why or why not the data is suitable for drawing conclusions for risk assessment and mitigation measures.

REFERENCES

EPA, 1999a, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15. Determination of Volatile Organic Compounds (VOCs) In Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS).* EPA/625/R-96/010b. Office of Research and Development, US EPA, Cincinnati, OH.

EPA, 1999b, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-17. Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes.* EPA/625/R-96/010b. Office of Research and Development, US EPA, Cincinnati, OH.

EPA, 2001, *EPA Requirements for Quality Assurance Project Plans*. EPA QA/R5. EPA/240/B-01/003.

EPA, 2002, *Guidance for Quality Assurance Project Plans.* EPA QA/G-5. Office of Environmental Information, United States Environmental Protection Agency, Washington, D.C.

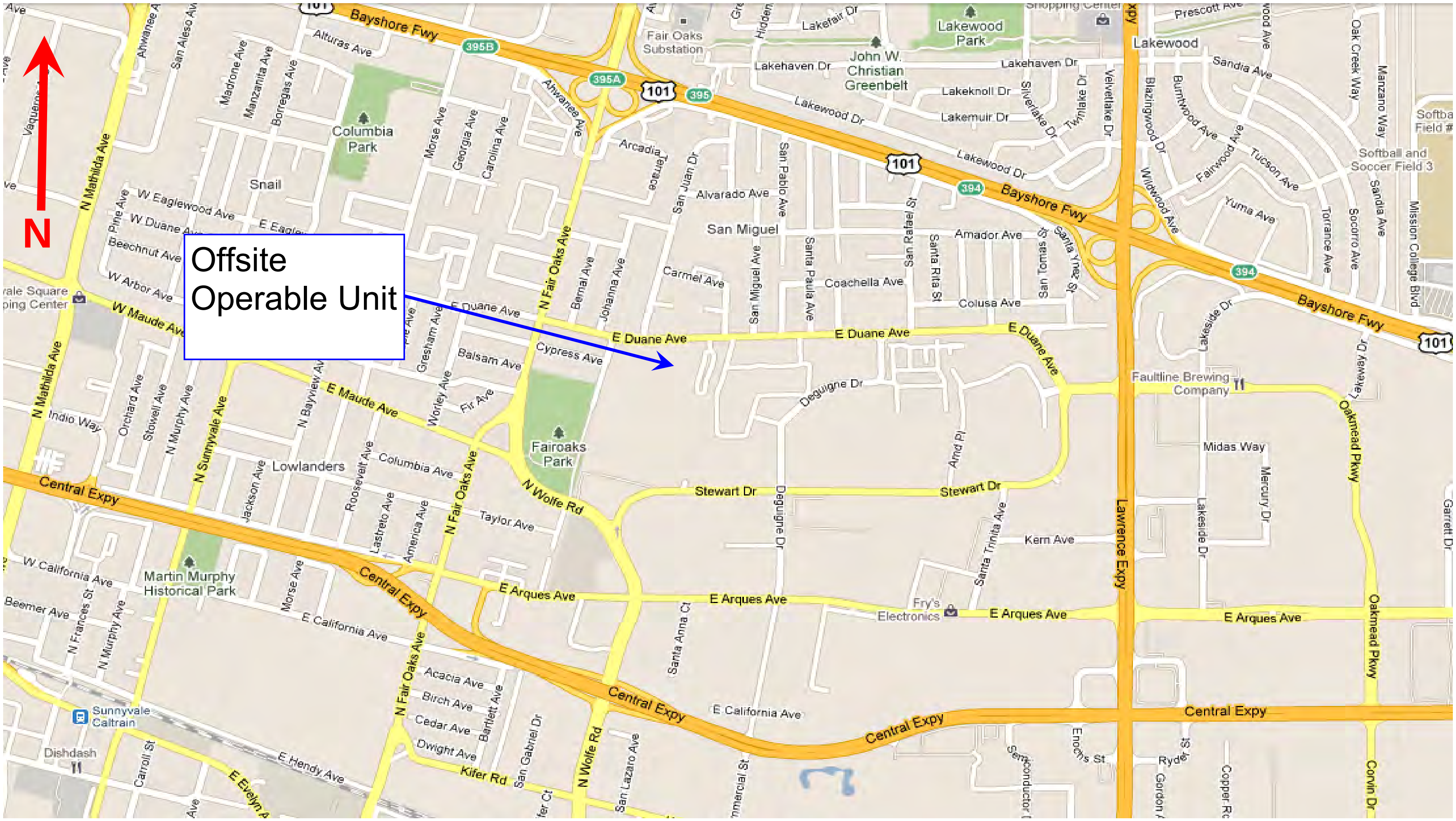

Figure 1

Site Location Map
The Companies Offsite
Operable Unit
Sunnyvale, California

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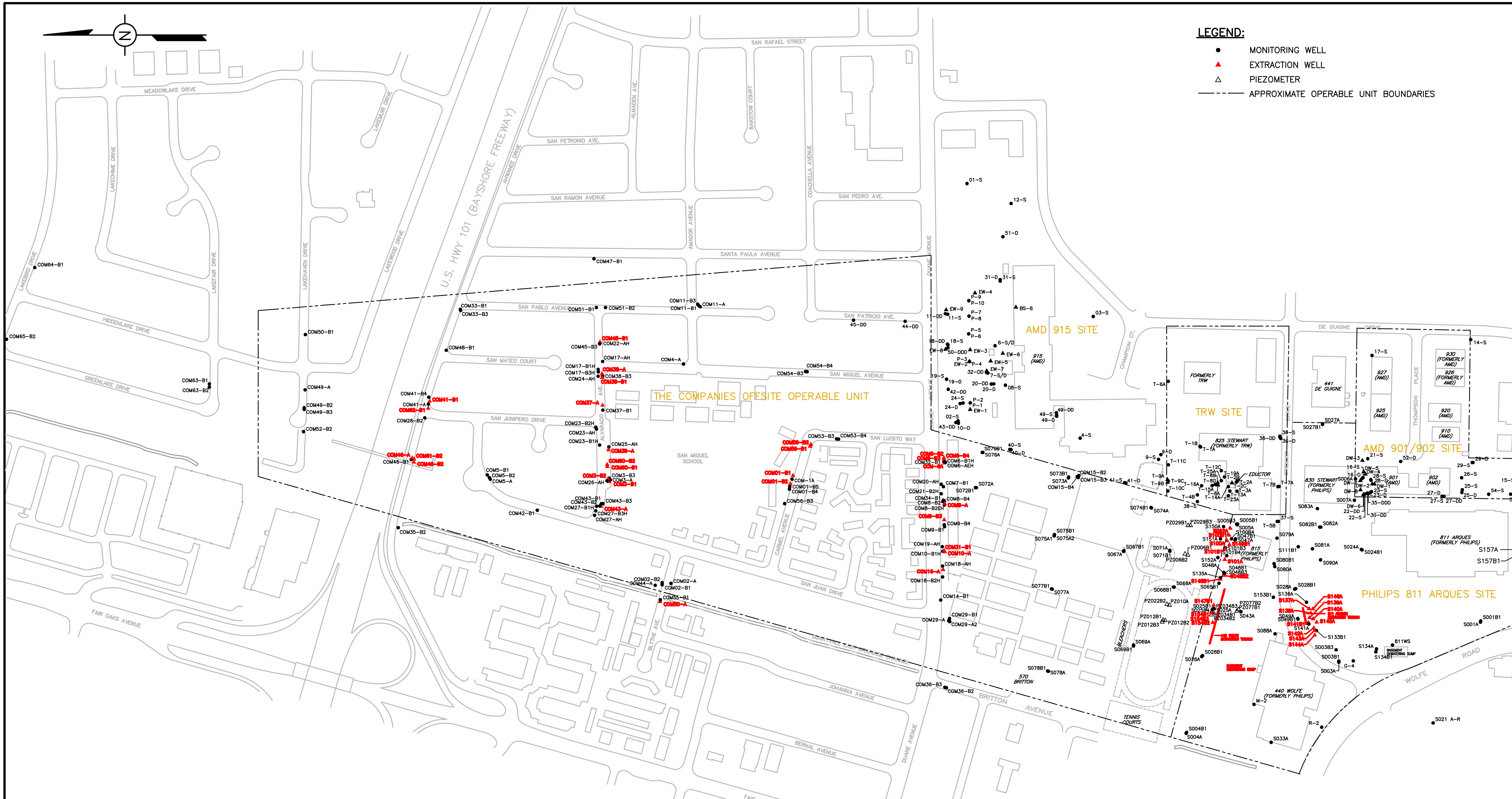
TECHNOLOGIES



SITE PLAN
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	26 JAN 07	ADDED WELLS 157A AND S157B1. DELETED SEALED WELLS S042A AND S042B1.	VZC	MMG	JWH
2	20 JAN 03	REMOVED SEALED WELLS S085A, S086A, S091A, G-3, A-6, G-1, G-5, M-1, S065A, S070A, S087A, and S089A.	JWH	JWH	JEB
1	28 JAN 00	ISSUED FOR REPORT	VZC	MJG	JEB

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SCALE: 200 0 200 400 FEET

DRAWING NO. 27-006-E284

FIGURE 2

REFERENCES:
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

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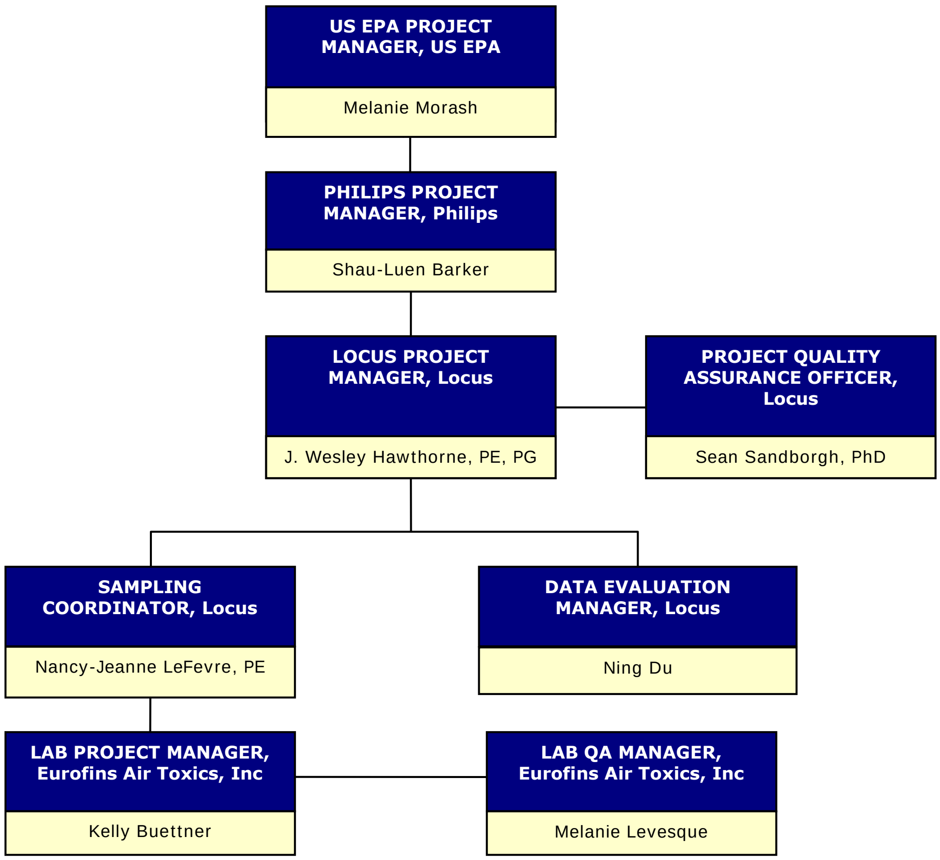

Figure 3
Organizational Chart
QAPP for Additional Vapor Intrusion Investigation
The Companies Offsite Operable Unit
Sunnyvale, California

Locus TECHNOLOGIES

ATTACHMENT H-1

QUALITY CONTROL LIMITS FOR

EPA METHODS TO-15 SIM AND TO-17

Method: EPA Method TO-14A/TO-15 Volatile Organic Compounds by SIM

Eurofins Air Toxics SOP #38 Revision 17 Effective Date: December 27, 2013 Methods Manual Summary

Description: This method involves Selective Ion Monitoring (SIM) gas chromatograph/mass spectrometer (GC/MS) analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds (VOCs) using EPA Method TO-14A/TO-15 protocols. An aliquot of the sample is withdrawn from the canister through a mass flow controller and concentrated onto a hydrophobic drying system that removes water from the sample stream. The sample is then focused onto a cryogenic-cooled column prior to analysis by GC/MS in the SIM mode.

Mass spectrometer detectors can be set to acquire both SIM and full scan data simultaneously. This generates two separate data files in the analytical software. One file contains full scan data and the other contains SIM data for selected compounds. The results for each sample in a report will be from two separate data files originating from the same analytical run. The two data files have the same base file name and are differentiated with a "sim" extension on the SIM data file.

Eurofins Air Toxics maintains a suite of TO-14A/TO-15 methods, each optimized to efficiently meet the data objectives for a wide range of targeted concentration ranges. The methods, their reporting limits, and typical applications are summarized in the table below. This method summary describes TO-14A/TO-15 SIM.

Eurofins Air Toxics Method	Base Reporting Limits	Typical Application
TO-14A/TO-15 (5&20)	5 – 20 ppbv	Soil gas and ppmv range vapor matrices
TO-14A/TO-15 (Standard or Quad)	0.5 – 5.0 ppbv	Ambient air, soil gas, and ppbv level vapor matrices
TO-14A/TO-15 (Low-level)	0.1 – 0.5 ppbv	Indoor and outdoor air
⇨ TO-14A/TO-15 SIM	0.003 – 0.5 ppbv	Indoor and outdoor air

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. If full validation of the required compound(s) is not available, the laboratory will present Quality Control (QC) options to the client based on the project objectives.

Please note that Methods TO-14A and TO-15 were validated for specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of the method and not recommended for ambient or indoor air samples. It is the responsibility of the data user to determine the usability of TO-14A and TO-15 results generated from Tedlar bags.

All samples submitted for TO-15 SIM are screened prior to analysis. If samples contain high concentrations of target and/or non-target VOCs, samples may be analyzed by an alternative TO-15 method (i.e. Standard or 5&20) with a higher dynamic calibration range.

Eurofins Air Toxics performs a modified version of TO-15 SIM as detailed in Table 1. Additionally, since Eurofins Air Toxics applies TO-15 methodology to all Summa™ canisters regardless of whether TO-14A or TO-15 is specified by the project, Eurofins Air Toxics performs a modified version of method TO-14A as described in Table 2. The default SIM target list, reporting limits (RL), QC criteria and QC summary may be found in tables 3 and 4.

Table 1. Summary of TO-15 SIM Method Modifications

Requirement	TO-15	Eurofins Air Toxics Modifications
Blank and standards	Zero Air	Nitrogen

Table 2. Summary of TO-14A SIM Method Modifications

Requirement	TO-14A	Eurofins Air Toxics Modifications
Sample Drying System	Nafion Dryer	Multibed hydrophobic sorbent
ICAL %RSD acceptance criteria	≤ 30% RSD for listed 39 VOCs	Follow TO-15 requirements of ≤ 30%RSD with 2 of standard compound list allowed out to ≤ 40%RSD
Blank and standards	Zero air	Nitrogen
BFB ion abundance criteria	Ion abundance criteria listed in Table 4 of TO-14A	Follow abundance criteria listed in TO-15.
BFB absolute abundance criteria	Within 10% when comparing to the previous daily BFB	CCV internal standard area counts are compared to ICAL; corrective action when recovery is less than 60%

Table 3. Method TO-14A/TO-15 Standard Analyte List (SIM) and QC Limits

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
Dichlorodifluoromethane (Fr12)	0.020	≤ 30%	70 – 130	70 – 130	± 25
Freon 114	0.020	≤ 30%	70 – 130	70 – 130	± 25
Chloromethane	0.050	≤ 30%	70 – 130	70 – 130	± 25
Vinyl Chloride	0.010	≤ 30%	70 – 130	70 – 130	± 25
Chloroethane	0.050	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethene	0.010	≤ 30%	70 – 130	70 – 130	± 25
Trans-1,2-Dichloroethene	0.100	≤ 30%	70 – 130	70 – 130	± 25
Methyl tert-Butyl Ether	0.100	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
cis-1,2-Dichloroethene	0.020	≤ 30%	70 – 130	70 – 130	± 25
Chloroform	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,1,1-Trichloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
Carbon Tetrachloride	0.020	≤ 40%	60 - 140	60 - 140	± 25
Benzene	0.050	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
Trichloroethene	0.020	≤ 30%	70 – 130	70 – 130	± 25
Toluene	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,1,2-Trichloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
Tetrachloroethene	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dibromoethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
Ethyl Benzene	0.020	≤ 30%	70 – 130	70 – 130	± 25
m,p-Xylene	0.040	≤ 30%	70 – 130	70 – 130	± 25
o-Xylene	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,1,2,2-Tetrachloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dichlorobenzene	0.020	≤ 30%	70 – 130	70 – 130	± 25
Naphthalene	0.050	≤ 40%	60 – 140	60 – 140	± 25

Table 3 is the list of Standard compounds, reporting limits and QC acceptance criteria. Each project may be customized as needed. Additional compounds and different reporting limits may be obtainable and/or achieved upon request.

Table 4. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15 by SIM

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours	TO-15 Ion Abundance criteria	Correct problem then repeat tune.
Multi-point Calibration (Minimum of 5 points)	Prior to sample analysis	≤ 30% for standard compounds with 2 compounds allowed out to ≤ 40% RSD	Correct problem then repeat Initial Calibration Curve.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each initial calibration curve, and daily prior to sample analysis	Recoveries for 85% of standard compounds must be 70–130% (≤ 40% for Methyl tert-Butyl Ether and trans-1,2-Dichloroethene). No recovery may be ≤ 50%. If specified by the client, in-house generated control limits may be used.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS) for Non-Standard Compounds	Per client request or specific project requirements only	Recoveries of compounds must be 60–140%. No recovery may be ≤ 50%.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Continuing Calibration Verification (CCV)	At the start of each day after the BFB tune check	70–130%	Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than two compounds from the standard list recover outside of 70–130%, corrective action will be taken. If any compound exceeds 60–140%, samples are not analyzed unless data meets project needs. Check the system and re-analyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV) for Non-Standard Compounds	Per client request or specific project requirements only	Recoveries of compounds must be 60–140%. No recovery may be ≤ 50%.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory reporting limit (Table 4) or project required reporting limit.	Inspect the system and re-analyze the blank. “B” flag data for common contaminants.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Internal Standard (IS)	As each standard, blank, and sample is being loaded	Retention time (RT) for blanks and samples must be within ±0.33 min of the RT in the CCV and within ±40% of the area counts of the daily CCV internal standards.	**For blanks:** Inspect the system and re-analyze the blank. **For samples:** Re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.
Surrogates	As each standard, blank, and sample is being loaded	70–130% If specified by the client, in-house generated control limits may be used.	**For blanks:** Inspect the system and re-analyze the blank. **For samples:** Re-analyze the sample unless obvious matrix interference is documented. If the %Rs are within limits in the re-analysis, report the second analysis. If %Rs are out-of-limits a second time, report data from first analysis and narrate.
Laboratory Duplicates - Laboratory Control Spike Duplicate (LCSD)	One per analytical batch	RPD ≤ 25%	Narrate exceedances. If more than 5% of compound list outside criteria or if compound is > 40%RPD, investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.

Method: Modified EPA TO-17 VOCs and SVOCs (Vapor Intrusion Application) by GC/MS (Full Scan)

Eurofins Air Toxics SOP #109 Revision 5 Effective Date: May 21, 2014 Methods Manual Summary

Description: The TO-17 "Vapor Intrusion" method utilizes a multi-bed thermal desorption tube for the measurement of air-phase Volatile Organic Compounds (VOCs) and Polycyclic Aromatic Hydrocarbons (PAHs). These tubes are marketed by Eurofins Air Toxics as "TO-17 VI" tubes. The TO-17 VI tubes are applicable to a wide variety of vapor matrices including soil gas, indoor air, and outdoor air. Parameters are optimized to effectively manage high humidity conditions. The TO-17 VI method is an alternative to the canister-based sampling and analysis methods that are presented in EPA Compendium Methods TO-14A and TO-15 as well as an alternative to PUF/XAD sampling for semi-volatile compounds as described by EPA Compendium TO-13A. The VI tube provides sufficient retention of light VOCs such as 1,3-Butadiene while providing an efficient desorption of semi-volatile compounds such as Pyrene.

Samples are collected by drawing a measured volume of air through the VI sorbent tubes. Collection is performed using a low-flow vacuum pump or a volumetric syringe attached to the outlet side of the tube. Analysis is accomplished by heating the sorbent tube and sweeping the desorbed compounds onto a secondary "cold" trap for water management and analyte refocusing. The secondary trap is heated for efficient transfer of compounds onto the gas chromatograph (GC) for separation followed by detection using mass spectrometry (MS).

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compounds during sample storage, safe sampling volume, and desorption efficiency are not validated. Full validation may be available upon request.

Since the TO-17 VI application significantly extends the scope of target compounds addressed in EPA Method TO-15 and TO-17, the laboratory has implemented several method modifications as outlined in Table 1.

Table 1. EPA TO-17 Method Modifications – VI Application

Requirement	TO-17	Eurofins Air Toxics Modifications
Initial Calibration	%RSD ≤ 30% with 2 allowed out up to 40%	For the VOC list: %RSD ≤ 30% with 2 allowed out up to 40% For the PAH list: %RSD ≤ 30% with 2 allowed out up to 40%
Daily Calibration	%D for each target compound within ±30%.	Fluorene, Phenanthrene, Anthracene, Fluoranthene, and Pyrene within ±40%D
Audit Accuracy	70 – 130%	Second source recovery limits for Fluorene, Phenanthrene, Anthracene, Fluoranthene, and Pyrene = 60 – 140%
Distributed Volume Pairs	Collection of distributed volume pairs required for monitoring ambient air to ensure high quality.	If the client is sampling well-characterized air or has verified performance through previous sampling or distributed pairs, single tube sampling may be appropriate. Distributed volume pairs may not be practical or useful for soil vapor collection due to required configuration and volume constraints.

Table 2. Method TO-17 VI Standard Analyte List and QC Limits

Volatile Organic Compounds	Reporting Limit (ng)	QC Acceptance Criteria			
		ICAL (%RSD)	ICV (%R)	CCV (%D)	LCS (%R)
Freon 114	14	30	70 – 130	30	70 – 130
Vinyl Chloride	2.6	30	70 – 130	30	70 – 130
1,3-Butadiene	2.2	30	70 – 130	30	70 – 130
Isopentane	5.9	30	70 – 130	30	70 – 130
Freon 11	11	30	70 – 130	30	70 – 130
1,1-Dichloroethene	4.0	30	70 – 130	30	70 – 130
Methylene Chloride	21	30	70 – 130	30	70 – 130
Freon 113	7.7	30	70 – 130	30	70 – 130
Trans-1,2-Dichloroethene	4.0	30	70 – 130	30	70 – 130
1,1-Dichloroethane	4.0	30	70 – 130	30	70 – 130
cis-1,2-Dichloroethene	4.0	30	70 – 130	30	70 – 130
Hexane	35	30	70 – 130	30	70 – 130
Chloroform	4.9	30	70 – 130	30	70 – 130
1,2-Dichloroethane	4.0	30	70 – 130	30	70 – 130
1,1,1-Trichloroethane	5.4	30	70 – 130	30	70 – 130
Benzene	6.4	30	70 – 130	30	70 – 130
Carbon Tetrachloride	6.3	30	70 – 130	30	70 – 130
Cyclohexane	6.9	30	70 – 130	30	70 – 130
1,2-Dichloropropane	4.6	30	70 – 130	30	70 – 130

Trichloroethene	5.4	30	70 – 130	30	70 – 130
1,4-Dioxane	11	30	70 – 130	30	70 – 130
2,2,4-Trimethylpentane	9.4	30	70 – 130	30	70 – 130
Heptane	8.2	30	70 – 130	30	70 – 130
Methylcyclohexane	8.0	30	70 – 130	30	70 – 130
1,1,2-Trichloroethane	5.4	30	70 – 130	30	70 – 130
Methyl isobutyl ketone	8.2	30	70 – 130	30	70 – 130
Toluene	7.5	30	70 – 130	30	70 – 130
Methylbutylketone	8.2	30	70 – 130	30	70 – 130
Tetrachloroethene	6.8	30	70 – 130	30	70 – 130
Chlorobenzene	4.6	30	70 – 130	30	70 – 130
Ethylbenzene	4.3	30	70 – 130	30	70 – 130
M,p-xylene	8.7	30	70 – 130	30	70 – 130
o-Xylene	8.7	30	70 – 130	30	70 – 130
Styrene	8.5	30	70 – 130	30	70 – 130
1,1,2,2-Tetrachloroethane	6.9	30	70 – 130	30	70 – 130
Cumene	9.8	30	70 – 130	30	70 – 130
n-Propylbenzene	9.8	30	70 – 130	30	70 – 130
4-Ethyltoluene	9.8	30	70 – 130	30	70 – 130
1,3,5-Trimethylbenzene	9.8	30	70 – 130	30	70 – 130
1,2,4-Trimethylbenzene	29	30	70 – 130	30	70 – 130
1,3-Dichlorobenzene	6.0	30	70 – 130	30	70 – 130
1,4-Dichlorobenzene	6.0	30	70 – 130	30	70 – 130
1,2-Dichlorobenzene	6.0	30	70 – 130	30	70 – 130
1,2,4-Trichlorobenzene	15	30	70 – 130	30	70 – 130
Hexachlorobutadiene	21	30	70 – 130	30	70 – 130
Chloroethane†	16	30	70 – 130	30	70 – 130
Isopropyl alcohol†	49	30	70 – 130	30	70 – 130
Carbon Disulfide†	6.2	30	70 – 130	30	70 – 130
MTBE†‡	22	30	70 – 130	30	70 – 130
Methyl Ethyl Ketone†	59	30	70 – 130	30	70 – 130

Polyaromatic Hydrocarbons	Reporting Limit (ng)	ICAL (%RSD)	ICV (%R)	CCV (%D)	LCS (%R)
Naphthalene	0.5	30	70 – 130	30	70 – 130
2-Methylnaphthalene	1.0	30	70 – 130	30	70 – 130
1-Methylnaphthalene	1.0	30	70 – 130	30	70 – 130
Acenaphthylene	5.0	30	70 – 130	30	70 – 130
Acenaphthene	5.0	30	70 – 130	30	70 – 130
Fluorene	5.0	30	60 – 140	40	60 – 140
Phenanthrene	5.0	30	60 – 140	40	60 – 140
Anthracene	5.0	30	60 – 140	40	60 – 140
Fluoranthene	5.0	30	60 – 140	40	60 – 140
Pyrene	5.0	30	60 – 140	40	60 – 140

†Non-routine compounds by special request only.
‡Poor recovery performance when dry purge is applied for sample collection volumes greater than 1 Liter.

Table 3. Commonly requested TPH parameters – Optional

TPH	Reporting Limit (ng)	ICAL (%RSD)	ICV (%R)	CCV (%D)	LCS (%R)
GRO (Gasoline Range)	1000	30	60-140	30	60 – 140
DRO (C10-C24 Diesel Range)	1000	30	60-140	30	60 – 140

Table 4. Internal Standard and Field Surrogate Recoveries

Internal Standards		
Analyte	**CCV IS % Recovery**	**Sample IS % Recovery**
Bromochloromethane	60 – 140	60 – 140
1,4-Difluorobenzene	60 – 140	60 – 140
Chlorobenzene-d_5	60 – 140	60 – 140
Bromofluorobenzene	60 – 140	60 – 140
Field Surrogates		
Analyte	**% Recovery**	
1,2-Dichloroethane-d4	50 – 150	
Toluene-d8	50 – 150	
Naphthalene-d8	50 – 150	

Table 5. Summary of Calibration and QC Procedures for Modified Method TO-17 VI

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
BFB Tune Check	Before initial and daily calibration. Check is valid for 24 hours.	TO-15 tune criteria	Correct problem then repeat tune.
5-Point Calibration	Prior to sample analysis	%RSD $\leq$ 30% with 2 VOCs exceeding up to 40% RSD and 2 PAHS exceeding criteria up to 40%RSD.	Correct problem then repeat Initial Calibration Curve.
Initial Calibration Verification (ICV)	After each initial Calibration Curve	See Table 2; 20% of the compounds are allowed to exceed criterion.	Determine if the exceedance is due to an inaccurate calibration standard or inaccurate ICV standard. Recalibrate with an accurate standard or re-prepare the ICV as necessary. If any VOC exceeds 50–150% recovery, system is checked and the ICV is reanalyzed. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case-by-case basis.
Continuing Calibration Verification (CCV)	At the start of each 24-hour clock after the Tune Check	70 – 130% 60–140% for Fluorene, Phenanthrene, Anthracene, Fluoranthene and Pyrene	If project-specified risk drivers exceed these criteria, more than 5% of the compounds exceed these criteria, or any VOC exceeds 50–150% recovery, maintenance is performed and the CCV test repeated. If the system still fails the CCV, perform a new 5-point Calibration Curve.
Laboratory Blank	After the CCV and before the samples and at end of sequence	Results less than the laboratory RL for Lab Blank analyzed prior to samples	Inspect the system and re-analyze the Blank. Flag associated data as appropriate.
Laboratory Control Spike (LCS)	Once per analytical batch	70 – 130% 60–140% for Fluorene, Phenanthrene, Anthracene, Fluoranthene and Pyrene; 20% of compound list may exceed criteria before corrective action is required.	Verify accuracy of standard. Re-prepare LCS if necessary. If calibration curve and/or system is found to be out of control, perform maintenance and re-calibrate. If any VOC exceeds 50–150% recovery, maintenance is performed and the ICV test is repeated. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case-by-case basis.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Laboratory Control Spike Duplicate (LCSD)	Once per analytical batch (reanalysis of LCS)	<20%RPD for all compounds with exception of Fluorene, Phenanthrene, Anthracene, Fluoranthene, and Pyrene which must be <30%RPD.	Verify accuracy of standard. Re-prepare LCS if necessary. If calibration curve and/or system is found to be out of control, perform maintenance and re-calibrate. If any VOC exceeds 50–150% recovery, maintenance is performed and the ICV test is repeated. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case-by-case basis.
Internal Standard (IS)	As each QC sample and sample are being loaded	**CCVs:** Area counts > 60% recovery; Retention Time (RT) within 20 seconds of mid-point in ICAL. **Blanks and samples**: Retention time (RT) must be within ±0.33 minutes of the RT in the CCV. The IS area must be within ±40% of the CCV's IS area for the Blanks and samples.	**CCV:** Inspect and correct system prior to sample analysis. **Blanks:** Inspect the system and re-analyze the Blank. **Samples:** Investigate the problem by verifying the instrument is in control by running a Lab Blank. Re-analyze recollected samples to verify recovery. Report the run with acceptable IS recovery. If both runs are unacceptable, narrate and flag associated data.
Field Surrogates	Added to each tube prior to shipment to field. Added to QC samples prior to analysis.	50–150%, or in-house control limits	**For blanks:** Inspect the system and re-analyze the Blank. **For samples:** Review data to determine whether sample collection parameters or matrix interference resulted in the exceedances. If so, narrate and flag recovery. If no cause is evident, verify the instrument is in control by running a Lab Blank. Re-analyze recollected sample to verify recovery.
Field Blank	Project-dependent	Artifact levels should be less than the reporting limit or less than 10% of the mass measured on the sampled tubes, whichever is less.	Flag associated results and evaluate tube conditioning and storage procedures.
Distributed Pairs	Project-dependent	%RPD ≤ 25%	Narrate discrepancy.