
Final

Additional Vapor Intrusion Evaluation Work Plan

Former Synertek Building No. 1 Facility
Santa Clara, California

Prepared for

Honeywell International Inc.

June 2014

CH2MHILL®

155 Grand Avenue
Suite 800
Oakland, CA 94612

Additional Vapor Intrusion Evaluation Work Plan

Former Synertek Building No. 1 Santa Clara, California

Submitted to

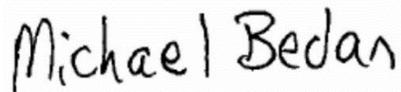
California Regional Water Quality Control Board, San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

On behalf of

Honeywell International Inc.
Torrance, CA

June 25, 2014

Prepared by



Mike Bedan, Vapor Intrusion Task Leader

June 25, 2014

Date

Approved by



Teresa Tamburello, P.E., Project Manager

June 25, 2014

Date

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Acronyms and Abbreviations

| | |
|-------------------|---|
| µg/L | micrograms per liter |
| µg/m ³ | micrograms per cubic meter |
| DCA | dichloroethane |
| DCE | dichloroethene |
| DTSC | Department of Toxic Substances Control (California Environmental Protection Agency) |
| ESL | environmental screening level |
| ft ² | square foot |
| HAPSITE | Inficon HAPSITE portable gas chromatograph/ mass spectrometer |
| Honeywell | Honeywell International Inc. |
| HVAC | heating, ventilation, and air-conditioning. Includes additional air-handling devices such as fume hoods and clean-room-associated units |
| ITRC | Interstate Technology Regulatory Council |
| NPL | National Priority List |
| PCE | tetrachloroethene |
| QAPP | Quality Assurance Project Plan |
| RAL | interim short-term response action level |
| RBSL | risk-based screening level |
| ROD | Record of Decision |
| RSL | regional screening level |
| SCR | Site Cleanup Requirements |
| SOP | standard operating procedure |
| TCA | trichloroethane |
| TCE | trichloroethene |
| USEPA | United States Environmental Protection Agency |
| VI | vapor intrusion |
| VISL | vapor intrusion screening level |
| VOC | volatile organic compound |
| Water Board | California Regional Water Quality Control Board, San Francisco Bay Region |

SECTION 1

Introduction

CH2M HILL, on behalf of Honeywell International Inc. (Honeywell), has prepared this additional vapor intrusion (VI) evaluation work plan (Additional VI Work Plan) for the former Synertek Building No. 1 in Santa Clara, California (site) (Figure 1-1). The site is currently occupied by a building with three addresses: 3050, 3060, and 3070 Coronado Drive. This additional VI work plan was prepared in response to the request issued by the California Regional Water Quality Control Board, San Francisco Bay Area (Water Board) on December 16, 2013 (Water Board, 2013a) in light of the following new U.S. Environmental Protection Agency (USEPA) guidance:

- *External Review Draft –Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from the Subsurface to Indoor Air* (USEPA, 2013a).
- *Guidelines and Supplemental Information Needed for Vapor Intrusion Evaluations at South Bay National Priority List Sites* (USEPA Region 9, 2013a).

Environmental activities at the site are conducted under the Water Board Site Cleanup Requirements (SCR) Order No. 91-051 (Water Board, 1991). Under agreements with the USEPA, the Water Board provides lead regulatory oversight for environmental activities at the site. The USEPA has been involved in this site since it was included on the National Priority List (NPL) as a Superfund site in 1991 and since a USEPA Record of Decision (ROD) was issued (USEPA, 1991). Recently, the USEPA has been providing VI guidance to the South Bay NPL sites as a group, and the site has been included in that group because of its geographic location.

The results of the VI evaluation activities outlined in this additional work plan and the results of the previous VI evaluations at the site, as reported in the *Vapor Intrusion Evaluation Report, March/April 2013* (2013 VI Report, CH2M HILL, 2013a), will provide information to help the Water Board further evaluate potential VI concerns arising in light of new USEPA guidance. Specifically, within the new USEPA guidance, this Additional VI Work Plan will address the following items:

- Commercial indoor air sampling with the heating, ventilation, and air-conditioning (HVAC) system turned off.
- VI evaluation in the offsite commercial buildings overlying the Synertek groundwater pollutant plume where groundwater trichloroethene (TCE) levels exceed 5 micrograms per liter ($\mu\text{g/L}$).
- Comparison of indoor air sampling results to the interim TCE short-term response action levels (RAL).

1.1 Objective

The objective of this Additional VI Work Plan is to comply with the Water Board and USEPA requests to further assess potential impacts to indoor air from site-related volatile organic compounds (VOCs) detected in the shallow groundwater.

1.2 Organization of the Document

This report is structured as follows:

- Section 1 introduces the work plan, as well as its objective and organization.
- Section 2 describes the site and its background.
- Section 3 describes the scope of the planned VI evaluation activities, including a description of the project area, building survey, preliminary screening assessment, sampling and analysis plan, quality assurance plan, health and safety plan, and public outreach plan.
- Section 4 presents the proposed data evaluation approach and the potential response actions that may be completed after evaluation of the investigation data.
- Section 5 presents the reporting associated with this VI evaluation and proposed schedule.

Site Background

2.1 Site Location and History

The site is located at 3050 Coronado Drive in Santa Clara, California, in a relatively flat portion of the Santa Clara Valley. The site covers approximately 1.5 acres on a level parcel of land, and contains one structure (a 23,100 square foot [ft²] office building) and parking areas. This is an industrial park setting, dominated by the electronics industry. That being the case, the majority of the area is developed and largely paved. Surface water is controlled by the storm sewer system, which directs runoff to San Tomas Aquino Creek. Residential areas are located 3,600 feet south of the site and 6,000 feet north-northeast of the site. None of these residential areas are within the areas impacted by the past chemical releases onsite.

The area was agricultural land prior to 1974, when Synertek Inc. (Synertek) leased the site for semiconductor manufacturing. In 1979, Honeywell acquired Synertek as a wholly owned subsidiary. Synertek manufacturing operations ceased in 1985, and the building remained vacant until 1989, when it was leased to two tenants (Media Publications, Inc., and Westmar Printing Company). Today, Jim Lindsey and Kalil Jenab own the site and lease the building. Approximately 18,900 ft² of the building was leased to Crystal Solar in 2008 and is currently used as office space and for research and development of solar panels. The address for this space is both 3050 Coronado Drive and 3070 Coronado Drive. Approximately 4,200 ft² of the building—listed at 3060 Coronado Drive—was leased to Family Prayer House in 2013.

Prior to 1985, Synertek constructed and operated two underground tank systems east of the building. One 200-gallon-capacity solvent tank was used for storing solvents between 1976 and 1982. Three former neutralization system tanks were used between 1974 and 1982 as holding tanks. These tanks stored a variety of chemicals, including chlorinated solvents. The quantity of solvents released by these tanks and the dates of the releases are unknown. These tanks, along with the affected soils, were removed in 1985. VOCs related to the past releases associated with historical operations are found in groundwater at the site. Investigation and remediation activities have been ongoing since the 1980s at the site.

Further information on site geology, hydrogeology, and remediation history is provided in the *Focused Feasibility Study Report* (CH2M HILL, 2013b).

2.2 Site Contamination

On March 20, 1991, the Water Board issued SCR Order No. 91-051 for the site, which established final cleanup standards for the target VOCs:

- Trichloroethene (TCE): 5 µg/L
- 1,1-Dichloroethene (DCE): 6 µg/L
- 1,1-Dichloroethane (DCA): 5 µg/L
- 1,1,1-Trichloroethane (TCA): 200 µg/L
- Vinyl chloride: 0.5 µg/L
- 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113): 1,200 µg/L
- trans-1,2-Dichloroethene (trans-1,2-DCE): not established

Based on the 2013 groundwater monitoring and sampling data for the site (CH2M HILL, 2014), total target VOC concentrations within the plume show that the size and location of the plume have generally remained relatively unchanged since 2001, when a groundwater extraction and treatment system was shut down, although TCE concentrations have decreased significantly in the source area since performing groundwater treatment (enhanced in situ bioremediation) in May 2011.

Figure 2-1 presents the TCE concentrations contours for the zone A-aquifer. TCE concentrations in groundwater above 5 µg/L are potentially found beneath the onsite building and one offsite building (3111 Coronado Drive).

2.3 Previous Vapor Intrusion Evaluation Activities

On March 1, 2012, a VI evaluation for the onsite building was requested by the USEPA and the Water Board during a conference call to support the USEPA's protectiveness determination of the remedy at the site; the protectiveness determination of the remedy is reported in the five-year review report required in 2012 (USEPA, 2012).

CH2M HILL conducted a building survey, pathway sampling, and preliminary indoor air-screening assessment for the onsite building using the HAPSITE (under normal HVAC operating conditions) on April 24, 2012. The available evidence from the building survey and the preliminary indoor air evaluation indicated that the VI pathway into the onsite building from groundwater contamination at the site is not a potential concern under current conditions. However, given the uncertainty in addressing this pathway and the potential for changing building conditions in the future, an additional investigation was recommended. More detailed results of the building survey, pathway sampling, and preliminary indoor air-screening assessment are included in the *Revised Vapor Intrusion Investigation Work Plan* (hereinafter 2012 Revised VI Work Plan) submitted in October 2012 (CH2M HILL, 2012a).

On June 29, 2012, CH2M HILL submitted a VI work plan (CH2M HILL, 2012b) to the Water Board. CH2M HILL received comments on the VI work plan from the Water Board in an e-mail dated August 9, 2012 (Water Board, 2012). On October 2, 2012, CH2M HILL submitted to the Water Board the 2012 Revised VI Work Plan (CH2M HILL, 2012a), which addressed Water Board comments. The 2012 Revised VI Work Plan was conditionally approved by the Water Board on February 19, 2013 (Water Board, 2013b). The conditional approval required collecting an additional indoor air sample from the fire closet in the building and removing, at least 48 hours prior to sampling, a TCE container (used by the current tenant) that was identified during the April 2012 building inspection.

The results of this VI evaluation for the onsite building with the HVAC on are presented in the 2013 *VI Evaluation Report* (CH2M HILL, 2013a) and indicate that the VI pathway is not complete or significant under current building use and no further action is required. Although the low groundwater concentrations beneath the buildings at the site paired with the conclusions of the 2013 *VI Evaluation Report* (CH2M HILL, 2013a) do not indicate that the VI pathway is complete or significant under current building use and no further action should be required, the Water Board issued a 13267 letter on December 16, 2013 (Water Board, 2013a) to Honeywell requesting an additional vapor intrusion investigation work plan for the site to address USEPA December 3, 2013 guidance (USEPA, 2013a) and USEPA Region 9 VI guidance for the South Bay NPL sites (USEPA Region 9, 2013a). This Additional VI Work Plan was prepared in response to the Water Board request.

Planned Vapor Intrusion Evaluation Activities

3.1 Project Area and General Scope of Activities

Based on the new USEPA VI guidance (USEPA Region 9, 2013b and 2013c), the Water Board indicated that VI study areas should include buildings within the 5 µg/L TCE shallow-zone groundwater contour. This would include the onsite building and one offsite building (3111 Coronado Drive), as shown in Figure 2-1.

Based on site conditions, results of the 2012 and 2013 VI evaluation activities, recent USEPA vapor intrusion guidance, and a Water Board request, this additional work plan includes:

- Performing a building survey at the onsite building and one offsite building (3111 Coronado Drive), which will include identifying potential VI pathways and gathering detailed information on the HVAC system setup and operation.
- Performing a preliminary screening and pathway sampling using a portable gas chromatograph/mass spectrometer (HAPSITE) at the onsite building and one offsite building (3111 Coronado Drive) with the HVAC operating normally.
- Performing indoor air and subslab soil gas sampling at the one offsite building (3111 Coronado Drive) with the HVAC system operating normally, provided that permission to conduct sampling is granted by the property owner and the tenant(s). The EPA will be notified if this permission cannot be obtained.
- Performing pathway sampling, indoor/outdoor air sampling, and subslab soil gas sampling at the onsite building and one offsite building (3111 Coronado Drive) with the HVAC off¹ provided that permission to conduct sampling is granted by the property owner and the tenant(s). The EPA will be notified if this permission cannot be obtained.
- Performing a VI data evaluation that uses VI screening levels based on a 10-hour workday and includes the TCE indoor air short-term RAL² and mitigation response guidelines.

3.2 Building Survey

The building survey will consist of a visual survey of the building, an interview with one or several of the building owners and/or tenants, and a detailed evaluation of the building systems.

3.2.1 Visual Survey and Interviews

A visual survey of the onsite building and the one offsite building (3111 Coronado Drive) will be conducted, and building owners and/or tenants will be interviewed to determine additional information about the building. The visual surveys and interviews will, at a minimum, include:

¹ Although USEPA stated that “it may be useful to assess susceptibility to soil gas entry and diagnose vapor intrusion in such buildings under conditions when the HVAC system is not operating” (USEPA, 2013b), shutting down the HVAC system for an extended period of time is inconsistent with the current operation of the buildings in the project area. Normal building use and building codes for the project area include operating the HVAC system 24 hours a day. Sampling indoor air with the HVAC system off is not representative of normal operating conditions and is not considered representative of building indoor air quality. Doing so may result in detections of VOCs in the indoor air that would not be detected during normal operations or that are higher than what would be measured during normal operations.

² Honeywell agrees in principle for the need to promptly respond to VI conditions that may pose a human health risk. As a matter of practice, Honeywell incorporates contingency planning into its VI assessment process to be able to promptly deploy interim measures (including sealing, air purifiers, and HVAC modifications) as needed to address TCE indoor air concentrations that are higher than regulatory screening levels. However, Honeywell has concerns that USEPA’s recommendations (USEPA Region 9, 2013a and 2013b) are not sufficiently developed to formulate appropriate responses to elevated indoor air concentrations potentially associated with VI. Although Honeywell believes significant scientific uncertainty is associated with current TCE short-term RALs based on the risks of fetal cardiac malformations, and is concerned regarding their use in regulatory decision-making at VI sites, Honeywell has incorporated the short-term limits and response timeframes referenced in EPA’s November 21, 2013, comment letter (USEPA Region 9, 2013b) as a consideration as part of the data evaluation included in this work plan. Honeywell welcomes an opportunity to discuss this issue further with the Regional Board.

- Conducting interviews with available building managers or other workers familiar with the building and office environment to document building use, hours of operation, types of chemicals used within the building, and generally how the HVAC system is set up and operates.
- Observing and documenting the building layout and building construction features.
- Identifying potential storage and indoor uses of chemicals or products to document potential indoor sources that might affect indoor air-sampling results. This task will include requesting and reviewing Material Safety Data Sheets, if applicable, during the interviews.
- Identifying potential pathways for VI (that is, presence of intrusion points, cracks, joints, drains, or other potential vapor-entry points).
- Identifying potential locations for subslab samples; also identifying potential utility clearance problems with those locations and flooring and foundation conditions.
- Identifying potential locations for indoor air samples.
- Evaluating overall building airflow characteristics by observing areas that might be pressurized either positively or negatively and, if feasible, the relative portion of outside air being supplied to indoor spaces.
- Determining, based on discussions with the building manager, whether HVAC systems associated with clean rooms or other dedicated spaces can be turned off for a period of 36 hours prior to sampling without disrupting normal building occupant operations.

The building survey standard operating procedure (SOP) is included in Appendix A. A written description of work performed, including documentation provided by the owner and/or tenant(s), will be included in the report.

3.2.2 HVAC Survey

An HVAC survey of the onsite building and the one offsite building (3111 Coronado Drive) will be conducted to assess the existing HVAC systems within the buildings to determine whether they are operating properly with sufficient makeup air being brought into the building. In addition, the HVAC systems shall be evaluated to determine whether they can maintain a positive pressure in the occupied spaces relative to the subslab and the outdoor pressures or whether they can be modified to increase the exchange rate inside the entire building. The survey will also assess the contribution of any mechanical air handlers associated with clean rooms or other dedicated spaces. The HVAC surveys will, at a minimum, include:

- Identifying the number, location, and type of the various components of the mechanical air-handling and other HVAC systems, including air-handling units, control units, and return/exhaust fans.
- Determining how air is distributed within the occupied spaces by identifying supply, return, and exhaust air distribution or pathways.
- Determining how the HVAC systems are controlled, both for temperature and ventilation air quantities.
- Interviewing operation and maintenance staff to understand the current operating parameters and internal comfort set points for HVAC equipment; any known operation or maintenance issues; and any planned changes to the currently operating systems.
- Measuring the operating parameters of the air-handling systems (amount of total supply air, total return air, total exhaust air, and outside air) under current and varying conditions. Possibly adjusting available controls and set points to determine the system air flow rates under a variety of expected operating conditions for the HVAC systems.
- Collecting name-plate data from the components of the HVAC systems.
- Determining whether clean rooms or other dedicated spaces (if present) are negatively or positively pressurized and are connected or isolated from other parts of the building or HVAC systems.

The HVAC survey SOP is included in Appendix A. A written description of work performed, including documentation of measurements and information, will be included in the report.

3.3 Preliminary Screening Assessment

A HAPSITE will be used to do a preliminary screening assessment of the buildings to:

- Obtain a preliminary understanding of indoor air concentrations.
- Evaluate the potential for background sources within the buildings.
- Survey potentially significant vapor entry pathways identified during the building survey.
- Aid in the selection of pathway, indoor air, and subslab soil gas sampling locations.

Grab samples (1 to 5 minutes in duration) will be taken at various locations within the building using the HAPSITE in quantitation (“quant”) mode to get a preliminary understanding of indoor air concentrations and determine whether certain areas of the buildings are higher in VOCs than others. The HAPSITE will then be used in survey mode (also called the “sniff” mode) to help identify vapor-entry points (for example, near plumbing drains) and/or background indoor sources of VOCs. Pathway and indoor air-sampling locations, as outlined in Section 3.5, may be biased toward areas or rooms in the buildings where higher concentrations of VOCs are detected and/or closer to suspected points of entry.

The HAPSITE does have limitations and cannot identify all potential indoor sources and/or points of entry that may be present and detecting vapor potentially entering through entry points does not conclude that there is significant VI occurring; therefore, the HAPSITE results will not be interpreted as a single line of evidence. The HAPSITE data will be used in conjunction with the other lines of evidence (for example, subslab soil gas sampling, indoor/outdoor air sampling, building characteristics, building survey results, chemical use history) for assessing the occurrence and significance of VI. It will also be used to identify any points of entry should interim mitigation activities (such as sealing cracks) be required.

The quant mode sample locations will be marked on a map and linked to a photographic log for each point surveyed. The survey mode sample locations will also be marked on a map with an indication of whether noticeable levels are detected (based on survey mode detection limit). The locations will also be linked to a photographic log for each point surveyed. A written description of work performed, including results, will be included in the report.

3.4 Sampling and Analysis Plan

Pathway, indoor air, subslab soil gas, and outdoor air sampling will be conducted at the onsite building and one offsite building (3111 Coronado Drive) after the building survey and preliminary screening assessment are completed. If any background sources are discovered during the building survey, they will be removed at least 36 hours prior to indoor air sampling (if possible). When possible, the sampling performed during each event will be conducted concurrently. VI sampling at the site will be completed both with the HVAC operating normally and with the HVAC system turned off for a minimum of 36 hours, if allowed by site commerce and operations. Subslab samples will be taken concurrently with the indoor air samples to understand whether having the HVAC off causes any changes in the concentrations of VOCs in the subslab soil gas. However, in some cases (clean room, fume hood, etc.), it may not be possible or to turn off all devices. This information will be gathered during the building and HVAC survey, and the locations of the samples will be revised as needed.

All sampling requires permission to conduct sampling is granted by the property owner and the tenant(s). The EPA will be notified if this permission cannot be obtained. Table 3-1 summarizes the proposed sampling and analysis activities, and Table 3-2 provides the sample identifiers from the proposed sampling locations.

The following sections outline the sample collection methodology, analytical methods, field documentation, and quality control measures to be implemented. The proposed number and locations of samples may be modified based on results of the building survey and preliminary screening assessment. Revised locations and number of

samples will be submitted conceptually to the Water Board and USEPA for approval prior to performing the sampling. Any changes to the proposed number and type of samples to be collected at each building will be presented as an update to this Additional VI Work Plan following completion of the building surveys and pathway sampling.

3.4.1 Pathway Sampling

Pathway sampling will be conducted during each event using a HAPSITE. Grab or quant mode samples (1 to 5 minutes in duration) will be taken at various locations identified during the building survey to be potential VI pathways (that is, intrusion points, cracks, joints, drains, or other potential vapor-entry points) and where elevated responses were measured during the preliminary screening assessment. The grab samples will be taken as close as possible to the entry point and, if VOC concentrations are elevated, may also be taken in the breathing zone in the vicinity of the entry point. The HAPSITE does have limitations and cannot identify all points of entry that may be present and detecting vapor potentially entering through entry points does not conclude that there is significant VI occurring; therefore, the HAPSITE results will not be interpreted as a single line of evidence. The HAPSITE data will be used in conjunction with the other lines of evidence (for example, subslab soil gas sampling, indoor/outdoor air sampling, building characteristics, building survey results, chemical use history) for assessing the occurrence and significance of VI. It will also be used to identify any points of entry should interim mitigation activities (such as sealing cracks) be required.

The quant mode sample locations will be marked on a map and linked to a photographic log for each point sampled. A written description of work performed, including results, will be included in the report.

3.4.2 Indoor Air Sampling

Indoor air sampling will be conducted during each event. Indoor air sampling will occur over a 10-hour period using 6-liter SUMMA canisters equipped with flow controllers as outlined in the *Standard Operating Procedure for Indoor, Outdoor, and Crawl Space Air Sampling for VOCs Using Canisters*, provided in Appendix B, which is consistent with methods described in DTSC (2011 and 2012a), USEPA (2002), and ITRC (2007) VI guidance.

The canisters will be placed at the sampling locations, turned on, and left undisturbed for 10 hours during each event. For indoor air sampling with the HVAC turned off for a minimum of 36 hours, the windows of the building will be closed. Doors, intake vents, and other openings will also be closed, as is practicable. For indoor air sampling with the HVAC operating normally, indoor air sampling will be conducted under conservative conditions following DTSC guidance (DTSC, 2011): "In general, the windows of the building should be closed. However, certain exceptions may be necessary if sampling is done in the summer in a building that is not air conditioned. Likewise, ingress and egress activities should be minimized. Heating, ventilation, and air conditioning (HVAC) systems should be operated normally for the season and time of day."

Figure 3-1 shows seven proposed indoor air-sample locations and one outdoor air-sample location for the onsite building. These proposed indoor air-sample locations are approximately the same locations sampled during the previous March/April 2013 sampling event, which were based on location relative to the core of the groundwater plume (as indicated by the groundwater sampling results in monitoring well [MW] 07A, MW-12A, and MW-37A), the results of the building survey (April 2012), activities of the building occupants, and at the request of the USEPA (that is, the closet containing the fire sprinkler system riser). Figure 3-2 shows seven proposed indoor air-sample locations and one outdoor air-sample location for the offsite building (3111 Coronado Drive). These locations were based on the general layout of the building. The proposed number of samples and locations may be modified based on results of the building survey and preliminary screening assessment. Revised locations and number of samples will be submitted to the Water Board for approval prior to performing the sampling.

The indoor air samples will be shipped via FedEx to an analytical laboratory under standard chain-of-custody protocol. The sample canisters will be shipped in a cardboard box at ambient temperature. The indoor air samples will be analyzed for VOCs using USEPA Method TO-15 SIM (that is, selective ion-monitoring mode).

3.4.3 Subslab Soil Gas Sampling

Temporary subslab soil gas probes will be installed to allow sampling of the subslab soil gas. A USA ticket will be opened, and a private utility location survey will be conducted to clear utilities prior to installing the subslab soil gas probes. The temporary subslab soil gas probes (Cox Colvin vapor pins) will be installed in the foundation of the building and removed, as outlined in the *Standard Operating Procedure Installation and Extraction of the Vapor Pin*, provided in Appendix C. The temporary soil gas probes will be removed when the Water Board agrees that no further subslab soil gas sampling is required.

Subslab soil gas sampling will be conducted during each event. Subslab soil gas sampling will occur over a 10-hour period using 6-liter SUMMA canisters equipped with flow controllers as outlined in the *Standard Operating Procedure for Installing Subslab Probes and Collecting Subslab Soil Gas Samples using SUMMA Canisters*, provided in Appendix C, which is consistent with methods described in DTSC (201 and 2012a), USEPA (2002), and ITRC (2007) VI guidance.

Figure 3-1 shows seven proposed subslab soil gas sample locations for the onsite building. These proposed subslab soil gas sample locations are approximately the same locations sampled during the previous March/April 2013 sampling event and will be paired with the indoor air-sampling locations. Figure 3-2 shows seven proposed subslab soil gas sample locations for the offsite building (3111 Coronado Drive). These locations were based on the general layout of the building and will be paired with the indoor air-sampling locations. The proposed number of samples and locations may be modified based on results of the building survey and preliminary screening assessment. Revised locations and number of samples will be submitted to the Water Board for approval prior to performing the sampling.

The subslab soil gas samples will be shipped via FedEx to an analytical laboratory under standard chain-of-custody protocol. The sample canisters will be shipped in a cardboard box at ambient temperature. The subslab soil gas samples will be analyzed for VOCs using USEPA Method TO-15 (Scan method).

3.4.4 Outdoor Air Sampling

Outdoor air sampling will be conducted during each event. Outdoor air sampling will occur over a 10-hour period using 6-liter SUMMA canisters equipped with flow controllers as outlined in the *Standard Operating Procedure for Indoor, Outdoor, and Crawl Space Air Sampling for VOCs Using Canisters*, provided in Appendix B, which is consistent with methods described in DTSC (2011 and 2012a), USEPA (2002), and ITRC (2007) VI guidance.

Figure 3-1 shows the one proposed outdoor sample location for the onsite building. Figure 3-2 shows the one proposed indoor air sample location for the offsite building (3111 Coronado Drive). The outdoor air-sample canister will be secured to a fence or other structure with a chain and padlock, if feasible. Appropriate signage, with a description of the sampling and contact information, will be included on and near the outdoor canister.

The outdoor air samples will be shipped via FedEx to an analytical laboratory under standard chain-of-custody protocol. The sample canisters will be shipped in a cardboard box at ambient temperature. The outdoor air samples will be analyzed for VOCs using USEPA Method TO-15 SIM.

3.4.5 Quality Control and Contingency Sampling

Field duplicates will be collected at a minimum frequency of 10 percent or one per sampling event, whichever is more frequent for each type of analysis as indicated in the Quality Assurance Project Plan (QAPP) (Appendix D). This equates to one indoor air and one subslab soil gas field duplicate per building per event (a total of six field duplicates).

The proposed number and locations of samples may be modified based on results of the building survey and preliminary screening assessment. Revised locations and number of samples will be submitted to the Water Board for approval prior to performing the sampling. In addition to those modifications based on results of the building survey and preliminary screening assessment that will be approved by the Water Board, contingency samples may be collected during the sampling event if the following conditions occur:

- New potential background source is identified within the buildings.

- New potential VI pathway is identified within the buildings.
- Results of the building survey show the potential for significant indoor air transfer through the walkway between 3111 and 3151 Coronado Drive

The contingency sampling will be conducted initially using the HAPSITE in the quant mode and if VOC concentrations are detected at concentrations exceeding the indoor air RBSLs, an additional indoor air sample may be collected using a SUMMA canister.

3.5 Quality Assurance Project Plan

CH2M HILL has prepared a QAPP for this investigation, included as Appendix D. This QAPP was prepared to present the project-specific quality assurance/quality control requirements for all sampling activities at the site. The QAPP is intended for use by CH2M HILL and its subcontractors who provide services associated with the environmental data-collection effort.

Data-quality validation will be performed to assess the effects of the overall field and analytical processes on the usability of the data. The subslab soil gas, indoor air, and outdoor air analytical data will be validated in accordance with the QAPP.

3.6 Health and Safety Plan

CH2M HILL has prepared a site-specific Health and Safety Plan, included as Appendix E, to be kept onsite during field activities and reviewed as necessary. The Health and Safety Plan contains information regarding potentially hazardous substances that have previously been detected in groundwater at the site. It also provides emergency contact information, hazard controls, an emergency response plan, and incident notification procedures.

3.7 Public Outreach Plan

Honeywell is committed to informing owners and tenants about the groundwater cleanup and VI evaluation work conducted and/or planned for the site. USEPA and Honeywell will jointly implement a public outreach plan prior to and after conducting the activities outlined in this Additional VI Work Plan. In addition, prior to any work being performed, Honeywell will need to secure access with each of the owners. The public outreach plan proposed for this site was based on DTSC's *Final Vapor Intrusion Public Participation Advisory* (DTSC, 2012b) and includes the following items (listed in order of occurrence):

- Honeywell submits information to the Water Board and USEPA to prepare a Fact Sheet for the site to facilitate understanding of the vapor intrusion evaluation.
- Water Board and USEPA finalize the Fact Sheet and it is posted to the public on Geotracker and the USEPA websites associated with the site.
- Honeywell receives agency approval of the Additional VI Work Plan and contacts owners to discuss access and plan to implement Additional VI Work Plan.
- Honeywell team facilitates a meeting with tenants to discuss sampling locations and schedules, property restoration requirements, access restrictions, sampling event instructions, and emphasize the importance of providing accurate information and being available at the scheduled sampling time. The building survey interviews may also be conducted during this meeting.
- Project team issues a follow-up reminder or work notice prior to the scheduled sampling event that lists products that commonly contain volatile chemicals that should be removed or not used 48 hours prior to the sampling time, provides written information concerning the sampling process, provides contact information for questions and concerns (including access to an interpreter or translated information when necessary or requested), and dates and details about how and when the sampling results will be communicated.

TABLE 3-1
Proposed Sampling Events and Sampling Activities
Additional Vapor Intrusion Evaluation Work Plan

| Sampling Event | Street Address | HVAC Status | Pathway Sampling | Proposed Number of Samples ⁽¹⁾ | | |
|-------------------|--------------------------|-------------------------------|-------------------|---|---------------------------------|----------------------------|
| | | | | Indoor Air ⁽²⁾ | Subslab Soil Gas ⁽³⁾ | Outdoor Air ⁽²⁾ |
| Onsite, HVAC off | 3050-3070 Coronado Drive | Off for a minimum of 36 hours | Yes, with HAPSITE | 7 + 1 FD | 7 + 1 FD | 1 |
| Offsite, HVAC on | 3111 Coronado Drive | Operating normally | Yes, with HAPSITE | 7 + 1 FD | 7 + 1 FD | 1 |
| Offsite, HVAC off | 3111 Coronado Drive | Off for a minimum of 36 hours | Yes, with HAPSITE | 7 + 1 FD | 7 + 1 FD | 1 |

Notes:

(1) The proposed number of samples may be modified based on results of the building survey and preliminary screening assessment.

(2) Indoor and outdoor air samples will be analyzed for VOCs by USEPA Method TO-15 SIM.

(3) Subslab soil gas samples will be analyzed for VOCs by USEPA Method TO-15 (Scan method).

FD = field duplicate

TABLE 3-2

Proposed Sampling Location Identifiers*Additional Vapor Intrusion Evaluation Work Plan*

| Sampling Event | Street Address | Indoor Air⁽¹⁾ | Subslab Soil Gas⁽¹⁾ | Outdoor Air⁽¹⁾ |
|-----------------------|--------------------------|---------------------------------|---------------------------------------|----------------------------------|
| Onsite, HVAC off | 3050-3070 Coronado Drive | SYN-IA-1-YYMMDD | SYN-SS-1-YYMMDD | SYN-OA1-YYMMDD |
| | | SYN-IA-2-YYMMDD | SYN-SS-2-YYMMDD | |
| | | SYN-IA-3-YYMMDD | SYN-SS-3-YYMMDD | |
| | | SYN-IA-4-YYMMDD | SYN-SS-4-YYMMDD | |
| | | SYN-IA-5-YYMMDD | SYN-SS-5-YYMMDD | |
| | | SYN-IA-6-YYMMDD | SYN-SS-6-YYMMDD | |
| | | SYN-IA-7-YYMMDD | SYN-SS-7-YYMMDD | |
| | | SYN-IA-X-FD-YYMMDD | SYN-SS-X-FD-YYMMDD | |
| Offsite, HVAC on | 3111 Coronado Drive | SYN2-IA-1-YYMMDD | SYN2-SS-1-YYMMDD | SYN2-OA1-YYMMDD |
| | | SYN2-IA-2-YYMMDD | SYN2-SS-2-YYMMDD | |
| | | SYN2-IA-3-YYMMDD | SYN2-SS-3-YYMMDD | |
| | | SYN2-IA-4-YYMMDD | SYN2-SS-4-YYMMDD | |
| | | SYN2-IA-5-YYMMDD | SYN2-SS-5-YYMMDD | |
| | | SYN2-IA-6-YYMMDD | SYN2-SS-6-YYMMDD | |
| | | SYN2-IA-7-YYMMDD | SYN2-SS-7-YYMMDD | |
| | | SYN2-IA-X-FD-YYMMDD | SYN2-SS-X-FD-YYMMDD | |
| Offsite, HVAC off | 3111 Coronado Drive | SYN2-IA-1-YYMMDD | SYN2-SS-1-YYMMDD | SYN2-OA1-YYMMDD |
| | | SYN2-IA-2-YYMMDD | SYN2-SS-2-YYMMDD | |
| | | SYN2-IA-3-YYMMDD | SYN2-SS-3-YYMMDD | |
| | | SYN2-IA-4-YYMMDD | SYN2-SS-4-YYMMDD | |
| | | SYN2-IA-5-YYMMDD | SYN2-SS-5-YYMMDD | |
| | | SYN2-IA-6-YYMMDD | SYN2-SS-6-YYMMDD | |
| | | SYN2-IA-7-YYMMDD | SYN2-SS-7-YYMMDD | |
| | | SYN2-IA-X-FD-YYMMDD | SYN2-SS-X-FD-YYMMDD | |

Notes:

(1) YYMMDD = Year, month, and date that the sample was collected.

FD = Field duplicate

Data Evaluation and Potential Response Actions

4.1 Data Evaluation

The multiple-lines-of-evidence approach recommended in the DTSC (2011 and 2012a), USEPA (2002), and ITRC (2007) guidance will be used to evaluate the VI potential for the buildings identified in the project area, as well as to evaluate the potential human health risks to the building users due to VI (if any). The multiple lines of evidence for this site include pathway, indoor air, outdoor air, and subslab soil gas sample data that will be gathered with both the HVAC system running normally (HVAC-on) and with the HVAC system turned off for a minimum of 36 hours (HVAC-off), as outlined in this Additional VI Work Plan. Additionally, the lines of evidence will include the pathway, indoor air, outdoor air, and subslab soil gas sample data that were gathered with the HVAC system running normally for the onsite building and reported in the 2013 VI Report (CH2M HILL, 2013a). The building survey, preliminary screening assessment, and recent groundwater concentrations reported in the 2013 groundwater monitoring and sampling report (CH2M HILL, 2014) will also be included in the multiple-lines-of-evidence evaluation. Additional lines of evidence not explicitly stated in this section may also be included in the VI data evaluation.

The data evaluation approach is presented in Figures 4-1 and 4-2, for evaluation of HVAC-on and HVAC-off sampling results, respectively. In general terms, the data evaluation approach has been broken into four main components:

1. Compare indoor air concentrations to outdoor air concentrations to assess the potential for an outdoor source of the VOCs, if VOCs are also detected in the indoor air.
2. Compare indoor air concentrations to the interim TCE indoor air short-term RAL, which is $7 \mu\text{g}/\text{m}^3$. This step was included in response to comments received from USEPA Region 9 (USEPA Region 9, 2013a and 2013b).
3. Compare indoor air concentrations to the long-term risk-based screening levels (RBSLs). The indoor air RBSLs that will be used for this evaluation are presented in Table 4-1. The indoor air RBSLs for the VOCs that have been detected historically in groundwater at this site are based on the Water Board Environmental Screening Levels (ESLs) (Water Board, 2013c and the USEPA Regional Screening Levels (RSLs) and Vapor Intrusion Screening Levels (VISLs) (USEPA, 2013b and 2013c) for commercial/industrial use. The RBSLs shown in Table 4-1 are derived assuming a 1×10^{-6} target excess lifetime cancer risk level or a target non-cancer hazard quotient of 1. The published ESLs, RSLs, and VISLs are based on the assumption of a standard 8-hour workday for 250 days per year for 25 years. However, the RBSLs for this site were adjusted based on the assumption of a 10-hour work day.
4. Compare subslab soil gas concentrations to the subslab-to-indoor-air RBSLs. The subslab-to-indoor-air RBSLs that will be used for this evaluation are presented in Table 4-1. The subslab-to-indoor-air RBSLs for the VOCs that have been detected historically in groundwater at this site are based on the Water Board Environmental Screening Levels (ESLs) (Water Board, 2013c) and the the USEPA RSLs and VISLs (USEPA, 2013b and 2013c) for commercial/industrial use. The RBSLs shown in Table 4-1 are derived assuming a 1×10^{-6} target excess lifetime cancer risk level or a target non-cancer hazard quotient of 1. The subslab-to-indoor-air RBSLs are derived based on a generic subslab soil gas-to-indoor-air attenuation factor and indoor industrial air RBSL (Water Board, 2013c; USEPA, 2013b and 2013c). The published ESLs, RSLs, and VISLs are based on the assumption of a standard 8-hour workday for 250 days per year for 25 years. However, the RBSLs for this site were adjusted based on the assumption of a 10-hour work day.

The remaining steps of the data evaluation process outlined in Figures 4-1 and 4-2 include expanding the evaluation to include other lines of evidence. Other lines of evidence that may be evaluated include data from other sampling events; building survey results, including information regarding HVAC operation; pathway sampling results; comparison of indoor air concentrations with published background data (USEPA, 2011),

evaluating potential spatial correlations with indoor air, outdoor air, subslab soil gas, and groundwater concentrations; calculating and comparing empirical subslab-to-indoor-air attenuation factors; and assessing the concentration ratios for TCE and vinyl chloride in samples from the different media. A key line of evidence is the presence of possible background sources. If possible, background sources that may be causing the indoor air concentrations to exceed the RALs and/or RBSLs will be removed, and indoor air will be resampled.

If the background source cannot be removed, then further evaluate using the remaining lines of evidence to determine the response action. Similarly, if indoor air or subsoil gas samples are above the RBSLs, further evaluate using the remaining lines of evidence to understand whether the VI pathway is complete and significant to determine the response action.

4.2 Potential Response Actions

No additional response actions will be recommended for certain scenarios, as shown in Figures 4-1 and 4-2, as the data evaluation show that the VI pathway is not complete or significant. For the remainder of the scenarios where the multiple lines of evidence show that the VI pathway is complete and significant or where data gaps are identified, one or more of the following response action may be recommended:

- Require building controls (that is, set HVAC operational conditions). This action may be recommended if the HVAC-off indoor air concentrations exceed the indoor air RBSLs and/or if the subslab concentrations exceed the subslab-to-indoor-air RBSLs but the indoor air concentrations with the HVAC operating normally are acceptable.
- Implement mitigation measures. This action could include adjusting the HVAC system to increase air-exchange rate, maintaining the building in a positive pressure state, sealing cracks and other penetrations through the slab, installing carbon air-purifying units, and/or installing and operating an active mitigation systems (for example, subslab pressurization system).
- Additional indoor air monitoring. This action may be recommended if adjustments are made (that is, mitigation measures implemented and/or building controls required) or the building use changes that require sampling to ensure TCE concentrations are or remain below interim indoor-air short-term RALs and/or long-term RBSLs.

If building controls or mitigation measures are required to address indoor-air concentrations that exceed the interim TCE indoor-air short-term RALs, it will be implemented on an expedited schedule. If mitigation measures or building controls are required to address indoor air concentrations that exceed the long-term RBSLs, a vapor mitigation plan will be prepared.

TABLE 4-1
Summary of Subslab Soil Gas and Indoor Air Investigation Screening Levels
Additional Vapor Intrusion Evaluation Work Plan

| VOCs (µg/m ³) | Commercial / Industrial | Commercial / Industrial | Commercial / Industrial | Commercial / Industrial | Commercial / Industrial | Commercial / Industrial |
|---------------------------|---|---|---|-----------------------------|-----------------------------|------------------------------|
| | Subslab-to-Indoor Air ESL ¹ | Subslab-to- Indoor Air VISL ² | Subslab-to- Indoor Air RBSL ³ | Indoor Air ESL ¹ | Indoor Air RSL ⁴ | Indoor Air RBSL ⁵ |
| TCE | 2,400 | 24 | 24 | 2.4 | 2.4 | 2.4 |
| PCE | 1,680 | 376 | 376 | 1.7 | 38 | 1.7 |
| Vinyl Chloride | 128 | 22 | 22 | 0.13 | 2.2 | 0.13 |
| 1,1-DCE | 704,000 | 7,040 | 7,040 | 704 | 704 | 704 |
| Freon 113 | -- | 1,040,000 | 1,040,000 | -- | 104,000 | 104,000 |
| trans-1,2-DCE | 208,000 | 2,080 | 2,080 | 208 | 208 | 208 |
| 1,1-DCA | 6,160 | 62 | 62 | 6.2 | 6.2 | 6.2 |
| cis-1,2-DCE | 24,800 | -- | 24,800 | 5.8 | -- | 5.8 |
| 1,2-DCA | 464 | 3.8 | 4 | 0.46 | 0.38 | 0.38 |
| 1,1,1-TCA | 17,600,000 | 176,000 | 176,000 | 17,600 | 17,600 | 17,600 |

Notes

1. Commercial / Industrial Subslab-to-Indoor Air ESL (Water Board, 2013b)
2. Commercial / Industrial Subslab-to-Indoor Air VISL (USEPA, 2013b)
3. Commercial / Industrial Subslab-to-Indoor Air RBSL is based on the minimum of the ESL and VISL.
4. Commercial / Industrial Indoor Air RSL (USEPA, 2013a)
5. Commercial / Industrial Indoor Air RBSL is based on the minimum of the ESL and RSL.

The published ESLs, VISLs, and RSLs are based on a standard 8-hour workday, an exposure frequency of 250 days per year and an exposure duration of 25 years. However, the risk-based Screening Levels presented here are adjusted based on a 10-hour workday

Abbreviations:

- = no screening level available
- ESL = Environmental Screening Level
- VISL = Vapor Intrusion Screening Level
- RBSL = risk-based screening level
- RSL = Regional Screening Level
- µg/m³ = micrograms per meter cube
- TCE = Trichloroethene
- PCE = Tetrachloroethene
- 1,1-DCE = 1,1-Dichloroethene
- trans-1,2-DCE = trans-1,2-Dichloroethene
- 1,1-DCA = 1,1-Dichloroethane
- cis-1,2-DCE = cis-1,2-Dichloroethene
- 1,2-DCA = 1,2-Dichloroethane
- 1,1,1-TCA = 1,1,1-Trichloroethane
- Freon 113 = 1,1,2-Trichloro-1,2,2-trifluoroethane

Reporting and Proposed Schedule

5.1 Reporting

The results of the activities outlined in the Additional VI Work Plan will be summarized in a letter report that will include data tables, sampling location figures, an evaluation of the VI potential for the two buildings identified in the project area, an evaluation of the potential human health risks to the building users due to VI (if any) based on comparison to RBSLs, and recommend response action and/or a recommendation for no further action. The letter report will be provided to the Water Board for review and approval.

If mitigation is required to address indoor air concentrations that exceed the interim TCE indoor-air short-term RALs, a vapor mitigation plan will be submitted to the Water Board within five days of receiving the report, and the plan will be implemented on an expedited schedule.

5.2 Proposed Schedule

Implementation of this Additional VI Work Plan is subject to the receipt of Water Board and USEPA comments and approvals and assuming permission to conduct sampling is granted by the property owner and the tenant(s). The EPA will be notified if this permission cannot be obtained. Table 5-1 provides the proposed schedule based on the approximate duration for the tasks once the approvals and access agreements are in place.

TABLE 5-1

Proposed Schedule

Additional Vapor Intrusion Evaluation Work Plan

| Task Name | Estimated Duration | Estimated Completion Schedule |
|---|--|--------------------------------------|
| Submit Draft Additional VI Work Plan for agency review | -- | April 15, 2014 (actual) |
| Received agency comments and approval for Draft Additional VI Work Plan | 9.5 weeks (actual) | June 20, 2014 (actual) |
| Submit Draft Fact Sheet for agency review | -- | June 5, 2014 |
| Submit Final Additional VI Work Plan | 1 week | June 25, 2014 (actual) |
| Agency finalizes of Fact Sheet | 3 weeks | June 25, 2014 |
| Implement Communication Plan | Ongoing throughout project | Ongoing throughout project |
| Complete building survey and preliminary screening assessments | 1 week | July 3, 2014 |
| Onsite, HVAC-off event | 1 week (July 4 Weekend) | July 7, 2014 |
| Offsite, HVAC-off event | 1 week (July 4 Weekend) | July 7, 2014 |
| Offsite, HVAC-on event | 1 week (immediately following HVAC-off sampling) | July 15, 2014 |
| Submit Draft Additional VI Report | 2 months | October 31, 2014 |
| Received agency comments on Draft Additional VI Report | 1 month | November 26, 2014 |
| Submit Final Additional VI Report | 2 weeks | December 15, 2014 |

SECTION 6

References

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- _____. 2013b. Synertek Building 1 Superfund Site, 3050 Coronado Drive in Santa Clara, California, *Preliminary Comments: - May 31, 2013 Vapor Intrusion Evaluation Report - Sept. 30, 2013 Focused Feasibility Study*. Letter from Melanie Marsh, USEPA Region 9, to David Barr, San Francisco Bay Regional Water Quality Control Board. November 21.

Figures

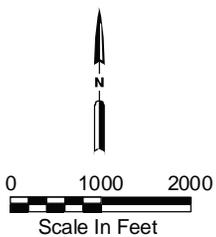
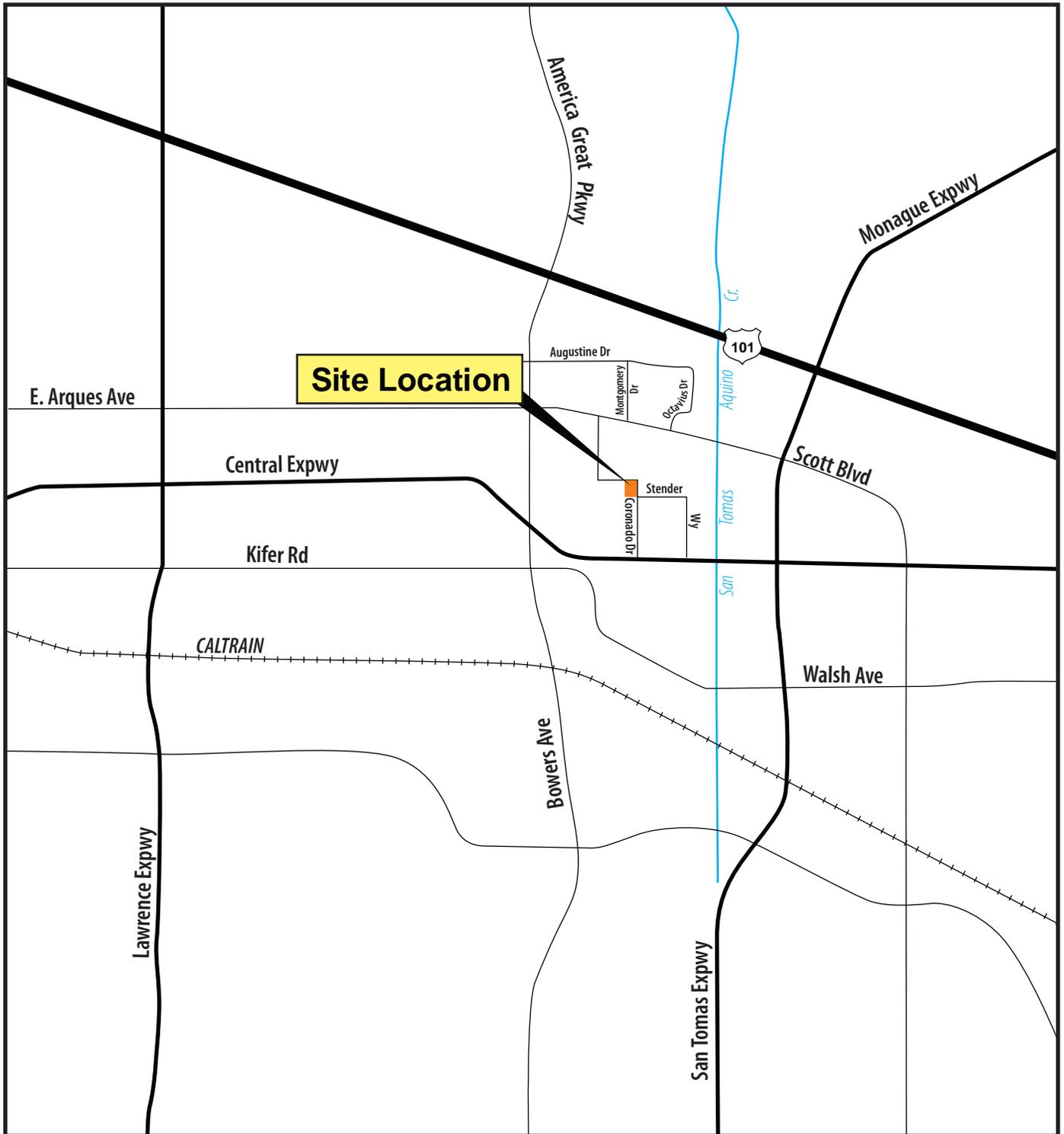


FIGURE 1-1
Site Location Map
 Synertek Building #1
 3050 Coronado Drive
 Santa Clara, California

- LEGEND**
- A - AQUIFER MONITORING WELL
 - A - AQUIFER EXTRACTION WELL
 - ⊕ FORMER AGRICULTURAL WELL
 - CONCENTRATION CONTOUR (DASHED WHERE INFERRED)
 - (<1.0) NOT DETECTED (DETECTION LIMIT INDICATED)
 - NOT SAMPLED
- | | |
|----------|-------------------|
| MW-37A | WELL ID |
| 10/29/13 | SAMPLING DATE |
| <0.1 | TCE CONCENTRATION |
- NOTES:**
- CONCENTRATIONS SHOWN IN MICROGRAMS PER LITER ($\mu\text{g/L}$).
 - BOLD VALUE** DENOTES CONCENTRATION EXCEEDING FINAL CLEANUP STANDARD ($5 \mu\text{g/L}$)

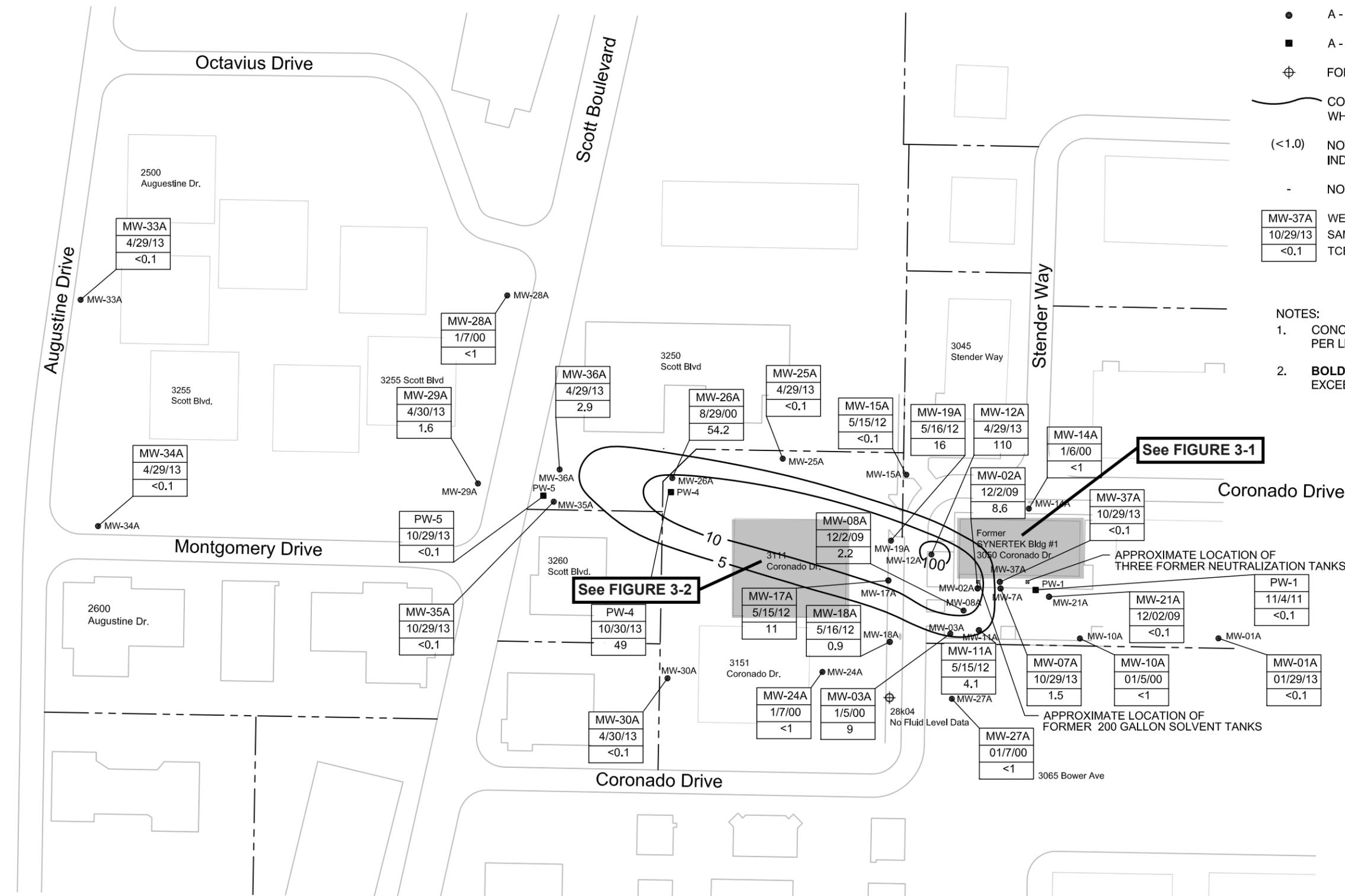
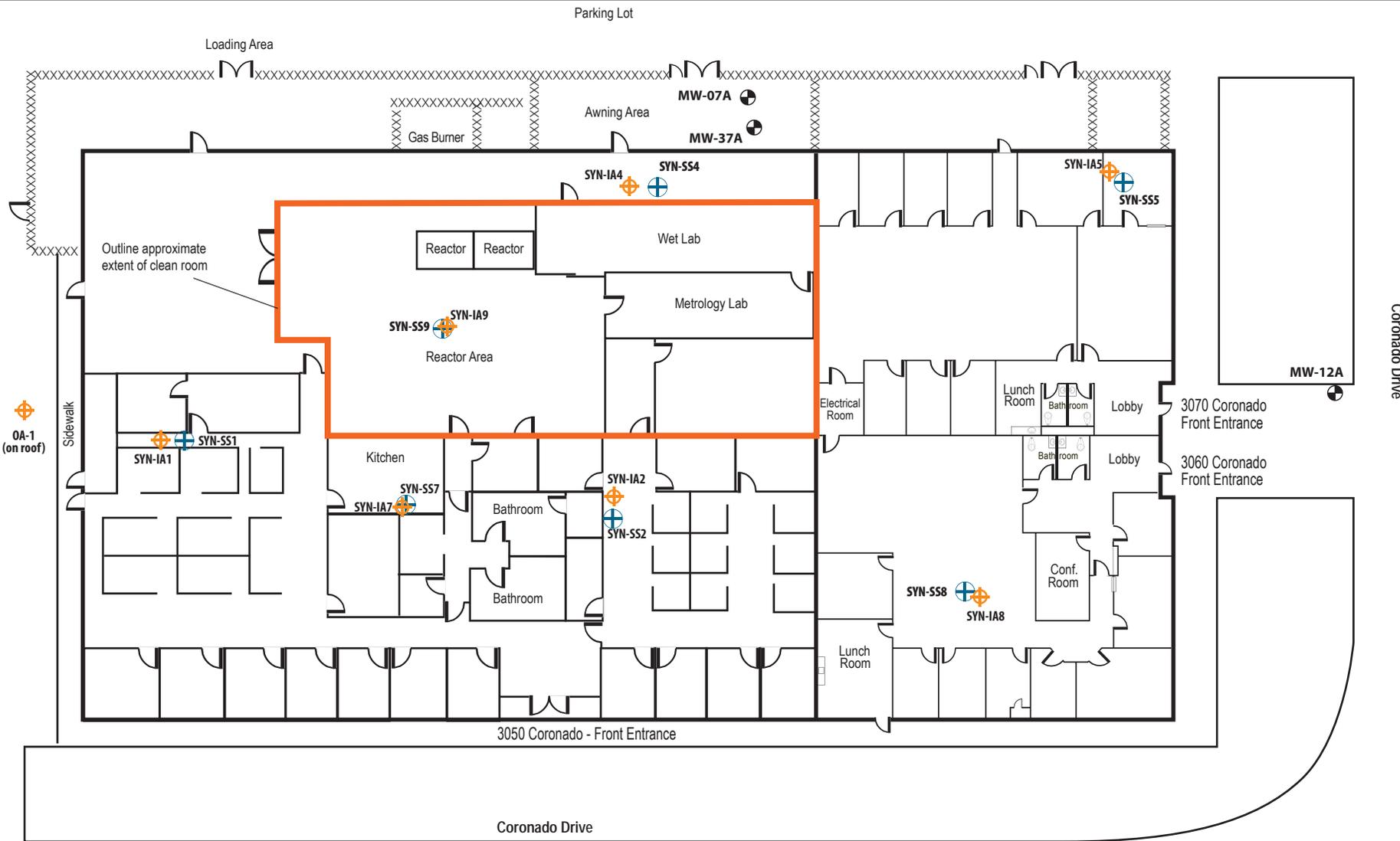


FIGURE 2-1
TCE Distribution
A-Aquifer (Most Recent Sampling Event)
 HONEYWELL INTERNATIONAL INC.
 FORMER SYNERTEK BUILDING NO. 1
 3050 CORONADO DRIVE, SANTA CLARA, CALIFORNIA



LEGEND

-  Existing Shallow Groundwater Monitoring Wells
-  Proposed Subslab Soil Gas Sampling Location
-  Proposed Indoor and Outdoor Air Sampling Location

Notes:

1. Building interiors and sampling locations are approximate and not based on survey data.
2. Sampling locations will be finalized based on results of building survey and preliminary screening assessment.



Not to Scale

FIGURE 3-1
On-site Building –
Proposed Vapor Intrusion
Sampling Locations

Former Synertek Building 1
 3050 Coronado Drive
 Santa Clara, California



LEGEND

- Proposed Subslab Soil Gas Sampling Location
- Proposed Indoor Air Sampling Location

Notes:

1. Building interiors and sampling locations are approximate and not based on survey data.
2. Sampling locations will be finalized based on results of building survey.



3111 Coronado Drive (First Floor Layout)

FIGURE 3-2
Off-site Building (3111 Coronado Drive) –
Proposed Vapor Intrusion Sampling Locations
 Former Synertek Building 1
 3050 Coronado Drive
 Santa Clara, California

Base drawing from figure Building A&C Floor 1 Seating Plan, FaciliCorp, 2013.

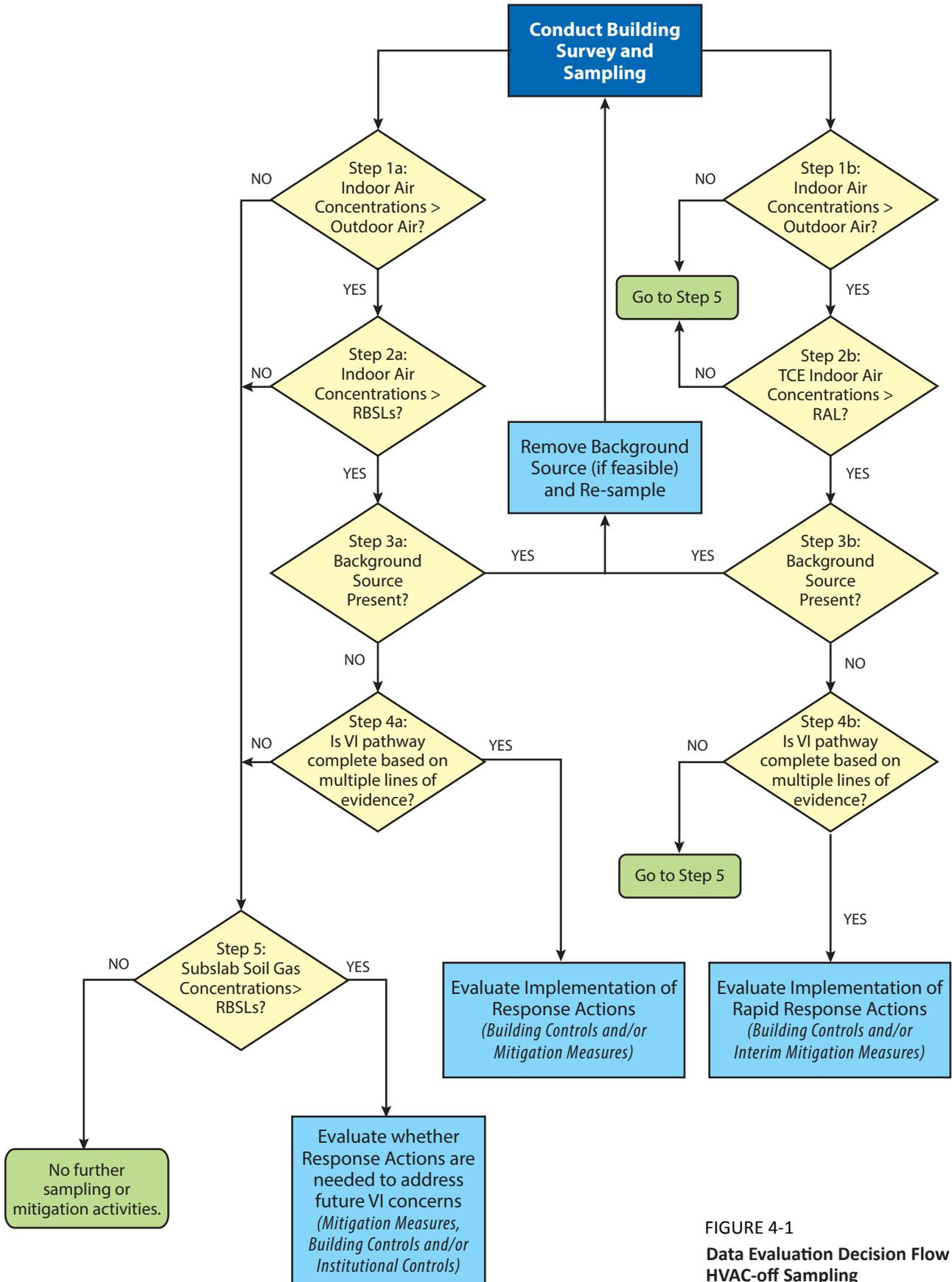


FIGURE 4-1
**Data Evaluation Decision Flow Chart
 HVAC-off Sampling**
Honeywell Synertek VI Work Plan

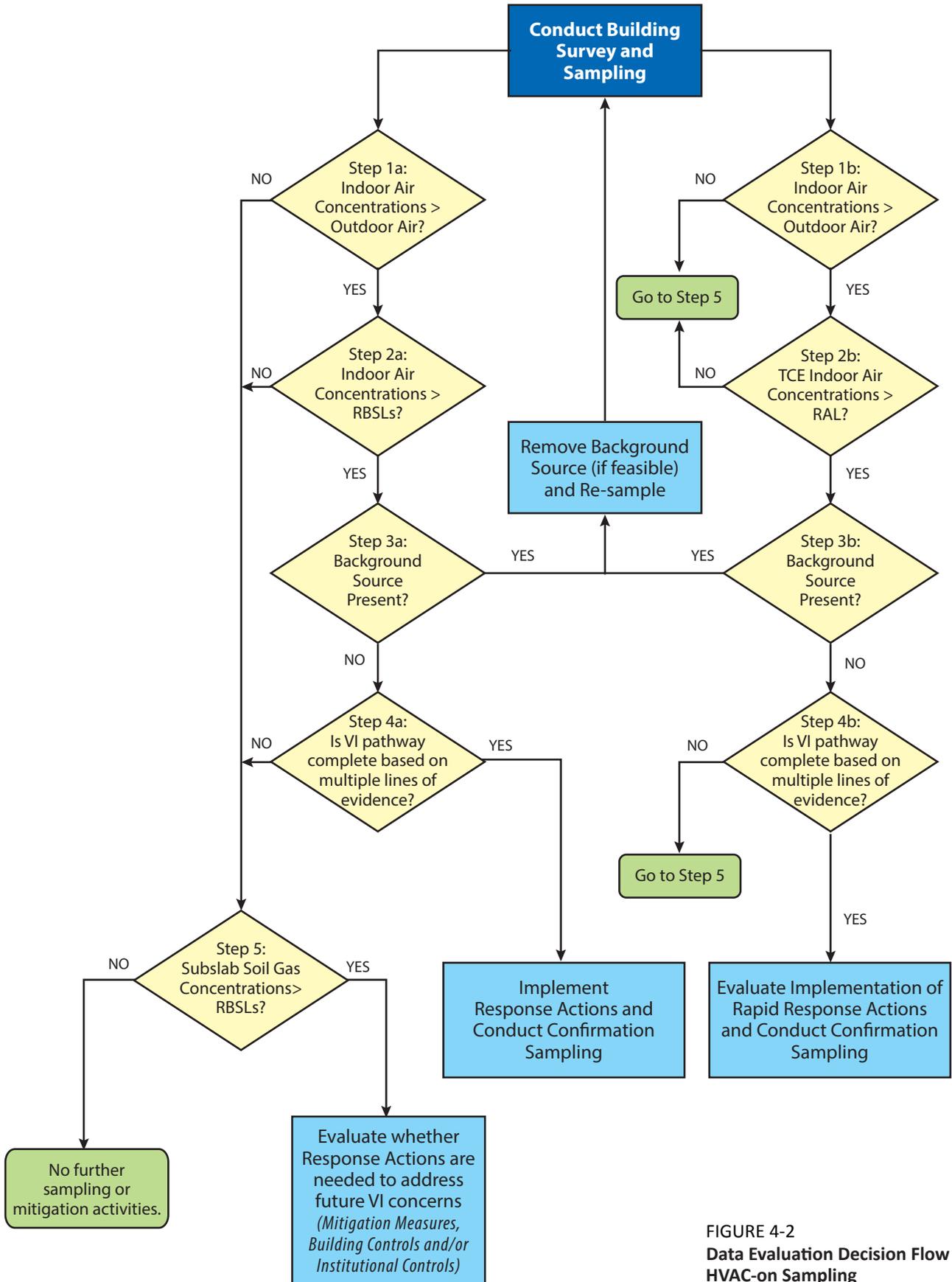


FIGURE 4-2
**Data Evaluation Decision Flow Chart
 HVAC-on Sampling**
Honeywell Synertek VI Work Plan

Appendix A
SOP for Building Survey and HVAC
Survey

Standard Operating Procedure for Conducting Building Surveys for Vapor Intrusion Evaluations

1. Purpose and Objectives

This standard operating procedure (SOP) presents general guidelines for conducting building surveys for vapor intrusion evaluations. A building survey is performed as part of a vapor intrusion evaluation to obtain information for development of a conceptual site model (CSM) and to prepare for vapor intrusion sampling (select optimal sampling locations and determine if there are any potential indoor sources of volatile organic compounds [VOCs]).

A CSM for vapor intrusion pathway evaluation describes potential constituent sources, migration pathways, and potential human receptors under current and/or future land uses at the site. The important building characteristics for vapor intrusion pathway evaluation include the following:

- building use and occupancy
- condition of the building envelope
- presence of a basement or crawl space
- dimensions of the building and interior compartments
- condition of the slab and basement walls and presence of potential vapor intrusion pathways
- type and typical operational settings of the heating, ventilation, and air conditioning (HVAC) system
- the presence of potential indoor sources of VOCs.

This SOP can be used to perform building surveys in residential, commercial, or industrial buildings. At project sites with multiple buildings, a building survey should be performed for each building that is included in the vapor intrusion evaluation.

2. Project-Specific Considerations

- 2.1** Some states include building survey procedures and forms in their regulations or guidance documents. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project.
- 2.2** The building survey will likely be the first interaction with the occupants at the building and is an appropriate time to provide occupants with information on the vapor intrusion evaluation being performed and any sampling procedures that will be used. For vapor intrusion evaluations in residential areas, a community outreach plan should be developed and the field team should be trained on how to communicate with residents.
- 2.3** Varying levels of detail can be attained for building surveys. The project should develop data quality objectives (DQOs) to determine what specific information should be collected for their project.

- 2.4 Ideally, the building survey should be conducted at least one week before the actual indoor air or subslab soil gas sampling event. This advance timeframe allows the vapor intrusion investigator to identify and eliminate (to the extent practical) potential background sources of indoor air contamination. It also permits the investigator to confirm the sample locations with the occupants and regulatory agency(s) (if applicable) ahead of the scheduled sampling event.

3. Health and Safety

There are several health and safety topics to consider when performing building surveys:

- 3.1 Field teams should work in pairs at residential buildings or at industrial/commercial buildings where a relationship with the building occupant has not yet been established. A field team member should never enter a building alone for the first time. The mental stability of a building occupant should not be taken for granted. Building surveys at abandoned buildings should also be performed in pairs; if one team member is injured, the other will be able to seek help.
- 3.2 Walk slowly and with caution to avoid slips, trips, and falls.
- 3.3 Beware of animals and insects. This applies to abandoned buildings and residences.
- 3.4 Be careful of overhead hazards in basements. Do not attempt to enter crawl spaces.

4. Materials

- 4.1 Building Survey Form – to record survey information. Example forms are provided as attachments to this SOP. There is one for residential buildings, and one for industrial/commercial buildings.
- 4.2 Figure showing the footprint of the building (if available) – to mark up during the building survey with information about the building characteristics. It may also be helpful to ask the building contact for a copy of the fire evacuation map which will show the building footprint and interior walls.
- 4.3 Flashlight
- 4.4 Walking wheel or measuring tape – to measure building and room dimensions
- 4.5 Camera – to photograph the building (interior and exterior) if allowed by the building owner
- 4.6 Photoionization detector – to monitor total VOCs for health and safety at sites where high VOC concentrations may be expected (*OPTIONAL*)

5. Field Procedures

5.1. Building Survey

- 5.1.1. Gain access to the building. Schedule the site visit with the site contact. At a client- owned and -operated site, this step may just require a phone call to the client. At an off-site residence, this may require significant coordination, including obtaining an access agreement and providing vapor intrusion fact sheets to inform residents of the vapor intrusion pathway and the reason for the investigation.
- 5.1.2. Obtain occupant information. The building occupants are the potential receptors in the vapor intrusion CSM. Is the building use residential, commercial, or industrial? How many people typically occupy the building? Are there sensitive receptors (children, elderly, or immune-impaired) in the building? How much time do occupants spend in the building? What areas of the building do the occupants typically use (i.e., where do they spend the most time)?
- 5.1.3. Obtain building information. How old is the building? What was its original use? Have there been any additions or other significant modifications? Additions will likely have slabs that are separate from the original building. How many floors does the building have? Does the building have a basement? If so, how far does it extend below grade? Is the slab on grade? Is the slab elevated above the ground surface?
- 5.1.4. Survey the building envelope. The condition of the building envelope will determine the rate of outdoor to indoor air exchange. A high rate of outdoor air exchange can dilute soil gas that may be migrating into the building. Walk around the inside and outside of the building and record information on the building construction and condition. How many doors/windows/loading docks are there, what condition are they in, and are they typically left open or closed? What are the building construction materials?
- 5.1.5. Determine the indoor air volume and the location and volume of separate indoor air compartments within the building. If a building has a very large indoor air volume, soil gas migrating into the building may become quickly diluted. Measure the building dimensions (length, width, and height). Measure the dimensions of compartments or rooms within the building. How are rooms connected? Are interior doors typically kept open or shut? Are there separate compartments within the building (i.e., areas that are not connected to other areas such that the indoor air does not mix)? Indoor air sampling may be necessary in multiple rooms if the indoor air volume is not connected.
- 5.1.6. Observe the slab condition. The building slab is the barrier between subslab soil gas and the indoor air. How thick is the slab? What is the general condition of the slab? What is the floor covering in each room of the lowest floor (carpet, tile, etc.)?
- 5.1.7. Identify potential vapor intrusion pathways. The entry of organic vapors into a structure is caused by the infiltration of contaminants through the slab and walls that are in contact with the soil. Any openings, cracks, or penetrations in the slab

or basement walls may be entryways for subslab soil gas. Are there any utilities that penetrate the slab or basement walls? Are they sealed properly? Are there cracks in the slab or basement walls? If so, note where these cracks are and their approximate size. Are there sumps? If so, note the dimensions of each and their typical operating conditions. Is the wall/floor juncture sealed well? Is there a french drain? Has the basement been waterproofed? Are there expansion joints in the slab? If so, note their condition.

- 5.1.8. Evaluate the HVAC system. The heating, air-conditioning, and ventilation (HVAC) system's operation can determine if the building is negatively or positively pressurized. If a building is negatively pressurized, then subslab gas will be pulled into the building; if the building is positively pressurized, subslab gas will not enter the building. Record the type/model of the systems and the typical operating conditions. Is there one air conditioning zone or multiple zones (look for multiple thermostats)? Does the HVAC system use radiant heat or forced air? If the HVAC system is forced air, where are the heating/cooling and return air vents? What is the HVAC system's fresh air intake? What is the heating fuel source (i.e., natural gas, oil, propane)? Are there ventilation fans? If so, note where and their typical operating conditions. Are there window air conditioning units?
- 5.1.9. Identify any existing vapor mitigation systems. Is there a radon mitigation system or other subslab depressurization system? Is there sealant on any cracks or crevices? Is there a sealant coat on the floor for vapor or water mitigation?
- 5.1.10. Sketch the building floor plan. Record all pertinent building characteristics for the vapor intrusion evaluation. Include building dimensions, locations of windows/doors/loading docks, outdoor surface cover (grass, asphalt, etc.), and locations of any potential indoor VOC sources.
- 5.1.11. Identify potential indoor contaminant sources within the building. Record the location of the potential sources and determine if they can be removed before indoor air sampling is performed. Potential indoor sources of VOCs may include cleaning products, paint, dry-cleaned clothes, gasoline, cosmetics, or cigarette smoke. Recent remodeling activities, including painting, installing new carpeting or flooring, and moving in new furniture should be identified, because they could be potential sources of VOCs. It may be necessary to include additional sheets to inventory all the potential VOC sources within the structure. Be sure to document any potential VOC sources that are removed from the structure so that it can be included in the data evaluation. When potential indoor VOC sources are identified and removed from a building, it may be necessary to ventilate the rooms affected in advance of the air sampling event. This ventilation should be completed at least 24 hours before the commencement of the indoor air sampling event. A hand-held field screening instrument can also be used to pinpoint potential indoor VOC sources.

5.1.12. Identify potential outdoor contaminant sources. These may include gas stations, major roadways, dry cleaners, repair shops, industries, or landfills.

5.2. **Identify possible indoor air, outdoor air, crawl space air, and subslab soil gas sample locations that meet the project-specific DQOs. (OPTIONAL)**

The selected sampling location(s) should be chosen in consultation with the property owner during the building survey.

Procedures for collecting indoor air, outdoor air, crawl space air, and subslab soil gas samples inside a building are described in the *Standard Operating Procedure for Indoor, Outdoor, and Crawl Space Sampling for VOCs Using Canisters* and the *Standard Operating Procedure for Installing and Sampling Subslab Soil Gas Probes Using Canisters*.

5.2.1. Indoor Air Sample Locations

- 5.2.1.1. Typically, indoor air samples should be collected from each compartment or HVAC zone within a building.
- 5.2.1.2. Typically, indoor air samples should be collected on the lowest floor of the building at breathing zone height (approximately 3 to 5 feet) toward the center of the building away from windows.
- 5.2.1.3. Consideration should be given on a case-specific basis to those situations (such as a daycare facility) where a different sampling height may also be appropriate to evaluate a unique setting or population.
- 5.2.1.4. Indoor air samples should be located in the areas of the building that are occupied most frequently and by the most amount of people.
- 5.2.1.5. Indoor air samples can be collected from more than one floor within a structure to address varying risk exposures and as part of the process to distinguish contaminants related to vapor intrusion from background sources. Thus, the location and position of the sample container will vary depending on which floor the sampling event takes place.
- 5.2.1.6. The basement sample(s) are primarily designed to investigate “worst case” situations within a structure. Therefore, basement samples are positioned as close as possible to the source area (e.g., sumps or major cracks in the foundation).

5.2.2. Outdoor Air Sample Locations

- 5.2.2.1. Typically, outdoor air samples are collected upwind and/or downwind of the building or site being investigated.
- 5.2.2.2. Avoid biasing the sample results by placing the canister near potential outdoor VOC sources such as busy roads or gas stations.

- 5.2.2.3. Outdoor air samples are typically located at least 10 feet away from buildings. However, the outdoor air canister may be placed near the outdoor air intake for the HVAC system for the building.
 - 5.2.2.4. Outdoor air sample canisters should be secured to an immovable structure to ensure security for sampling in public areas. A bicycle lock or piece of chain and padlock can be used. NOTE: Do not secure the canister to or close to a living tree, however, because the tree's evapotranspiration process may release VOCs from groundwater into the vicinity. It may be a good idea to attach a label to the canister explaining that it is an environmental sample and should not be tampered with. The label can also include contact information.
 - 5.2.2.5. Typically, outdoor air samples should be collected at breathing zone height (approximately 3 to 5 feet).
- 5.2.3. Crawl Space Air Sample Locations
- 5.2.3.1. Crawl space air samples are typically collected in locations selected to achieve adequate spatial coverage of the building's crawl space. Sample location selection will be limited by accessibility.
 - 5.2.3.2. Crawl space air sample inlets should be located several feet from the opening or access point to avoid dilution by outdoor air. In cases where the crawl space is most conveniently sampled by access through crawl space vents, a sampling probe (sample delivery line made of Teflon® or stainless steel) of sufficient length is attached to the inlet of the flow controller.
- 5.2.4. Subslab Soil Gas Sample Locations
- 5.2.4.1. Subslab soil gas sample locations should also be toward the center of the building and ideally in an area of exposed concrete away from any penetrations in the slab. Positions near the perimeter of the slab are subject to dilution and should be avoided. As a general rule, it is best to stay at least 5 to 10 feet away from any exterior wall.
 - 5.2.4.2. Typically, subslab soil gas sample locations are biased towards areas of the building where the highest subsurface VOC concentrations are expected.
 - 5.2.4.3. Typically, subslab soil gas sample locations should be spread out throughout the building to achieve adequate coverage of the entire building.
 - 5.2.4.4. Make sure the proposed subslab soil gas sample density is in accordance with applicable regulatory guidance documents. Recommendations about how many subslab soil gas samples to collect vary, ranging from one subslab soil gas sample for every 330 square feet (or two to three samples for every average-sized home) to one subslab soil gas sample for an average residential dwelling of 1,500 square feet; however, a lesser density for very large building is usually acceptable.

- 5.2.4.5. To minimize potential damage to flooring, it may be necessary to select a location in a closet or utility room (where carpeting or tiles are less visible or not present at all).

6. Data Reduction and Evaluation

The information collected during the building survey can be used to develop a preliminary vapor intrusion CSM for the work plan, refine an existing CSM, select locations for indoor air and subslab samples, or to provide information to support the evaluation of the vapor intrusion pathway in a vapor intrusion evaluation or human health risk assessment.

7. Quality Control

Adequate time should be reserved for performing building surveys and detailed notes should be recorded at the time of the building survey.

8. Attachments

- 8.1. *Residential Building Survey for Vapor Intrusion Evaluation Form*
- 8.2. *Industrial/Commercial Building Survey for Vapor Intrusion Evaluation Form*



Project Information Page 1 of 4

Project Name: Project #: Survey Completed By: Date: Building Address: Residence ID:

Resident and Contact Information

Name of Occupant: Owner / Tenant / Other: Occupant Phone #: Home: Work: Cell: Duration at Current Residence: Best Time To Call / Visit: Number of Building Occupants: Children (list ages): Adults: (If Rental) Property Owner Name: Owner Phone #: Home: Owner Address: Work: Name of Interviewee for Building Survey: Notes:

Building Construction Characteristics

Building Type: (Check box for all that apply) Single Family Residential, Ranch, Split Level, Duplex, Multi Family Residential, Two-story, Tri Level, Apartment, Commercial, Other. Describe Building: Approximate Age: Approximate Area: Total Living Space: First Floor: Floors: Foundation Type: Basement or Crawl Space Details: Basement or Crawl Space Floor: Foundation Walls: Does the basement or crawl space have a moisture problem - dampness? Is the basement or crawl space ever wet - flooded?

Building Address:

Date:

Basement or Crawl Space Details Continued: (if applicable)

Does the basement have any of the following? (Check all that apply)

- Floor cracks
 Wall cracks
 Floor Drain
 Sump pump
 Other hole / opening in floor (describe):

Is the sump pump used? Yes / No Depth of sump? ft Where does the sump pump drain?

Describe ventilation of crawl space:

Description of ground cover outside of building: Grass Concrete Asphalt Other:

Heating & Ventilation Systems

Heating System - Fuel Type: (Check box for all that apply)

- Natural Gas Electric Coal Fuel Oil
 Wood Other (specify):

Heating - Conveyance System: (Check box for all that apply)

- Forced Hot Air Electric Baseboard Wood Stove Fireplace
 Forced Hot Water Hot Water Radiation Heat Pump Kerosene Heater
 Other (specify):

Type of Ventilation System: (Check box for all that apply)

- Central air handler / blower Mechanical / ceiling fans Bathroom ventilation fans Air-to-air heat exchanger
 Kitchen range hood fan Other (specify):

Does the Residence have Air Conditioning: (Check box for all that apply)

- Central Air Conditioning Window Air Conditioners Other (specify):

Describe the current operating conditions of the HVAC system:

Miscellaneous Information

Does the Residence have any of the following?

Septic System? Yes / Yes (but not used) / No Irrigation / Private Well?

Existing subsurface depressurization (radon) system in place? Yes / No Is it running? Yes / No

Is there standing water outside the residence (pond, ditch, swale)? Yes / No If so, describe:

Has the residence been retrofitted / weatherized with any of the following? (Check box for all that apply)

- Insulation Storm Windows Energy-efficient windows Other (specify):

Does the building have an attached garage? Yes / No If so, is a car usually parked in the garage? Yes / No

Chemicals

Have any pesticides / herbicides been applied around the building foundation or in the yard / gardens? Yes / No

If so, when - and which chemicals?

Has the residence had a pesticide treatment inside? Yes / No When / by whom?

Do the occupants of the building have their clothes dry-cleaned? Yes / No

When were dry-cleaned clothes last brought into the building?

Have the occupants ever noticed any unusual odors in the building? Yes / No

Describe (with location):

Building Address:

Date:

Miscellaneous Information Continued:

Have there been any known spills of a chemical immediately outside or inside the building? Yes / No

Describe (with location):

Do any of the occupants smoke inside the building? Yes / No How often?

Do any of the occupants use solvents at work? Yes / No Are their clothes washed at home? Yes / No

If so, when - and what rooms?

Within the last 6 months, has there been any painting or remodeling in the residence? Yes / No If so, when

What rooms, and what specifically was done?

Within the last 6 months, has any new carpeting been installed? Yes / No Have the carpets or rugs been cleaned? Yes / No

If so, when, what rooms, and what cleaners?

Consumer Products Inventory

Check consumer products that are present in the residence.

| | Storage Location | Frequency of Usage | Date of Last Use |
|---|------------------|--------------------|------------------|
| <input type="checkbox"/> Paint or Wood Finishes (spray or can) | | | |
| <input type="checkbox"/> Paint stripper / remover / thinner | | | |
| <input type="checkbox"/> Solvent cleaners (eg. spray-on oven cleaner) | | | |
| <input type="checkbox"/> Metal degreaser / cleaner | | | |
| <input type="checkbox"/> Gasoline / diesel fuel | | | |
| <input type="checkbox"/> Glues or adhesives (super glue, etc) | | | |
| <input type="checkbox"/> Air fresheners & scented candles | | | |
| <input type="checkbox"/> Laundry / carpet spot removers | | | |
| <input type="checkbox"/> Pesticides / Insecticides | | | |
| <input type="checkbox"/> Nail polish remover (acetone) | | | |
| <input type="checkbox"/> Aerosols (deodorizers, polish, cleaners) | | | |
| <input type="checkbox"/> Other: | | | |
| <input type="checkbox"/> Other: | | | |
| <input type="checkbox"/> Other: | | | |

Describe any products that are containerized during sampling event:

.....

Provide any additional information that is provided by interviewee:

.....

Building Address:

Date:

Building Sketch

Provide sketch of floors in house, including the following information:

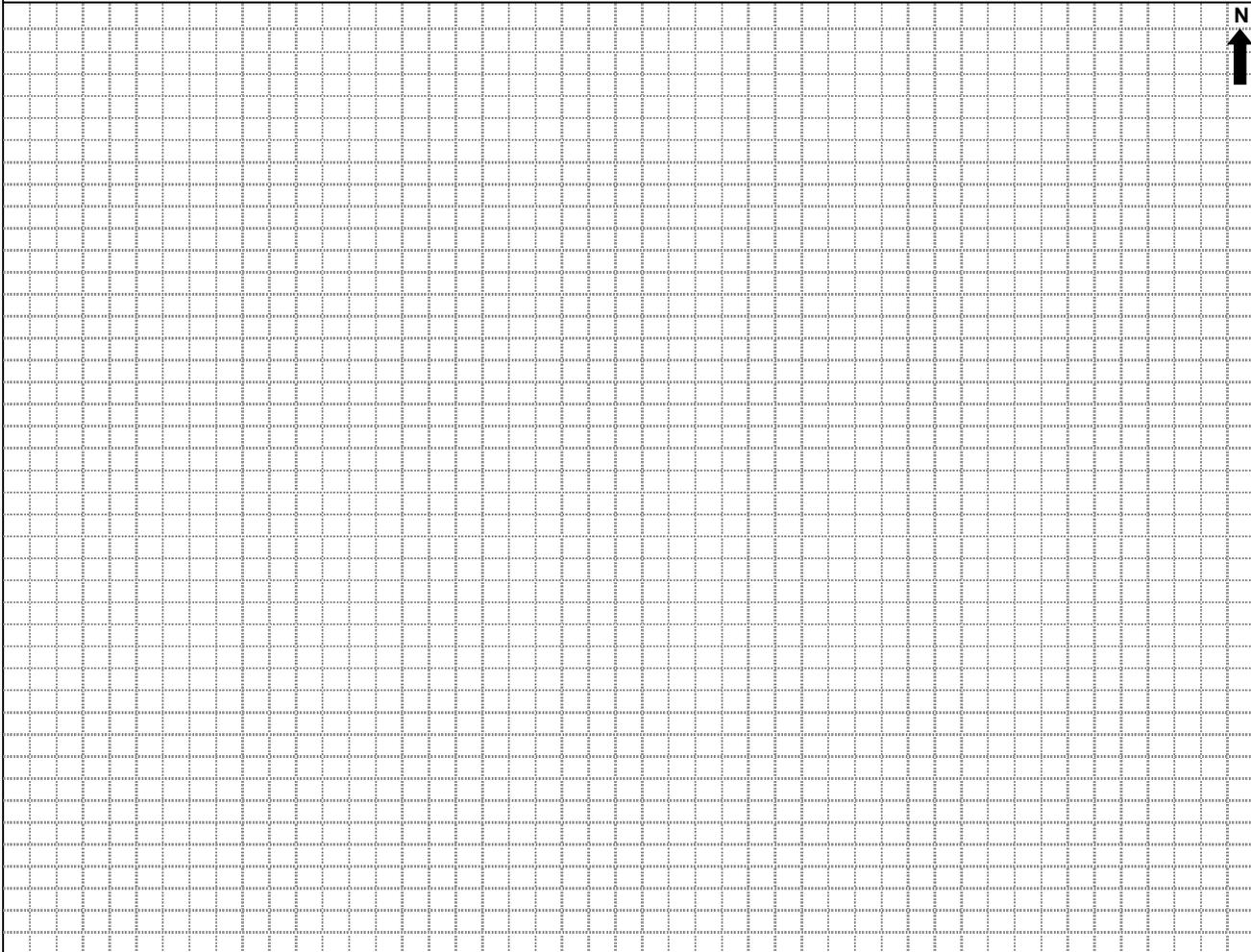
Street (sidewalk, patios, driveway, distance to house)

Primary chemical storage location(s)

Location of heating and cooling systems, including fireplace

General orientation of garage and main rooms

General location of doors and windows



Post Sampling Review

Date Noted:

Sampling Team:

Has any information changed during the sampling event?

Did windows and doors remain closed?

Was any dry cleaning brought home?

Were any of the consumer products discussed yesterday used in the last 24-hours?

Were any of the containerized products opened?

Notes / other information observed post-sampling:

.....

.....

Preliminary Building Survey for Vapor Intrusion Investigation

Page 1 of 5



CH2MHILL

Date: _____
Preparer: _____
Facility: _____
Address: _____
Contact Person: _____
Phone Number: _____
e-mail address: _____

Building Description

Building or Room Identifier: _____

Primary Activity within Building (select one):

- | | | |
|--|--|--------------------------------|
| <input type="checkbox"/> Manufacturing | <input type="checkbox"/> Storage | <input type="checkbox"/> Other |
| <input type="checkbox"/> Chemical processing | <input type="checkbox"/> Chemical Storage | |
| <input type="checkbox"/> Administrative | <input type="checkbox"/> Instrumentation/Control | |

Historical Activities within Building (if different from above):

Notes:

Approximate floor space _____

Number of floors _____

Multi-room building or Single room

Ceiling height _____

Aboveground Construction Wood Concrete
 Brick Cinderblock
 Other _____

Floor plan attached? Yes No

Notes: _____

Preliminary Building Survey for Vapor Intrusion Investigation

Evaluation of Potential Conduits from Soil

Floor/foundation description (check all that apply)

Wood

Concrete

Elevated above grade?

Feet above grade: _____

Other _____

Below grade?

Feet above grade: _____

Slab on grade?

Expansion joints present (if concrete floor)?

Yes

No

N/A

Are expansion joints sealed?

Yes

No

N/A

Are sumps or floor drains present?

Yes

No

N/A

Are basements or subsurface vaults present?

Yes

No

N/A

Are there subsurface drainage problems?

Yes

No

N/A

Notes/Explanation for N/A responses:

Preliminary Building Survey for Vapor Intrusion Investigation

Evaluation of Potential Pathways/Driving Forces

Are there locations with elevated positive or negative pressure (look for doors not opening/closing properly, perceptible airflow, audible fan noise):

Is there one air conditioning zone or multiple zones (if in a multi-room building)?

Single zone Multi-zone Other _____

(building management may know; another tip-off is the presence of multiple thermostats = multiple

Sources of outdoor air

Mechanical (air handling unit) Doors
 Windows Attic Fans

Are windows/doors left open routinely? Yes No

Notes:

Preliminary Building Survey for Vapor Intrusion Investigation

Evaluation of Potential Existing Chemical Sources Indoors

List principal solvent or VOC-containing products used (obtain MSDSs if available)

| | |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

Are any of the target analytes used in this building/room?

Yes No

| | |
|-------|-------|
| _____ | _____ |
| _____ | _____ |

Are pesticides used indoors for pest control?

Yes No

Names of pesticide products used?

| |
|-------|
| _____ |
| _____ |

Has there been a pesticide application within the past 6 months?

Yes No

Is smoking permitted in the building?

Yes No

Notes:

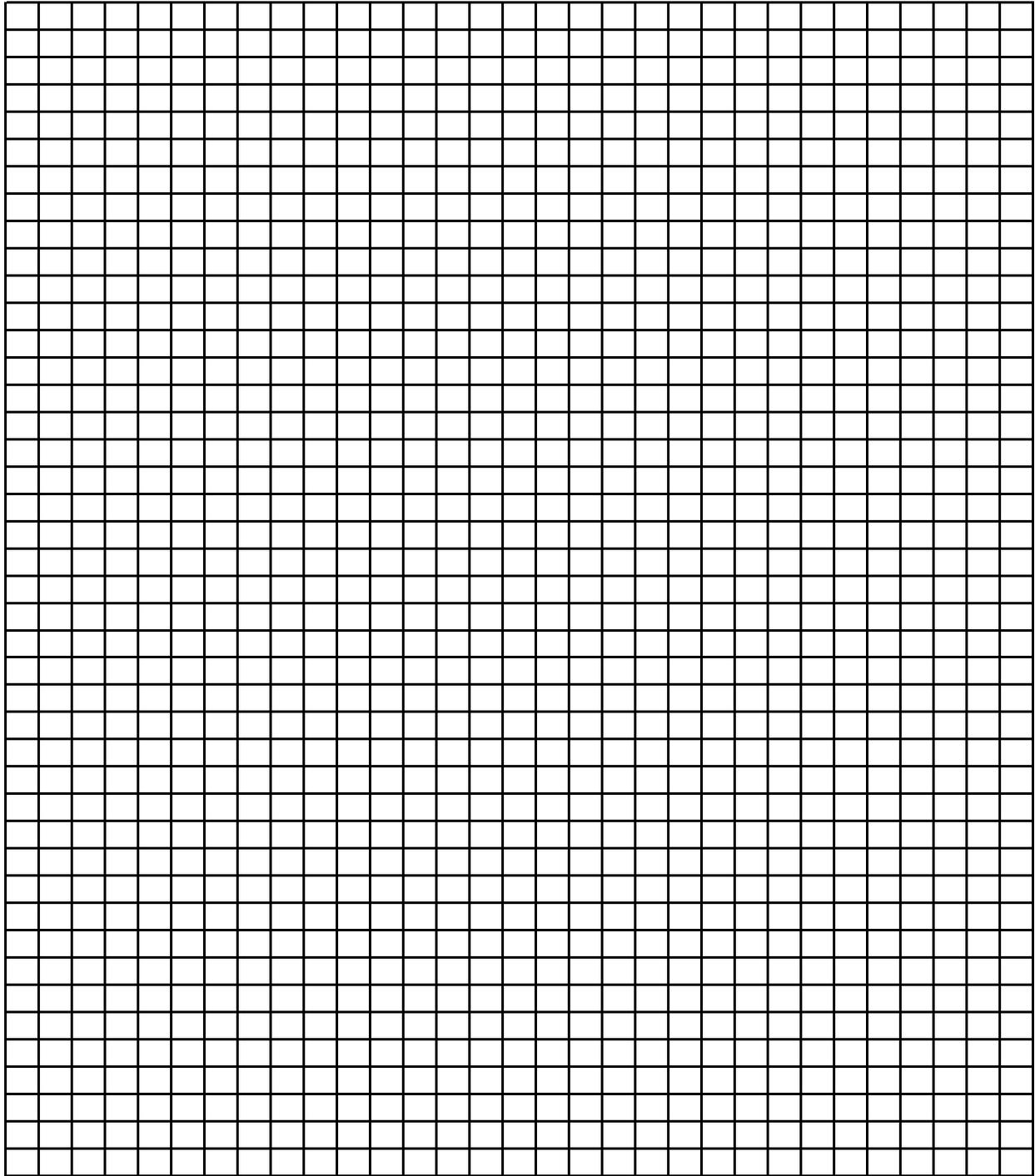
| |
|-------|
| _____ |
| _____ |
| _____ |

Date: _____
Preparer: _____

Facility: _____
Description (floor): _____



Floor Plan Information



Building Name: _____

Address: _____

Completed By: _____ Date: _____

DISTRIBUTION SYSTEM

| Zone/ Room # | Zone/ Room Name | System Type | Supply Air | | Outdoor Air* | Return Air | | Power Exhaust | | | HVAC Unit Serving Space |
|--------------------|-----------------------|----------------|---------------------|-----|--------------|---------------------|-----|---------------|---------|-------------------------|-------------------------------|
| | | | ducted/ unducted | cfm | cfm | ducted/ unducted | cfm | cfm | control | serves (e.g. toilet) | |
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* Calculated from OA%
 Note: For very simple systems this information can be estimated, for example using building construction/engineering drawings.
 May need a test and balance firm to perform measurements for more complicated systems.

Condition of distribution system and terminal equipment (note locations of problems)

Adequate access for maintenance? _____

General notes on distribution system (condition, potential issues): _____

Appendix B

**CH2M HILL SOP for Indoor, Outdoor, and Crawl
Space Air Sampling for VOCs Using Canisters**

Standard Operating Procedure for Indoor, Outdoor, and Crawl Space Air Sampling for VOCs Using Canisters

1. Scope and Application

This standard operating procedure (SOP) describes the approach for collecting indoor, outdoor and crawl space air samples for targeted volatile organic compounds (VOCs). Reporting limits for these samples are usually very low and extremely prone to positive bias from interfering VOC sources. The method presented here is based on 'clean' sampling techniques. The requirements of clean sampling dictate that sampling and sample handling are done by trained personnel. A building survey must be performed before sample collection. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project. Vapor intrusion (VI) subject-matter experts (SMEs) should be consulted as needed to address technical, regulatory or field implementation issues associated with the use of this SOP.

2. Project Specific Considerations

2.1. Selection of sample locations - Indoor, outdoor and crawl space air sample locations should be selected during the building survey and in consultation with the building owner/occupant. The sample locations should be selected to meet the project-specific data quality objectives. Procedures for performing a building survey are described in the Standard Operating Procedure – Building Surveys for Vapor Intrusion Evaluation.

2.1.1. Guidelines for selecting indoor air sample locations

- 2.1.1.1.** Typically, indoor air samples should be collected from each compartment or heating, air-conditioning, and ventilation (HVAC) zone within a building.
- 2.1.1.2.** Typically, indoor air samples should be collected on the lowest floor of the building at breathing zone height (approximately 3 to 5 feet) toward the center of the building away from windows.
- 2.1.1.3.** Consideration should be given on a case-specific basis to those situations (such as a daycare facility) where a different sampling height may also be appropriate to evaluate a unique setting or population.
- 2.1.1.4.** Indoor air samples should be located in the areas of the building that are occupied most frequently and by the most amount of people.
- 2.1.1.5.** Indoor air samples can be collected from more than one floor within a structure to address varying risk exposures and as part of the process to distinguish contaminants related to vapor intrusion from background sources. Thus, the location and position of the sample container will vary depending on which floor the sampling event takes place.
- 2.1.1.6.** The basement sample(s) are primarily designed to investigate worst-case situations within a structure. Therefore, basement samples are positioned as close as possible to the source area (e.g., sumps or major cracks in the foundation).

2.1.2. Guidelines for selecting outdoor air sample locations

- 2.1.2.1.** Typically, outdoor air samples are collected upwind and/or downwind of the building or site being investigated.
- 2.1.2.2.** Avoid biasing the sample results by placing the canister near potential outdoor VOC sources such as busy roads or gas stations.

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

2.1.2.3. Outdoor air samples are typically located at least 10 feet away from buildings. However, the outdoor air canister may be placed near the outdoor air intake for the HVAC system for the building.

2.1.2.4. Outdoor air sample canisters should be secured to an immovable structure to ensure security for sampling in public areas. A bicycle lock or piece of chain and padlock can be used. NOTE: Do not secure the canister to or close to a living tree, however, because the tree's evapotranspiration process may release VOCs from groundwater into the vicinity. It may be a good idea to attach a label to the canister explaining that it is an environmental sample and should not be tampered with. The label can also include contact information.

2.1.2.5. Typically, outdoor air samples should be collected at breathing zone height (approximately 3 to 5 feet).

2.1.3. Guidelines for selecting crawl space air sample locations

2.1.3.1. Crawl space air samples are typically collected in locations selected to achieve adequate spatial coverage of the building's crawl space. Sample location selection will be limited by accessibility.

2.1.3.2. Crawl space air sample inlets should be located several feet from the opening or access point to avoid dilution by outdoor air. In cases where the crawl space is most conveniently sampled by access through crawl space vents, a sampling probe (sample delivery line made of Teflon® or stainless steel) of sufficient length is attached to the inlet of the flow controller.

2.2. Selection of sampling duration - Sample collection can be integrated over time by adjusting the flow controller. Project-specific sample periods as short as 10 minutes to as long as 24 hours can be achieved based on the size of canister used and the sampling rate selected (see Table 1). Generally, 6-liter canisters are used for air sampling. The sampling duration is usually selected to mimic the building occupants daily exposure period. Residential air sampling durations are typically 24 hours and commercial/industrial durations are typically 8-hours. However, depending on the workers or occupants schedule this may be adjusted.

TABLE 1
Common Sampling Rates for Air Sampling

| Can Size | Length of Sampling Time | Sampling Flow Rate (mL/min) |
|-----------------|--------------------------------|------------------------------------|
| 6 Liter | 1 hour | 90 |
| 6 Liter | 8 hours | 11.25 |
| 6 Liter | 24 hours | 3.75 |
| 1 Liter | 5 minutes | 180 |
| 1 Liter | 1 hour | 15 |
| 850 ml | 5 minutes | 150 |
| 850 ml | 1 hour | 12 |

2.3. Selection of sampling schedule - Sample collection should ideally occur during typical operating conditions (i.e., if workers occupy the building from 8am to 4pm, the sample collection would also take place from 8am to 4pm). However, building owners/occupants

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

may request that sampling take place when the building is not in use. In this case, make sure the HVAC system is set to typical operating conditions. Also, consider when the sample pressure will need to be checked (e.g., it's not a good idea to start 24-hour samples at 8am because they will need to be checked around 4am the next day).

3. Health and Safety

There are several health and safety topics to consider when performing air sampling.

- 3.1. Field teams should work in pairs at residential buildings or at industrial/commercial buildings where a relationship with the building occupant has not yet been established. A field team member should never enter a building alone for the first time. The mental stability of a building occupant should not be taken for granted. Building surveys at abandoned buildings should also be performed in pairs; if one team member is injured, the other will be able to seek help.
- 3.2. Beware of animals and insects. This applies to abandoned buildings and residences.
- 3.3. Be careful of overhead hazards in basements. Do not attempt to enter crawl spaces.
- 3.4. Beware of pinch points and use the correct hand tools to avoid hand injuries.

4. Canister Security

- 4.1. Field teams should assure that sampling canisters are not disturbed by building occupants.
- 4.2. If there is a community outreach program associated with the VI sampling event, then information should be made available to building occupants prior to the sampling event that informs occupants about the sampling activities and sampling equipment.
- 4.3. Each sampling canister should be clearly marked with a sign that includes contact information for a point of contact. An example of a sign that can be attached to each sampling canister is provided in the attachment to this SOP. This sign can be edited with project-specific information, laminated and attached to each sampling canister using cable ties (do not attach the signs using adhesive tape).

5. Apparatus and Materials

- 5.1. Canister, stainless steel, polished, certified clean and evacuated. (Canisters are typically cleaned, evacuated, and provided by the laboratory.)
- 5.2. Flow controller, certified clean, and set at desired sampling rate. (Flow controllers are typically cleaned, set, and provided by the laboratory.)
- 5.3. Shipping container suitable for protection of canister during shipping. Typically, strong cardboard boxes are used for canister shipment. The canisters should be shipped back to the laboratory in the same shipping container in which they were received.
- 5.4. Wrenches and screwdriver (clean and free of contaminants), various sizes as needed for connecting fittings and making adjustment to the flow controller. A 9/16-inch wrench fits the 1/4-inch Swagelok® fittings, which most canisters and flow controllers have.
- 5.5. Negative pressure (vacuum) gauge, oil-free and clean, to check canister vacuum. (The gauges are typically provided by the laboratory.) The laboratory may either provide one vacuum gauge to be used with all of the canisters, or a vacuum gauge for each canister to be left on during sample collection. Sometimes the canisters are fitted with built-in vacuum gauges that are not removable. These gauges are for field use only, and are an approximate measure of the actual vacuum. Regularly calibrated -- and less rugged -- vacuum gauges are used at the laboratory to measure vacuum before shipment and again after sample receipt.

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

- 5.6. Sampling probe, new Teflon® or stainless steel tubing, fitted with compression fittings. (For crawl space samples)
- 5.7. Swagelok® nut and ferrule set (part #SS-400-NFSET) to connect tubing to the canister
- 5.8. Sampling cane or similar device for outdoor air sampling to prevent water from entering canister during sampling.
- 5.9. Shipping container, suitable for protection of canister(s) during shipping. Typically, strong cardboard boxes are used for canister shipment. The canisters should be shipped to the laboratory in the same shipping container(s) in which they were received.

6. Sample Collection Procedure

- 6.1. Clean sampling protocols must be followed when handling and collecting air samples. This requires care in the shipping, storage, and use of sampling equipment. Cleanliness of personnel who come in contact with the sampling equipment is also important: no smoking, eating, drinking, perfumes, deodorants, dry cleaned clothing, etc. Canisters should not be transported in vehicles with gas-powered equipment or fuel cans. Sharpie®-type markers should not be used for labeling or note-taking during sampling.
- 6.2. The field team should order some additional canisters in case these are needed to replace visibly damaged canisters or canisters that have leaked during initial leak testing (see Paragraph 6.6.4).
- 6.3. The sampling canisters are certified clean and evacuated by the laboratory to negative 30 inches mercury (inches Hg). Care should be used at all times to prevent inadvertent loss of canister vacuum. Never open the canister's valve unless the intent is to collect a sample or check the canister vacuum with an attached gauge.
- 6.4. Prior to taking air samples, be sure to complete a building survey for vapor intrusion evaluations (see SOP – *Building Surveys for Vapor Intrusion Evaluation*). Note any changes in building conditions (especially potential VOC sources) since the building survey was performed.
- 6.5. Inspect the canister for damage and do not use a canister that has visible damage.
- 6.6. Verify that the canister has sufficient initial vacuum for sampling. Initial canister vacuums that are less than certified by the laboratory (~29 to 30 inches Hg) are a potential indication of leakage which could affect the accuracy of analytical results. Measure the initial canister vacuum using an external vacuum gauge, as described below:
 - 6.6.1. Remove the protective cap from the canister; make sure the canister valve is closed before doing this.
 - 6.6.2. Attach an external vacuum gauge to the canister and open the valve. If the vacuum gauge has two openings, make sure that the other opening is closed; the canister cap can be used for this. After taking the reading, record the initial vacuum, close the canister valve and remove the gauge.
 - 6.6.3. Measure the initial canister pressure using a digital vacuum gauge with 0.25% accuracy at the -30 to 0 inches Hg range and NIST-traceable calibration for vacuum measurements. See the *Technical Bulletin: Use of External Vacuum Gauges with Canisters* for a recommended model of vacuum gauge¹ for use with Summa canisters used for vapor intrusion sampling.

¹ A PG5 Digital Pressure Gauge from Automation Products Group (APG), Inc. (<http://www.apgsensors.com/products/pressure-sensors/digital-pressure-gauges/pg5>) with National Institute of Standards and Technology (NIST)-traceable calibration certificate, or equivalent, is recommended for making vacuum measurements.

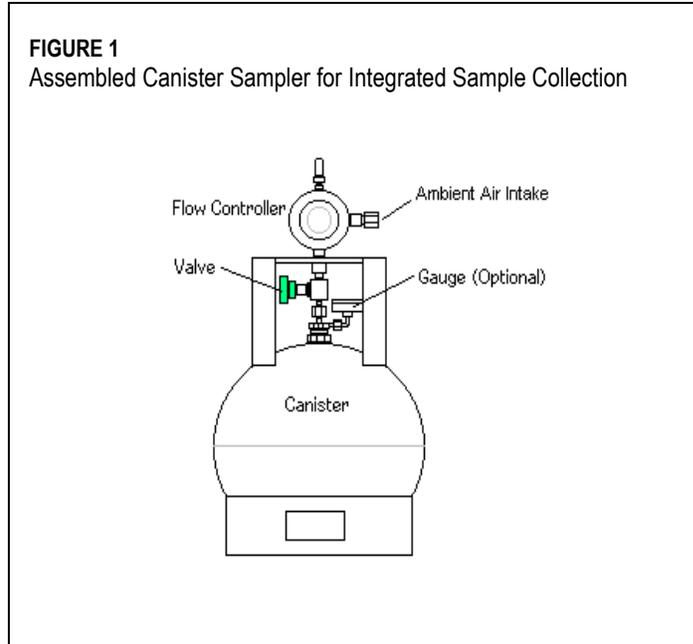
This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

- 6.6.4.** Do not sample using a canister without sufficient initial vacuum. Be advised that sampling data may be flagged or rejected from canisters with low initial vacuum (less than 28 inches Hg). Low initial vacuum could create a low bias in analytical results due to air leakage. While there is also a smaller risk that air leakage could introduce contaminants into the canister, the primary concern is the low bias to analytical results; this bias is within the range of analytical variability allowed with the EPA Method TO-15 ($\pm 30\%$) for initial vacuums >24 inches Hg. The table presented in Paragraph 6.5.5 identifies the field team's response based on the initial vacuum reading for a canister. In addition, this table also identifies the potential bias to results at different initial canister vacuums.
- 6.6.5.** Use the following table to determine when to use canisters based on initial vacuum readings:

| Initial Vacuum Reading | Potential Error in Analytical Results Due to Leakage | Field Team Response |
|-------------------------------|---|---|
| >30 to 28 inches Hg | Up to -10% error | Use canister for sampling – no limitations on use. |
| >26 to 28 inches Hg | Up to -21% error | Use canister for sampling if necessary; replace canister with a spare if spares are available. |
| >24 to 26 inches Hg | Up to -30% error | Sampling with canister is not advisable. Contact project manager and obtain direction before sampling with this canister. Be advised that qualifiers may be applied to analytical results sampled with canisters with vacuums less than 26 inches Hg. |
| <24 inches Hg | $>-30\%$ error | Do not use this canister for sampling. Analytical results will be rejected. |

- 6.7.** Flow controllers should come pre-set by the laboratory to sample at a pre-determined rate based on specific project requirements (see Table 1 for the most common options). In some cases (that is, project-specific quality assurance [QA]), the flow rate will need to be verified in the field prior to use. This is accomplished with a bubble meter, vacuum source, and instructions supplied by the laboratory.
- 6.8.** In the field log record the canister identification (ID), flow controller ID, initial vacuum, desired flow rate, sample location information, and all other information pertinent to the sampling effort. The indoor and outdoor temperature and barometric pressure should be recorded when sampling begins and is completed.
- 6.9.** Connect the flow controller to the canister (Figure 1).
- 6.9.1.** The flow controller fitting denoted "LP" or "OUT" is connected to the canister. Tighten the fitting to be leak free but do not over-tighten (a 1/4 turn past snug is usually enough.) When tightening the fitting, be sure that the valve assembly does not rotate, by using your other hand to hold the valve steady.
- 6.9.2.** If an assigned vacuum gauge is used for each canister, the vacuum gauge should be attached to the canister first and then the flow controller should be attached to the vacuum gauge.
- 6.9.3.** When the flow controller and vacuum gauge are attached correctly they will not move separately from the canister (they will not spin around).

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.



- 6.10. For outdoor samples, be sure that the inlet to the flow controller is protected from precipitation. Either place the canister and flow controller under a shelter/enclosure, use a sampling cane provided by the laboratory, or use a clean piece of aluminum foil to build a tent over the flow controller inlet.
- 6.11. If crawl spaces are being sampled remotely through a crawl space vent, adjust the length of the sampling probe to achieve the desired sampling location and place an inert spacer (wire clothes hanger) near the end of the probe to keep the probe tip opening suspended ~ 3 inches above the ground level. Now connect the sampling probe to the inlet of the flow controller.
- 6.12. Remove all work articles from the sampling area.
- 6.13. To begin sampling, slowly open the canister valve one full turn.
- 6.14. For canisters with built-in or assigned vacuum gauges, monitor the vacuum change several times during the course of the selected sample period to ensure the canister is filling at the desired rate.
- 6.15. At the end of the sample period, close the canister valve finger tight.
- 6.16. Remove the flow controller and replace the protective cap on the canister valve fitting.
- 6.17. Measure the final canister vacuum with the digital vacuum gauge. Attach the digital vacuum gauge, open the canister valve, and record the final vacuum. Close the valve, remove the gauge, and replace and tighten the cap on the canister.
- 6.18. Ideal final vacuum in the canister is between 2 and 10 inches Hg. More than 10 inches Hg means that a smaller than expected sample volume has been collected, which can increase reporting limits. A small amount of vacuum should be left in the canister to assess the potential for leakage during transport to the laboratory.
- 6.19. Consult with the project manager before submitting the sample to the laboratory if a final vacuum greater than 10 inches Hg, or less than 2 inches Hg are encountered. Use the following table for guidance to determine how to address final vacuum measurements:

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

| Final Vacuum Reading | Field Team Response |
|---------------------------------|---|
| < 2 inches Hg | Contact Project Manager before submitting sample. Notify analytical laboratory to report their laboratory-measured pressure and to get direction from the Project Manager before analyzing sample. |
| > 2 inches Hg and <10 inches Hg | Submit sample for analysis - no limitations on data use |
| >10 inches Hg | Contact Project Manager before submitting sample. Verify final vacuum with the analytical laboratory before analysis. |

- 6.20. Canisters with no vacuum left (i.e., 0 inches Hg) should not be analyzed. Contact the Project Manager before submitting a sample with a final vacuum of 0 inches Hg to determine the appropriate course of action. One option is to verify the final vacuum with the analytical laboratory. If there is vacuum remaining in the canister according to the laboratory vacuum gauge, the Project Manager may direct the analytical laboratory to analyze the sample.
- 6.21. The analytical laboratory should be directed to not analyze a sample showing a final vacuum of 0 inches Hg (as measured by the laboratory), and to notify the Project Manager and obtain further guidance regarding that sample.
- 6.22. If the flow controller is going to be used for more than one sample collection, be sure to purge it between uses. To do this, attach the flow controller to a vacuum source and draw clean air or gas (ultra-high purity) through it for several minutes before attaching it to the canister.

7. Altitude Correction

- 7.1. Air pressure decreases with elevation. Therefore, a canister evacuated at a laboratory located at sea level will show a lower vacuum measurement at a higher altitude. Generally, a 1,000 foot rise in elevation corresponds to a 1 inch Hg drop in pressure OR a 1 inch Hg decrease in measured vacuum. For example, a canister evacuated to 30 inches at sea level and used at 3,000 ft would show an initial vacuum of 27 inches Hg.
- 7.2. If you plan to sample at altitude, be sure to inform the laboratory ahead of time so they adjust the flow controllers accordingly
- 7.3. If sampling is being conducted at higher elevations, verify the elevation difference between the analytical laboratory and field location and determine the associated decrease in measured vacuum.
 - 7.3.1. Calculate the pressure difference between the laboratory and field location as follows: Difference from Sea Level (field) – Difference from Sea Level (laboratory). Use the Altitude Correction Table attached to this SOP.
 - 7.3.2. Subtract the pressure difference determined in Section 7.2.1 from allowable initial vacuum levels (Section 5.5.4) and final vacuum levels (Section 5.18) to determine appropriate initial and final vacuum levels.

8. Sample Handling and Shipping

- 8.1. Fill out all appropriate documentation (chain of custody, sample tags) and return canisters and equipment to the laboratory
- 8.2. The canisters should be shipped back to the laboratory in the same shipping container in which they were received. The samples should not be cooled during shipment. DO NOT put ice in the shipping container.

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- 8.3. When packing the canisters for shipment, verify that the valve (just past finger-tight) and valve caps are snug (1/4 turn past finger tight), and use sufficient clean packing to prevent the valves from rubbing against any hard surfaces. Never pack the canisters with other objects or materials that could cause them to be punctured or damaged. Ensure that flow controllers and gauges are separately and adequately wrapped to prevent damage.
- 8.4. **Do not place sticky labels or tape on any surface of the canister.**
- 8.5. Place a custody seal over the openings of the shipping container.
- 8.6. Make sure to insure the package for the value of the sample containers and flow controllers if corporate card policy does not cover this.
- 8.7. Ship canisters via overnight delivery. NOTE: If sampling on a Friday, ensure the laboratory accepts samples on Saturdays (you do not want the canisters sitting on a loading dock [or worse] for 3 days).

9. Quality Control

- 9.1. Canisters supplied by the laboratory must follow the performance criteria and quality assurance prescribed in U.S. Environmental Protection Agency (EPA) Method TO-14/15 for canister cleaning, certification of cleanliness, and leak checking. SOPs are required.
- 9.2. Flow controllers supplied by the laboratory must follow the performance criteria and QA prescribed in EPA Method TO-14/15 for flow controller cleaning and adjustment. SOPs are required.

10. Attachments

- 10.1. Indoor, Outdoor, and Crawl Space Air Sampling Log - Canister Method (2 options)
- 10.2. Sample sign for posting.
- 10.3. Altitude correction table.

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

Altitude Correction Table

| Elevation (ft) | Pressure (in Hg) | Difference from Sea-Level (in Hg) | Elevation (ft) | Pressure (in Hg) | Difference from Sea-Level (in Hg) |
|----------------|------------------|-----------------------------------|----------------|------------------|-----------------------------------|
| 0 | 29.92 | 0 | 1500 | 28.37 | 1.553 |
| 50 | 29.87 | 0.053 | 1550 | 28.32 | 1.603 |
| 100 | 29.81 | 0.106 | 1600 | 28.27 | 1.653 |
| 150 | 29.76 | 0.159 | 1650 | 28.22 | 1.703 |
| 200 | 29.71 | 0.212 | 1700 | 28.17 | 1.753 |
| 250 | 29.66 | 0.265 | 1750 | 28.12 | 1.803 |
| 300 | 29.60 | 0.317 | 1800 | 28.07 | 1.853 |
| 350 | 29.55 | 0.370 | 1850 | 28.02 | 1.903 |
| 400 | 29.50 | 0.422 | 1900 | 27.97 | 1.953 |
| 450 | 29.45 | 0.474 | 1950 | 27.92 | 2.002 |
| 500 | 29.39 | 0.527 | 2000 | 27.87 | 2.052 |
| 550 | 29.34 | 0.579 | 2050 | 27.82 | 2.101 |
| 600 | 29.29 | 0.631 | 2100 | 27.77 | 2.151 |
| 650 | 29.24 | 0.683 | 2150 | 27.72 | 2.200 |
| 700 | 29.19 | 0.735 | 2200 | 27.67 | 2.249 |
| 750 | 29.13 | 0.787 | 2250 | 27.62 | 2.298 |
| 800 | 29.08 | 0.838 | 2300 | 27.57 | 2.347 |
| 850 | 29.03 | 0.890 | 2350 | 27.52 | 2.396 |
| 900 | 28.98 | 0.941 | 2400 | 27.47 | 2.445 |
| 950 | 28.93 | 0.993 | 2450 | 27.43 | 2.494 |
| 1000 | 28.88 | 1.044 | 2500 | 27.38 | 2.543 |
| 1050 | 28.82 | 1.095 | 2550 | 27.33 | 2.591 |
| 1100 | 28.77 | 1.147 | 2600 | 27.28 | 2.640 |
| 1150 | 28.72 | 1.198 | 2650 | 27.23 | 2.688 |
| 1200 | 28.67 | 1.249 | 2700 | 27.18 | 2.736 |
| 1250 | 28.62 | 1.299 | 2750 | 27.14 | 2.785 |
| 1300 | 28.57 | 1.350 | 2800 | 27.09 | 2.833 |
| 1350 | 28.52 | 1.401 | 2850 | 27.04 | 2.881 |
| 1400 | 28.47 | 1.452 | 2900 | 26.99 | 2.929 |
| 1450 | 28.42 | 1.502 | 2950 | 26.94 | 2.977 |
| | | | 3000 | 26.90 | 3.025 |

Note: use the following equation to calculate atmospheric for altitudes not shown on this table:

$P = P_0 \exp(-35.523 \times 10^{-6} y)$, where P is the pressure at the desired elevation, P₀ is the atmospheric pressure at sea level, and y is the desired elevation. Source: NASA, 1996. *Elevation Correction Factor for Absolute Pressure Measurements*. NASA Technical Memorandum 107240.

Appendix C
Cox-Colvin SOP Installation and Extraction of the
Vapor Pin and CH2M HILL SOP for Installing
Subslab Probes and Collecting Subslab Soil Gas
Samples Using Canisters

Scope:

This standard operating procedure describes the installation and extraction of the Vapor Pin™¹ for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the Vapor Pin™ for the collection of sub-slab soil-gas samples.

Equipment Needed:

- Assembled Vapor Pin™ [Vapor Pin™ and silicone sleeve (Figure 1)];
- Hammer drill;
- 5/8-inch diameter hammer bit (Hilti™ TE-YX 5/8" x 22" #00206514 or equivalent);
- 1½-inch diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch diameter bottle brush;
- Wet/dry vacuum with HEPA filter (optional);
- Vapor Pin™ installation/extraction tool;
- Dead blow hammer;
- Vapor Pin™ flush mount cover, as necessary;
- Vapor Pin™ protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel.



Figure 1. Assembled Vapor Pin™.

Installation Procedure:

- 1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.
- 2) Set up wet/dry vacuum to collect drill cuttings.
- 3) If a flush mount installation is required, drill a 1½-inch diameter hole at least 1¾-inches into the slab.
- 4) Drill a 5/8-inch diameter hole through the slab and approximately 1-inch into the underlying soil to form a void.
- 5) Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.
- 6) Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the extraction/installation tool over the Vapor Pin™ to protect the barb fitting and cap, and tap the Vapor Pin™ into place using a

¹Cox-Colvin & Associates, Inc., designed and developed the Vapor Pin™; a patent is pending.

dead blow hammer (Figure 2). Make sure the extraction/installation tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.



Figure 2. Installing the Vapor Pin™.

For flush mount installations, unscrew the threaded coupling from the installation/extraction handle and use the hole in the end of the tool to assist with the installation (Figure 3).



Figure 3. Flush-mount installation.

During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder. Place the protective cap on Vapor Pin™ to prevent vapor loss prior to sampling (Figure 4).



Figure 4. Installed Vapor Pin™.

- 7) For flush mount installations, cover the Vapor Pin™ with a flush mount cover.
- 8) Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to equilibrate prior to sampling.
- 9) Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™ (Figure 5).

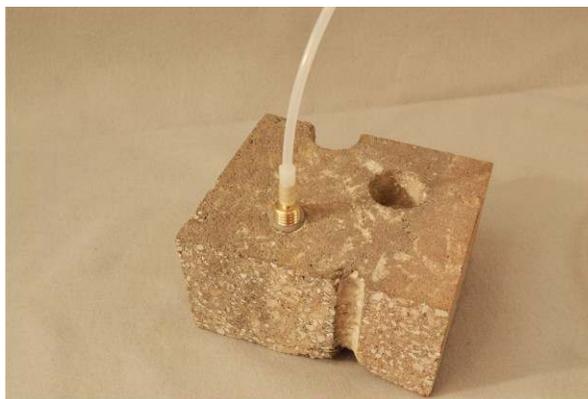


Figure 5. Vapor Pin™ sample connection.

- 10) Conduct leak tests [(e.g., real-time monitoring of oxygen levels on extracted sub-slab soil gas, or placement of a water

dam around the Vapor Pin™) Figure 6]. Consult your local guidance for possible tests.



Figure 6. Water dam used for leak detection.

- 11) Collect sub-slab soil gas sample. When finished sampling, replace the protective cap and flush mount cover until the next sampling event. If the sampling is complete, extract the Vapor Pin™.

Extraction Procedure:

- 1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the Vapor Pin™ (Figure 7). Continue



Figure 7. Removing the Vapor Pin™.

turning the tool to assist in extraction, then pull the Vapor Pin™ from the hole (Figure 8).



Figure 8. Extracted Vapor Pin™.

- 2) Fill the void with hydraulic cement and smooth with the trowel or putty knife.
- 3) Prior to reuse, remove the silicone sleeve and discard. Decontaminate the Vapor Pin™ in a hot water and Alconox® wash, then heat in an oven to a temperature of 130° C.

The Vapor Pin™ is designed to be used repeatedly; however, replacement parts and supplies will be required periodically. These parts are available on-line at www.CoxColvin.com.

Replacement Parts:

- Vapor Pin™ Kit Case - VPC001
- Vapor Pins™ - VPIN0522
- Silicone Sleeves - VPTS077
- Installation/Extraction Tool - VP1E023
- Protective Caps - VPPC010
- Flush Mount Covers - VPFM050
- Water Dam - VPWD004
- Brush - VPB026

Standard Operating Procedure for Installing Subslab Probes and Collecting Subslab Soil Gas Samples Using Canisters

1.0 Scope and Application

This standard operating procedure (SOP) describes the approach for installing subslab soil gas probes and collecting subslab soil gas samples using canisters (e.g., SUMMA canisters or equivalent). It includes instructions on probe installation, leak checking, soil gas sampling, and probe abandonment. This procedure should be used in conjunction with project data quality objectives. The project team is responsible for ensuring this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project. Vapor intrusion (VI) subject-matter experts (SMEs) should be consulted as needed to address technical, regulatory or field implementation issues associated with the use of this SOP. Only persons trained in the collection of subslab samples should attempt this procedure.

2.0 Project-Specific Considerations

- 2.1 A utility clearance must be performed prior to drilling through the slab, as with all intrusive site work. In addition, it is highly recommended that ground penetrating radar (GPR), specifically a concrete scanner (small, hand-held GPR unit designed for use inside buildings), be used to identify utilities, wire mesh, and/or rebar in the slab prior to drilling. The sampling team should look around the building to locate where utilities come into the building. Utility shut-off valves should be located in case an underground utility is encountered.
- 2.2 The Swagelok® parts (sampling union and nuts) may be re-used if they are decontaminated. Options for decontamination include: 1) purging with ultra pure air, 2) washing with alconox followed by hot water rinse, or 3) washing with methanol followed by hot water rinse. It is also advisable to heat the parts in an oven to a temperature of 130 degrees C (266 degrees F) after rinsing with water. The appropriate decontamination process should be selected during the work planning phase for each project. Typically subslab soil gas sampling does not generate investigation-derived waste (IDW) other than items that can be disposed of as solid waste; however, decontaminating with liquids will generate IDW. Compare the cost of buying new parts to the cost of managing and disposing of the IDW. The Teflon tubing cannot be reused or decontaminated.
- 2.3 There are three types of probe installation techniques. The type chosen depends on site access, probe seal integrity considerations, and the number of sampling events planned. It is critical that the sealing compound used is low in volatile organic compounds (VOCs). The following suggested sealing compounds below have been tested and approved for use. Consult a subject matter expert if another compound is preferred or available. See Table 1 for more specific details.
 - 2.3.1 Temporary – Beeswax – Use if time is short, access is an issue, and a higher risk of leaks (requiring repeated resealing of the probe) is acceptable. It MUST be 100 percent pure, natural beeswax.
 - 2.3.2 Semi-Permanent – Fix-It-All – Use if setting the probe and sampling in one day is preferred, access limitations are minimal, only one sampling event is intended, and minimal moisture is present.
 - 2.3.3 Permanent – Portland cement – Use if there is unlimited access and multiple sampling events are desired.

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

TABLE 1
Probe Seal Types

| Probe Type | Suggested Probe Seal | Benefits | Drawbacks |
|-------------------|-----------------------------|---|--|
| Temporary | Beeswax | Quick. Can Set probe and take sample in one visit Easy to remove | Wax is brittle when cool and is very susceptible to leakage. |
| Semi-permanent | Fix-It-All | Sets up fairly quickly (>30 min.), but may require 2 visits on the same day Solid seal Easy to remove | Not good for wet environments. Material breaks down |
| Permanent | Portland cement | Solid permanent seal Good for multiple sampling events | Takes at least 24 hours to set. Will require at least 2 visits on consecutive days Difficult to remove |

3.0 Health and Safety

There are several health and safety topics to consider when installing and sampling subslab soil gas probes:

- 3.1 Field teams should work in pairs at residential buildings or at industrial/commercial buildings where a relationship with the building occupant has not yet been established. A field team member should never enter a building alone for the first time. The mental stability of a building occupant should not be taken for granted. Probe installation should also be performed in pairs.
- 3.2 The hammer drill is a large and powerful hand tool. When drilling, do not apply downward pressure, allow the drill to do the work. The drill bit is likely to become stuck if the operator is pushing down on the drill. Be prepared for the drill bit to catch and for the drill to stop suddenly; it can twist the operators wrist badly if unexpected.
- 3.3 Have a photoionization detector ready to screen the breathing zone during installation and sampling. Significant VOC concentrations may be present in subslab soil gas.
- 3.4 Beware of pinch points and use the correct hand tools to avoid hand injuries.

4.0 Canister Security

- 4.1 Field teams should assure that sampling canisters are not disturbed by building occupants.
- 4.2 If there is a community outreach program associated with the VI sampling event, then information should be made available to building occupants prior to the sampling event that informs occupants about the sampling activities and sampling equipment.

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

- 4.3 Each sampling canister should be clearly marked with a sign that includes contact information for a point of contact. An example of a sign that can be attached to each sampling canister is provided in the attachment to this SOP. This sign can be edited with project-specific information, laminated and attached to each sampling canister using cable ties (do not attach the signs using adhesive tape).

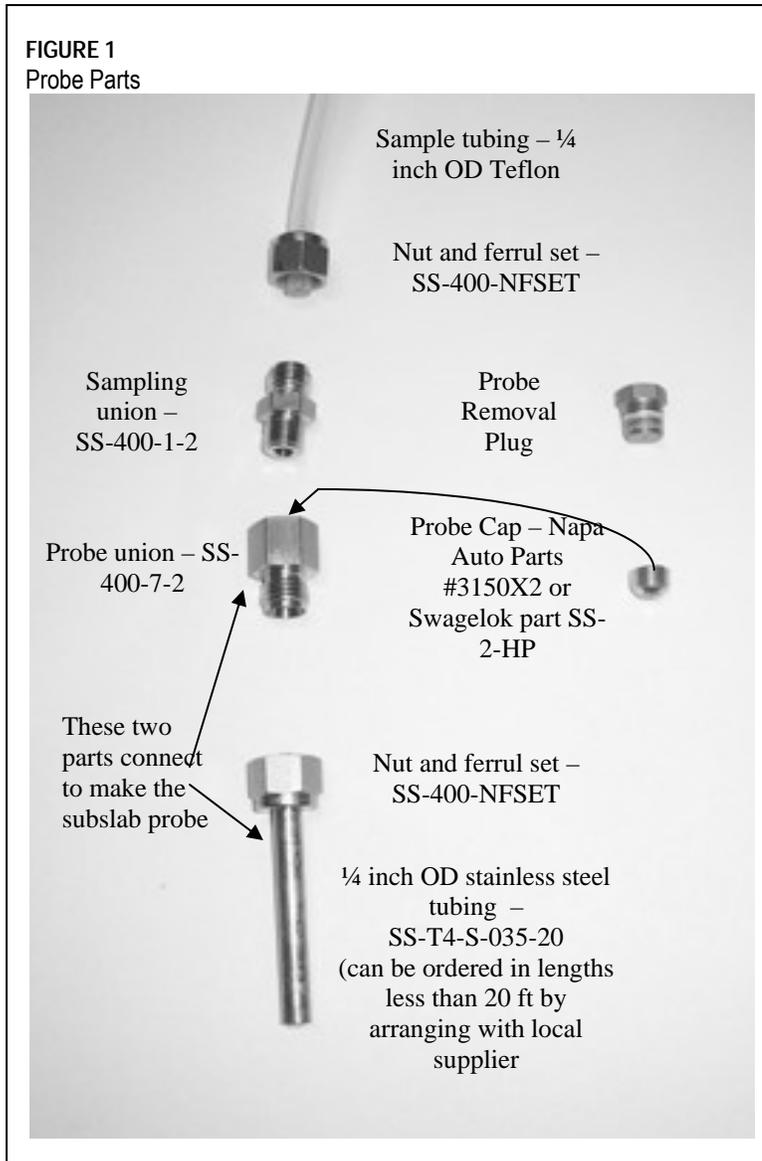
5.0 Materials

5.1 Subslab Soil Gas Probe Installation

- Hammer drill and drill bits (7/8-inch and 1-inch OR 5/16-inch and 1/2-inch). NOTE: It is a good idea to have an extra-long drill bit available to drill through the occasional extra-thick slab.
- Vacuum cleaner (shop vac type or handheld, with HEPA filtration) for removing concrete dust generated while drilling through the slab for probe installation. Continuously vacuum the dust as it is generated during the drilling process.
- Subslab soil gas probe (for permanent or semi-permanent installations) See Figure 1 for an expanded view of the probe parts.
 - 1/4-inch outer diameter (OD) stainless steel tube for probe (Swagelok® part #SS-T4-S-035-20)
 - Swagelok® nut and ferrule set (part #SS-400-NFSET)
 - Probe union (1/4-inch male Swagelok® to 1/8-inch female NPT – part #SS-400-7-2).
 - Probe cap (Napa Auto Parts #3150X2 or Swagelok® part SS-2-HP)
- Metal tubing cutter for adjusting the length of the probe so that the probe does not extend below the slab
- Probe seal consisting of beeswax, Fix-it-All, or portland cement
- Wax melter (for beeswax only) – can be obtained from a beauty supply store (paraffin wax melter or body hair wax melter). Also need a clean metal measuring cup with handle for placing the wax into the melter; this way the wax can be melted in the cup and then easily poured into the probe hole. The beeswax CANNOT be melted with a direct flame because this generates VOCs and particulate pollutants.
- Large cotton swabs or paper towels and non-chlorinated (de-ionized or distilled) water for cleaning the concrete dust out of the hole
- Tongue depressor, putty knife, or similar tool for putting the probe seal material into the hole
- Teflon® pipe tape to wrap the end of the probe tubing so that the probe fits tightly into the hole to prevent the seal material from clogging the probe
- Tape measure to measure the thickness of the slab (measured off of a long screwdriver or drill bit)
- Optional (required by some regulatory agencies): glass “seed beads” (available at a craft store) to fill the void space created in the subslab during installation

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

- Optional: Sonicare® toothbrush with bristles removed. This can be useful in removing air bubbles from the cement mixture while installing the probe, thus making a more competent seal. Toothpicks or cotton swabs without cotton tip can also be used for this purpose.



5.2 Helium Leak Check

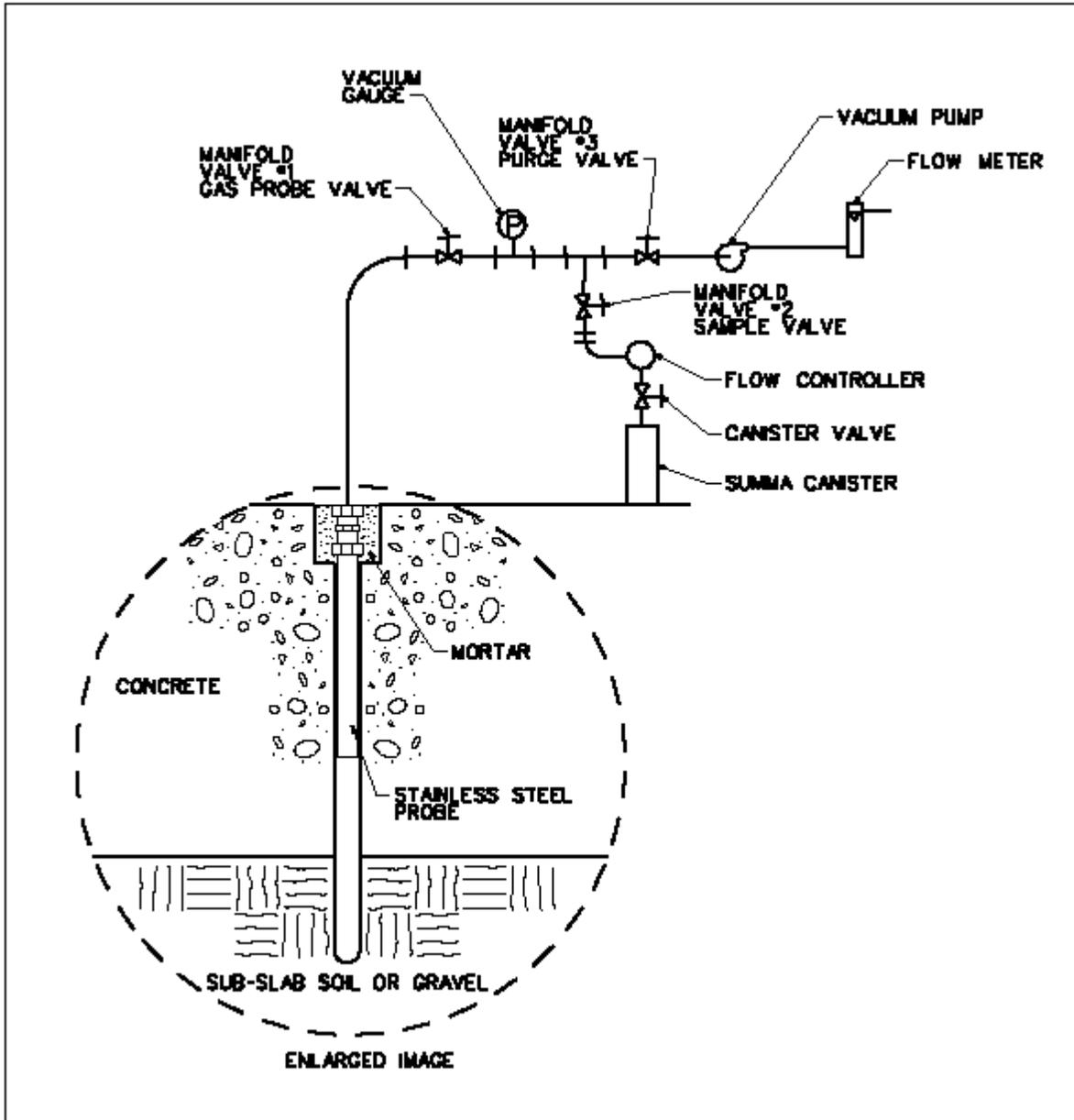
- Helium canister containing high-grade helium (NOT balloon grade) and regulator for the canister (should be set to a flow rate of 200 milliliters per minute [mL/min] or less)
- Enclosure, which may be constructed from a small bowl or container
- Helium detector (e.g. Dielectric MGD®-2002), which can be rented from an equipment rental company.

5.3 Subslab Soil Gas Sampling

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The subslab soil gas sampling set up is shown in Figure 2.

FIGURE 2
Subslab Soil Gas Sampling Diagram



- Sampling union: 1/4-inch male Swagelok® (or equivalent) to 1/4-inch male NPT (part # SS-400-1-2) (not necessary for beeswax method)
- Vacuum pump for purging with rotometer to control flow to 200 mL/min (should be a Cole Parmer # R-79200-00 grey diaphragm pump or equivalent)
- Sampling manifold consisting of Swagelok® gas-tight fittings with three valves and one vacuum gauge to attach the probe to the air pump and the sample canister. See

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Figure 10. This manifold must be clean, free of oils, and flushed free of VOCs before use. This is accomplished by flushing three or four volumes of purge gas (ultra-high-purity [UHP] air or nitrogen) through the manifold and associated tubing.

- Swagelok® valve (only necessary for extended sampling periods [e.g., 8- or 24-hours] so that the sampling manifold can be disconnected without introducing indoor air into the probe) (part # SS-4P4T)
- Teflon® (or inert nylon) tubing, 1/4-inch outer diameter (OD)
- Tedlar® bag (1-L or 3-L) to collect the purged soil gas, so: (1) it is not discharged into the building, (2) the volume of purged soil gas can be measured, and (3) field screening with a PID or GEM2000 meter can be performed on the purged gas
- GEM2000® Landfill Gas Meter – this is optional if field measurements of CO₂, O₂, or CH₄ are necessary (aerobic biodegradation parameters typically measured for petroleum hydrocarbon sites)
- MiniRae® PID Meter – for health and safety to ensure breathing zone VOC concentrations remain below levels specified by the health and safety plan. It is also optional to collect field measurements of total VOCs from the probe or purged soil gas; may warn the lab if high concentrations are detected so they can dilute the sample before analysis.
- Canister, stainless steel, polished, certified-clean, and evacuated. These are typically cleaned, evacuated, and provided by the laboratory.
- Flow controller or critical orifice, certified-clean, and set at desired sampling rate. These are typically cleaned, set, and provided by the laboratory. Common sampling rates for subslab soil gas sampling are provided in Table 2.

TABLE 2
Common Sampling Rates for Subslab Soil Gas Sampling

| Can Size | Length of Sampling Time | Sampling Flow Rate (mL/min) |
|----------|-------------------------|-----------------------------|
| 6 Liter | 1 hour | 90 |
| 6 Liter | 8 hours | 11.25 |
| 6 Liter | 24 hours | 3.75 |
| 1 Liter | 5 minutes | 180 |
| 1 Liter | 1 hour | 15 |
| 850 ml | 5 minutes | 150 |
| 850 ml | 1 hour | 12 |

- Miscellaneous fittings (Swagelok® nut and ferrule, part #SS-400-NFSET) to connect tubing to sampling union and the canister
- Negative pressure (vacuum) gauge, oil-free and clean, to check canister vacuum. The vacuum gauges are typically provided by the laboratory. The laboratory may either provide one vacuum gauge to be used with all of the canisters, or a vacuum gauge for each canister to be left on during sample collection. Sometimes the canisters are fitted with built-in vacuum gauges that are not removable. Gauges sent by the laboratory are

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for field use only, and are an approximate measure of the actual vacuum. Regularly calibrated – and less rugged – vacuum gauges are used at the laboratory to measure vacuum before shipment and again after sample receipt.

5.4 Probe Abandonment

- Probe removal fitting (or just use the sampling union)
- Crowbar
- Chisel and hammer
- Concrete patch (either pre-mixed cement patch or portland cement)

5.5 Miscellaneous

- Teflon® tape
- Modeling clay (VOC-free) for temporarily sealing probes that are leaking so the probe can be sampled and then patched with cement or Fix-It-All, or just abandoned for the beeswax method.
- Wrenches and screwdrivers (clean and free of contaminants) of various sizes as needed for connecting fittings and making adjustment to the flow controller. A 9/16-inch wrench fits the 1/4-inch Swagelok® fittings, which most canisters and flow controllers have.
- Extension cord
- Timer/watch
- Tools required to cut carpet and/or tools needed for removal of other floor coverings
- Shipping container suitable for protection of canister(s) during shipping. Typically, strong cardboard boxes are used for canister shipment. The canisters should be shipped to the laboratory in the same shipping container(s) in which they were received.

6.0 **Subslab Soil Gas Probe Installation Procedure**

- 6.1 Locate the sampling locations in accordance with the work plan. Note the location of the probe, locations of significant features (walls, cracks, sumps, drains, etc), and condition of the slab.
- 6.2 If needed, expose the concrete by cutting the carpet or other loose floor coverings (Note: carpet need not be removed, but rather an 'L' shape should be cut to expose the concrete for drilling and the leak-check enclosure).
- 6.3 Drill a 7/8-inch or 1-inch diameter hole to a depth of 1 and 3/4 inches (measured to the center of the hole) to allow room for installing the probe nut and probe union (See Figures 2 and 3). Remove the cuttings using the HEPA vacuum cleaner. Be careful to not compromise the integrity of the slab during drilling (e.g., cracking it), although make a note if this occurs. It

FIGURE 3
Drilling 1-inch mortar hole to a depth of 1 and 3/4-inch

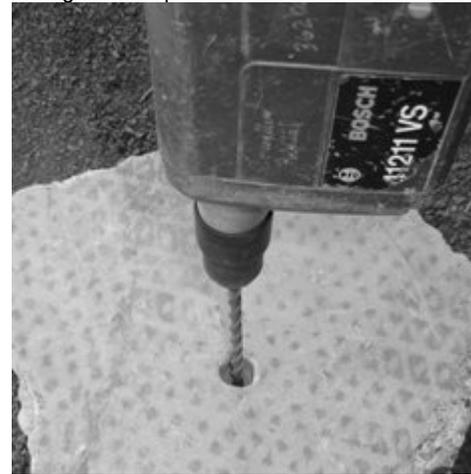


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is important that the slab and the probe hole remain airtight for sampling and that cracks are noted.

- 6.4 Drill a 5/16-inch or 1/2-inch diameter hole through the remainder of the slab and approximately 3 inches down into the subslab material (See Figures 2 and 4). Drilling into the subslab material creates a void that is free of obstructions that might plug the probe during sampling. Record the total depth of the slab and the depth drilled into the subslab material on the Subslab Soil Gas Sampling Log.
- 6.5 Clean out the drilled hole with the HEPA vacuum (equipped with a micro tip), cotton swabs, and paper towel. This removes any remaining dust, allowing the seal material to adhere to the hole wall better.
- 6.6 Some agencies may require that glass beads be poured into the subslab hole before installing the probe. If so, pour clean glass "seed beads" (available at a craft store) into the hole until enough beads have been added so that the top of the beads are even with the bottom of the slab. A thin piece of wire marked with the slab thickness and inserted into the hole can be used to determine this.
- 6.7 Install the subslab probe into the hole. First, trim the probe to the appropriate length so that, when inserted into the hole, it will not extend below the slab. Then wrap the end of the probe tubing with Teflon tape so that the probe fits tightly into the hole to prevent the seal material from clogging the probe. For permanent or semi-permanent probes, the probe is constructed of stainless steel tubing and Swagelok® parts. Temporary probes consist of 1/4-inch OD Teflon® tubing.
 - 6.7.1 Temporary Seal (beeswax)
 - 6.7.1.1 Melt the beeswax in the wax melter and pour the melted wax into the hole around the tubing. Be sure to get wax on all sides of the smaller diameter hole by moving the sample tube away from the walls. Continue to add wax until the hole is completely full.
 - 6.7.1.2 Let the wax cool for 10 minutes.
 - 6.7.1.3 Be sure to never leave the probe hole open to the atmosphere for extended periods to minimize the effects of surface infiltration.
 - 6.7.1.4 Be careful to never put too much force on the sampling tube. The wax is only a temporary seal, and its sealing integrity can be compromised easily.
 - 6.7.2 Semi-Permanent (Fix-It-All) or Permanent (portland cement) Seal
 - 6.7.2.1 Wet the walls of the hole using a cotton swab or moistened paper towel. This helps the mortar bond to the drilled concrete. Prepare the mortar in accordance with manufacturer's directions to a stiff consistency. Make sure that the consistency is such that the mixture will not run down the sides of the hole and potentially clog the probe or hole but is still easy enough to work with (so it can be easily scooped into the hole). Only mix an amount that can be used in 15 minutes. Place sample probe part-way into the hole, as

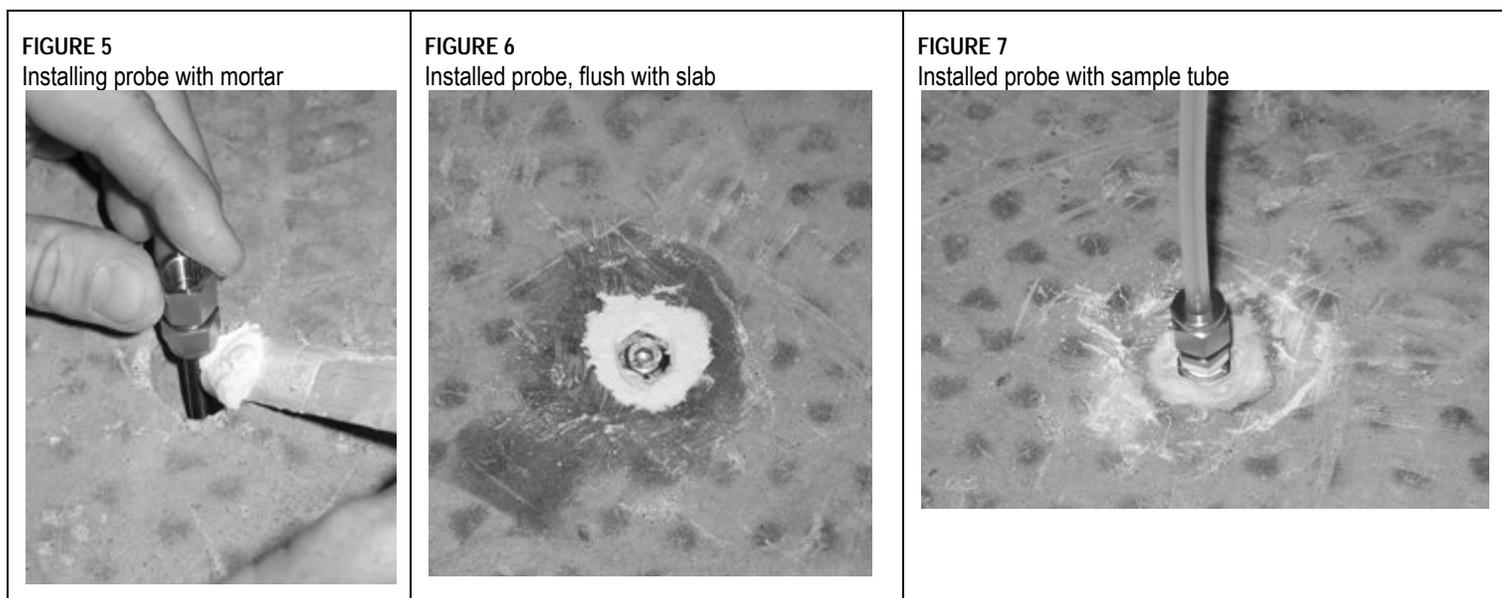
FIGURE 4
Drilling 3/8-inch probe hole



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shown in Figure 5. Using the tongue depressor or similar tool, apply mortar around the base of the sampling probe and sampling union such that it will be sealed once it is in place.

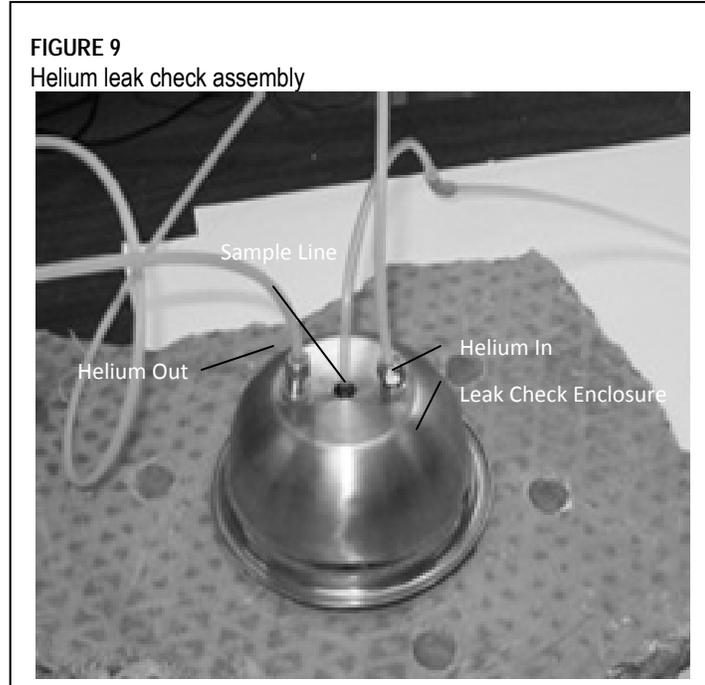
- 6.7.2.2 Fill the hole with mortar and press the probe further into the hole until its top is flush with the floor. In doing so, slightly wiggle the probe to create good 'wetting' contact between the probe and the mortar as well as the mortar and the drilled concrete. It may be helpful to work the concrete with a Sonicare® toothbrush (with the bristles removed) or a toothpick or similar object during this step to remove the air bubbles from the mortar and make a more effective seal. Scrape off excess and make sure there is clear access to the probe. See Figure 6.
- 6.7.2.3 For Fix-It-All, let dry for 30 minutes. For cement, let cure for 24 hours.
- 6.7.2.4 Be sure to never leave the probe hole open to the atmosphere for extended periods to minimize the effects of surface infiltration. The probe cap should be on the probe at all times except when sampling.



7.0 Subslab Soil Gas Sampling System Set-Up Procedure

- 7.1 For semi-permanent and permanent subslab probes, remove the probe cap and attach the sampling union to the subslab probe. Then attach 1/4-inch Teflon® tubing to the sampling union with a Swagelok® nut and ferrule set. See Figure 7.
- 7.2 Place the helium leak-check enclosure over the subslab probe by threading the Teflon® tubing through the hole of the enclosure. Slide the enclosure down so it seals on the concrete slab. Attach the other end of the sample tube to the sampling manifold with the use of a nut and ferrule set. See Figures 8 - 10.

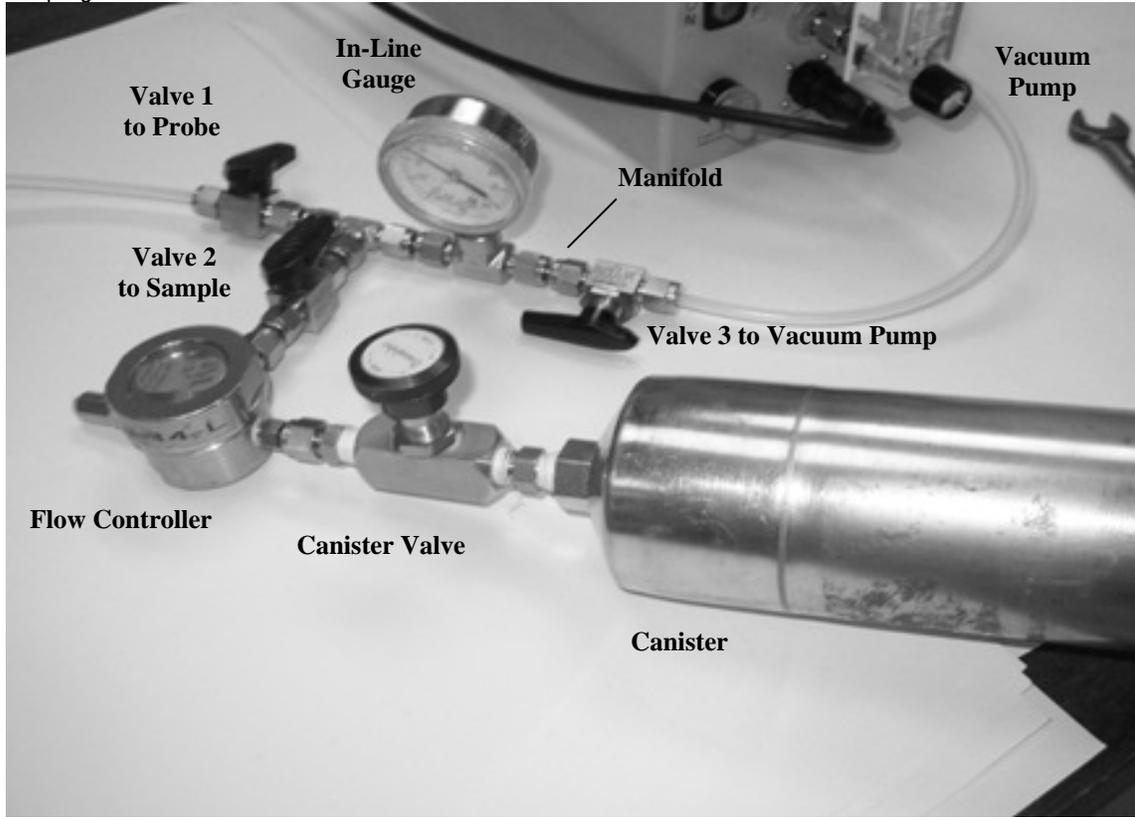
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- 7.3 Attach the subslab sample tubing to the sampling manifold. See Figure 10. Do not connect the canister at this time.
- 7.3.1 If the sample will be collected over a period of time greater than 30 minutes a flow diversion valve (Swagelok® part# SS-4P4T) should be placed in-line between the probe and the manifold. Once purging has been completed, the flow diversion valve can be turned to the off position, allowing disconnection of the manifold and vacuum pump for use at another location, without the loss of purge integrity at the purged location.
- 7.3.2 Adjust the vacuum pump to achieve the desired flow rate of 200 mL/min. This should be performed at the outlet of the vacuum pump before purging, either by using a suitable flow meter or calculating the amount of time required to fill a 1-liter Tedlar® bag.
- 7.4 Attach the air pump to the sampling manifold and the Tedlar® bag to the air pump exhaust.

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FIGURE 10
Sampling Manifold



8.0 Subslab Soil Gas Sampling System Leak Checking and Purging Procedure

8.1 Physical Leak Check - Perform a leak check of the sample manifold system (Figure 10):

- 8.1.1 Make sure the gas probe valve (valve #1) is closed and the sample valve (valve #2) is open.
- 8.1.2 Open the purge valve (valve #3) and start the vacuum pump. Verify that the flow is set to 200 ml/min.
- 8.1.3 Close the sample valve (valve #2) and achieve a vacuum gauge reading of 10 inches of mercury (inches Hg) or to a vacuum that will be encountered during sampling, whichever is greater.
- 8.1.4 A leak-free system will be evident by closing off the purge valve (valve #3), turning off the vacuum pump, and observing no loss of vacuum within the sampling manifold system for a period of 30 seconds. Repair any leaks prior to sample collection by tightening the fittings on the manifold. Re-test to make the sure the manifold passes the physical leak check before proceeding.
- 8.1.5 Record the leak check date and time on the Subslab Soil Gas Sampling Log.

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- 8.2 System Purge and Helium Leak Check - A purge of the subslab soil gas probe and sampling manifold system is required. The helium leak-check procedure is also performed during this step. This leak check will verify the integrity of the probe seal. This is accomplished by doing the following:
 - 8.2.1 Place the helium leak-check enclosure around the subslab probe to achieve a buildup of helium in the leak-check enclosure. The enclosure should not be tightly sealed and there should be an exhaust for the helium so pressure doesn't build up in the enclosure.
 - 8.2.2 Start the flow of helium to the leak-check enclosure at 200 mL/min. Let the helium fill the enclosure for 1 minute.
 - 8.2.3 Open the sample valve (valve #2) and the purge valve (valve #3) and start the purge pump. Verify that the flow rate is still 200 mL/min.
 - 8.2.4 To start the soil gas probe purge, open the gas probe valve (valve #1) and close the sample valve (valve #2) at the same time, and start timing. It is important to switch these two valves simultaneously. Otherwise, a vacuum can be built up in the sampling system, and its sudden release can draw concrete powder (left at the bottom of the probe hole after drilling) into the sampling system, which will damage the valves and vacuum pump.
 - 8.2.5 If there is shallow groundwater in the area, carefully watch the tubing as the pump is turned on. If water is observed in the sample tubing, shut the pump off immediately. Subslab soil gas collection will not be feasible if the probe is in contact with water.
 - 8.2.6 Connect the helium detector to the enclosure exhaust to confirm that helium is present in the enclosure during purging. It is optional to measure the helium concentration within the enclosure (see Step 7.2.7). Make sure that the helium detector is exposed to ambient air and "zeros out" before measuring the purged soil gas in Step 7.2.7.
 - 8.2.7 Purge the first 30 seconds (approx. 100 mL) into a 1-liter Tedlar® bag. Remove the bag and replace with a fresh 1-L Tedlar® bag. Continue the purge for at least another 2.5 minutes. This will result in a total of about 500 mL of purge gas in the second bag and 600 mL of purge volume total. At the end of the purge time, remove the Tedlar® bag from the pump and connect it to the helium detector. The helium concentration in the purged soil gas must be less than 1 percent of what it was in the helium enclosure during purging to pass the leak test (10,000 parts per million by volume [ppmv] if the helium concentration was 100%) (verify that this limit is consistent with appropriate project-specific regulatory guidance). Either: 1) calculate what 1 percent of the helium concentration was in the enclosure from the measured concentration in Step 7.2.6; or 2) use a limit of 0.1 percent (1,000 ppmv) which allows for a 10-times safety margin. If the probe fails the leak check then corrective action is required.
 - 8.2.8 There are three corrective action options:
 - 8.2.8.1 Make sure that all the fittings are tight and add Teflon tape to them.
 - 8.2.8.2 Try fortifying the probe seal by adding more sealing material or modeling clay and repeating the purge and leak check procedure.
 - 8.2.8.3 If the above two options fail, abandon the hole, drill a new one, and repeat the whole procedure.

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Note: **Helium leak detectors may be sensitive to high concentrations of methane or other atmospheric gasses.** If these are expected to be present in the subslab soil gas, then caution should be used with this technique, as false positive readings may be encountered during leak testing. Use a GEM2000® landfill gas meter to determine if methane is present in subslab soil gas.

- 8.2.9 At the end of the purge and after the system is verified to be leak-free, close the purge valve (valve #3). Do not open it again. Doing so will result in loss of the purge integrity and will require re-purging. Turn off the helium leak detector.
- 8.2.10 The purged subslab soil gas in the Tedlar® bag can be screened with a GEM2000® landfill gas meter to get field measurements of CO₂, O₂, and CH₄ and/or a MiniRae® PID can be used to measure concentrations of total VOCs in the field.
- 8.2.11 Record the purge and leak check information on the Subslab Soil Gas Sampling Log.
- 8.2.12 Immediately move on to the sampling phase. Little to no delay should occur between purging and sampling.

9.0 Subslab Soil Gas Sample Collection Procedure

- 9.1 Clean sampling protocols must be followed when handling and collecting samples. This requires care in the shipping, storage, and use of sampling equipment. The cleanliness of personnel who come in contact with the sampling equipment is also important, so smoking, eating, drinking, wearing of perfumes or deodorants, and dry-cleaned clothing are prohibited. Canisters should not be transported in vehicles with gas-powered equipment or fuel cans. Sharpie®-type markers should not be used for labeling or note-taking during sampling.
- 9.2 The air sampling canisters are certified clean and evacuated by the laboratory to ~29 to 30 inches Hg vacuum. Initial canister vacuums that are less than certified by the laboratory are a potential indication of leakage that could affect the accuracy of analytical results. Care should be used at all times to prevent inadvertent loss of canister vacuum. Never open the canister's valve unless the intent is to collect a sample or check the canister vacuum with an attached gauge.
- 9.3 Verify that the canister has sufficient initial vacuum for sampling. Measure the initial canister vacuum using an external vacuum gauge as described below:
 - 9.3.1 Remove the protective cap from the valve on the canister.
 - 9.3.2 Attach an external gauge, attach the gauge to the canister and open the valve. If the vacuum gauge has two openings, make sure that the other opening is closed; the canister cap can be used for this. After taking the reading, close the canister and remove the gauge.
 - 9.3.3 Measure the initial canister pressure using a digital vacuum gauge with 0.25% accuracy at the -30 to 0 inches Hg range and NIST-traceable calibration for vacuum measurements. See the *Standard Operating Procedure for Use of External Vacuum Gauges with Canisters* for a recommended model of vacuum gauge¹ for use with Summa canisters used for vapor intrusion sampling.

¹ A PG5 Digital Pressure Gauge from Automation Products Group (APG), Inc. (<http://www.apgsensors.com/products/pressure-sensors/digital-pressure-gauges/pg5>) with National Institute of Standards and Technology (NIST)-traceable calibration certificate, or equivalent, is recommended for making vacuum measurements.

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- 9.3.4 Do not sample using a canister without sufficient initial vacuum. Be advised that sampling data may be flagged or rejected from canisters with low initial vacuum (less than 28 inches Hg). Low initial vacuum could create a low bias in analytical results due to air leakage. While there is also a smaller risk that air leakage could introduce contaminants into the canister, the primary concern is the low bias to analytical results; this bias is within the range of analytical variability allowed with the EPA Method TO-15 ($\pm 30\%$) for initial vacuums >24 inches Hg. The table presented in Paragraph 9.3.5 identifies the field team's response based on the initial vacuum reading for a canister. In addition, this table also identifies the potential bias to results at different initial canister vacuums.
- 9.3.5 Use the following table to determine when to use canisters based on initial vacuum readings.

| Initial Vacuum Reading | Potential Error in Analytical Results Due to Leakage | Field Team Response |
|------------------------|--|---|
| >30 to 28 inches Hg | Up to -10% error | Use canister for sampling – no limitations on use. |
| >26 to 28 inches Hg | Up to -21% error | Use canister for sampling if necessary; replace canister with a spare if spares are available. |
| >24 to 26 inches Hg | Up to -30% error | Sampling with canister is not advisable. Contact project manager and obtain direction before sampling with this canister. Be advised that qualifiers may be applied to analytical results sampled with canisters with vacuums less than 26 inches Hg. |
| <24 inches Hg | $>-30\%$ error | Do not use this canister for sampling. Analytical results will be rejected. |

- 9.4 Attach the canister to the flow controller and then connect the flow controller to the sample valve (valve #2) on the sampling manifold. Open the sample valve (valve #2).
- 9.5 Before taking the sample, confirm that the sampling system valves are set as follows: (1) the purge valve (valve #3) is confirmed to be closed, (2) gas probe valve (valve #1) is open, and (3) the sample valve (valve #2) is open.
- 9.6 Slowly open (counter-clockwise) the canister's valve approximately one full turn.
- 9.7 After sampling for the appropriate amount of time (determined from project instructions; see Table 1), close the sample valve (valve #2) and the canister's valve. If the canister has a built-in or assigned vacuum gauge, allow the canister to fill until the vacuum reaches 2 to 10 inches Hg for 6-liter canisters and 2 to 5 inches Hg for 1-liter canisters. Remove the canister from the sampling manifold.
- 9.7.1 If sampling for extended periods of time (e.g., 8- or 24-hours), check the samples at some point several hours before the expected completion time (e.g., at 18 or 20 hours for a 24-hour sample) to make sure the canister is collecting at the expected rate. It may also be a good idea to check the canister several hours into the sampling period (e.g., 2 or 4 hours for a 24-hour sample). The flow controllers are rarely set to the exact sampling period.
- 9.8 If using an external vacuum gauge, re-attach it, open the canister valve, and record the final vacuum. Close the valve, remove the gauge, and replace and tighten the cap on the canister. Ideal final vacuum in the canister is between 2 and 10 inches Hg. More than 10 inches Hg of

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vacuum following sampling can greatly increase reporting limits; however, a small amount of vacuum should be left in the canister so the laboratory can confirm that the canister was not opened during shipment.

- 9.9 Consult with the project manager before submitting the sample to the laboratory if a final vacuum greater than 10 inches Hg, or less than 2 inches Hg are encountered. Use the following table for guidance to determine how to address final vacuum measurements:

| Final Vacuum Reading | Field Team Response |
|---------------------------------|--|
| < 2 inches Hg | Contact Project Manager before submitting sample. Notify analytical laboratory to report their laboratory-measured pressure and to get direction from the Project Manager before analyzing sample. |
| > 2 inches Hg and <10 inches Hg | Submit sample for analysis - no limitations on data use |
| >10 inches Hg | Contact Project Manager before submitting sample. Verify final vacuum with the analytical laboratory before analysis. Be advised that analytical results might have elevated reporting limits or qualifiers applied. |

- 9.10 Canisters with no vacuum left (i.e., 0 inches Hg) should not be analyzed. Contact the Project Manager before submitting a sample with a final vacuum of 0 inches Hg to determine the appropriate course of action. One option is to verify the final vacuum with the analytical laboratory. If there is vacuum remaining in the canister according to the laboratory vacuum gauge, the Project Manager may direct the analytical laboratory to analyze the sample.
- 9.11 The analytical laboratory should be directed to not analyze a sample showing a final vacuum of 0 inches Hg (as measured by the laboratory), and to notify the Project Manager and obtain further guidance regarding that sample.
- 9.12 Record the sampling date, times, canister identification (ID), flow controller ID, vacuum gauge ID(s), and any other observations pertinent to the sampling event on the Subslab Soil Gas Sampling Log. Also record the weather conditions (temperature, barometric pressure, precipitation, etc.) during sampling.
- 9.13 Fill out all appropriate documentation (sampling forms, sample labels, chain of custody, sample tags, etc.).
- 9.14 Disassemble the sampling system.
- 9.15 For permanent probes, replace the probe cap and make sure it is securely in place. Cover the probe with duct tape to ensure nobody tampers with it.
- 9.16 Evacuate the Tedlar® bags outside of the building.

10.0 Altitude Correction

- 10.1 Air pressure decreases with elevation. Therefore, a canister evacuated at a laboratory located at sea level will show a lower vacuum measurement at a higher altitude. Generally, a 1,000 foot rise in elevation corresponds to a 1 inch Hg drop in pressure OR a 1 inch Hg decrease in measured vacuum. For example, a canister evacuated to 30 inches at sea level and used at 3,000 ft would show an initial vacuum of 27 inches Hg.

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- 10.2 If you plan to sample at altitude, be sure to inform the laboratory ahead of time so they adjust the flow controllers accordingly.
- 10.3 If sampling is being conducted at higher elevations, verify the elevation difference between the analytical laboratory and field location and determine the associated decrease in measured vacuum.
 - 10.3.1 Calculate the pressure difference between the laboratory and field location as follows: Difference from Sea Level (field) – Difference from Sea Level (laboratory). Use the Altitude Correction Table attached to this SOP.
 - 10.3.2 Subtract the pressure difference determined in Section 10.3.1 from allowable initial vacuum levels (Section 9.3.5) and final vacuum levels (Section 9.9) to determine appropriate initial and final vacuum levels.

11.0 Sample Handling and Shipping Procedure

- 11.1 Fill out all appropriate documentation (chain of custody, sample tags) and return canisters and equipment to the laboratory
- 11.2 The canisters should be shipped back to the laboratory in the same shipping container in which they were received. The samples should not be cooled during shipment. DO NOT put ice in the shipping container.
- 11.3 When packing the canisters for shipment, verify that the valve (just past finger-tight) and valve caps are snug (1/4 turn past finger tight), and use sufficient clean packing to prevent the valves from rubbing against any hard surfaces. Never pack the canisters with other objects or materials that could cause them to be punctured or damaged. Ensure that flow controllers and gauges are separately and adequately wrapped to prevent damage.
- 11.4 **Do not place sticky labels or tape on any surface of the canister.**
- 11.5 Place a custody seal over the openings to the shipping container.
- 11.6 Make sure to insure the package for the value of the sample containers and flow controllers if corporate card policy does not cover this.
- 11.7 Ship canisters for overnight delivery. NOTE: If sampling on a Friday, ensure the laboratory accepts samples on Saturdays (you do not want the canisters sitting on some loading dock [or worse] for 3 days).

12.0 Subslab Soil Gas Probe Abandonment and Removal Procedure

- 12.1 After sampling, it is critical that the probe either be removed or securely plugged to prevent the creation of a new pathway for vapor intrusion.
- 12.2 To remove a temporary probe simply pull on the tubing until the beeswax comes out of the hole.
- 12.3 To remove a semi-permanent or permanent probe, insert the removal fitting or sampling union into the probe. Using a crowbar, remove the entire probe assembly. If this does not work, use a hammer and chisel to remove the concrete and loosen the probe. If the probe cannot be removed in this manner, then over-drill the probe with a rotary hammer drill and 1-inch drill bit.
- 12.4 Fill the hole with portland cement mix and return the surface as near to pre-sampling conditions as possible.

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13.0 Quality Control

13.1 Laboratories supplying canisters must follow the performance criteria and quality assurance prescribed in U.S. Environmental Protection Agency (EPA) Method TO-14/15 for canister cleaning, certification of cleanliness, and leak checking. SOPs are required.

13.2 Laboratories supplying flow controllers must follow the performance criteria and quality assurance prescribed in EPA Method TO-14/15 for flow controller cleaning and adjustment. SOPs are required.

14.0 Attachments

14.1 *Subslab Soil Gas Probe Installation and Sampling Log - Canister Method*

14.2 *Subslab Soil Gas Sampling Log - Canister Method*

14.3 *Sample sign for posting*

14.4 *Altitude correction table*

This SOP is to be used in conjunction with a work plan developed specifically for each project. Please obtain appropriate senior review before implementing this SOP in the field.

Altitude Correction Table

| Elevation (ft) | Pressure (in Hg) | Difference from Sea-Level (in Hg) | Elevation (ft) | Pressure (in Hg) | Difference from Sea-Level (in Hg) |
|----------------|------------------|-----------------------------------|----------------|------------------|-----------------------------------|
| 0 | 29.92 | 0 | 1500 | 28.37 | 1.553 |
| 50 | 29.87 | 0.053 | 1550 | 28.32 | 1.603 |
| 100 | 29.81 | 0.106 | 1600 | 28.27 | 1.653 |
| 150 | 29.76 | 0.159 | 1650 | 28.22 | 1.703 |
| 200 | 29.71 | 0.212 | 1700 | 28.17 | 1.753 |
| 250 | 29.66 | 0.265 | 1750 | 28.12 | 1.803 |
| 300 | 29.60 | 0.317 | 1800 | 28.07 | 1.853 |
| 350 | 29.55 | 0.370 | 1850 | 28.02 | 1.903 |
| 400 | 29.50 | 0.422 | 1900 | 27.97 | 1.953 |
| 450 | 29.45 | 0.474 | 1950 | 27.92 | 2.002 |
| 500 | 29.39 | 0.527 | 2000 | 27.87 | 2.052 |
| 550 | 29.34 | 0.579 | 2050 | 27.82 | 2.101 |
| 600 | 29.29 | 0.631 | 2100 | 27.77 | 2.151 |
| 650 | 29.24 | 0.683 | 2150 | 27.72 | 2.200 |
| 700 | 29.19 | 0.735 | 2200 | 27.67 | 2.249 |
| 750 | 29.13 | 0.787 | 2250 | 27.62 | 2.298 |
| 800 | 29.08 | 0.838 | 2300 | 27.57 | 2.347 |
| 850 | 29.03 | 0.890 | 2350 | 27.52 | 2.396 |
| 900 | 28.98 | 0.941 | 2400 | 27.47 | 2.445 |
| 950 | 28.93 | 0.993 | 2450 | 27.43 | 2.494 |
| 1000 | 28.88 | 1.044 | 2500 | 27.38 | 2.543 |
| 1050 | 28.82 | 1.095 | 2550 | 27.33 | 2.591 |
| 1100 | 28.77 | 1.147 | 2600 | 27.28 | 2.640 |
| 1150 | 28.72 | 1.198 | 2650 | 27.23 | 2.688 |
| 1200 | 28.67 | 1.249 | 2700 | 27.18 | 2.736 |
| 1250 | 28.62 | 1.299 | 2750 | 27.14 | 2.785 |
| 1300 | 28.57 | 1.350 | 2800 | 27.09 | 2.833 |
| 1350 | 28.52 | 1.401 | 2850 | 27.04 | 2.881 |
| 1400 | 28.47 | 1.452 | 2900 | 26.99 | 2.929 |
| 1450 | 28.42 | 1.502 | 2950 | 26.94 | 2.977 |
| | | | 3000 | 26.90 | 3.025 |

Note: use the following equation to calculate atmospheric for altitudes not shown on this table:

$P = P_0 \exp(-35.523 \times 10^{-6} y)$, where P is the pressure at the desired elevation, P_0 is the atmospheric pressure at sea level, and y is the desired elevation. Source: NASA, 1996. *Elevation Correction Factor for Absolute Pressure Measurements*. NASA Technical Memorandum 107240.

Appendix D
Quality Assurance Project Plan

Former Synertek Building No. 1

Sampling Analysis Plan and Quality Assurance Project Plan

Prepared for
Honeywell International, Inc.

April 2014

CH2MHILL

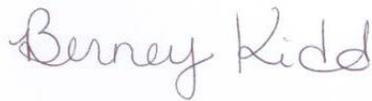
Sampling Analysis Plan and Quality Assurance Project Plan

for

Synertek Building #1
3050/3060/3070 Coronado Drive
Santa Clara, California

Prepared for
Honeywell International Inc.
Torrance, California

April 2014



Approved by: _____

Bernice Kidd
Project Chemist

Date: April 7, 2014

Approved by: _____



Project Manager

Date: April 7, 2014

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|---|---|

Acronyms and Abbreviations

| | |
|--------------------------------|---|
| °C | degrees Celsius |
| ASTM | American Society for Testing and Materials |
| BFB | bromofluorobenzene |
| CCB | continuing calibration blank |
| CCC | calibration check compound |
| CCV | continuing calibration verification |
| DM | data manager |
| DQO | Data Quality Objective |
| EICP | extracted ion current profile |
| EIM | Environmental Information Management |
| FCS | final cleanup standard |
| FTM | Field Task Manager |
| G | glass |
| G-TLC | glass with Teflon-lined cap |
| GETS | groundwater extraction and treatment system |
| HCl | hydrochloric acid |
| HNO ₃ | nitric acid |
| H ₂ SO ₄ | sulfuric acid |
| HSP | Health and Safety Plan |
| ICB | initial calibration blank |
| ICP | inductively coupled plasma |
| ICV | initial calibration verification |
| LCL | lower control limit |
| LCS/LCSD | laboratory control sample/laboratory control sample duplicate |
| MDL | method detection limit |
| MNA | monitored natural attenuation |
| mL | milliliter |
| MS/MSD | matrix spike and matrix spike duplicate |
| NaOH | sodium hydroxide |
| NELAP | National Environmental Laboratory Accreditation Program |
| PC | project chemist |
| PM | program manager |

| | |
|-------------|---|
| QA/QC | quality assurance/quality control |
| QAPP | Quality Assurance Project Plan |
| RF | response factor |
| RRF | relative response factor |
| RPD | relative percent difference |
| RSD | relative standard deviation |
| SCR | Site Cleanup Requirements |
| SOP | standard operating procedure |
| SPCC | system performance check compound |
| the site | Honeywell Synertek Building #1 site |
| UCL | upper control limit |
| USEPA | United States Environmental Protection Agency |
| VOA | volatile organic analysis |
| VOC | volatile organic compound |
| Water Board | California Regional Water Quality Control Board, San Francisco Bay Region |
| Work Plan | Groundwater Remediation Work Plan (CH2M HILL, 2010) |

SECTION 1

Introduction

This document describes the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) for groundwater and air sampling activities planned for the former Synertek Building No. 1 facility located at 3050/3060/3070 Coronado Drive in Santa Clara, California (the site). The sampling activities are being conducted on behalf of Honeywell International Inc. (Honeywell) in cooperation with the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board). During 2014, these sampling activities will include semiannual groundwater sampling [which may include post enhanced in situ bioremediation (EISB) injection monitoring], semiannual groundwater elevation level monitoring, and Vapor Intrusion (VI) sampling (indoor air, outdoor air and subslab soil gas).

The SAP and QAPP presented herein provide sampling objectives and methods, quality assurance/quality control (QA/QC) procedures, sample handling and custody guidelines, sample identification and project documentation requirements, analytical procedures, and data quality objectives. The SAP and QAPP is intended for use by CH2M HILL and their subcontractors who provide services associated with the environmental data collection effort.

The format and content of this SAP is consistent with *Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act* (U.S. Environmental Protection Agency [USEPA], 1988).

1.1 Site History

The Site is located on a level parcel of land and covers approximately 1.5 acres. The majority of the area is developed, with one structure (a 24,000-square-foot office building) and large paved areas for streets and parking lots. Prior to 1974, the area was agricultural land. In 1974, Synertek Inc. (Synertek) leased the Site for semiconductor manufacturing. In 1979, Honeywell acquired Synertek as a wholly owned subsidiary. Synertek manufacturing operations ceased in 1985. Today, Jim Lindsey and Kalil Jenab own the building located at 3050 Coronado Drive and it is leased for commercial/ industrial use.

Prior to 1985, Synertek constructed and operated two underground tank systems east of the building. One tank was used between 1976 and 1982 for storing chlorinated solvents, and three former neutralization system tanks (used between 1974 and 1982) were used as holding tanks for a variety of chemicals, including solvents. The quantity of solvents released from the tanks and the dates of the releases are unknown, but these tanks and affected soils were removed in 1985. Results from post-excavation sampling indicate VOC contamination in groundwater in both the A and B aquifer zones.

Honeywell began operating a groundwater extraction and treatment (GWET) system in 1987 as part of an interim remedial measure to address the VOC contamination identified in the groundwater when the tanks were removed. The extracted water was treated using an air stripper and then discharged under a National Pollutant Discharge Elimination (NPDES) permit to the storm sewer which flowed to San Tomas Aquino Creek (USEPA, 1991).

In 1990, a remedial investigation/feasibility study (RI/FS) report that evaluated the results of the subsurface investigations, the effectiveness of the interim groundwater cleanup actions, and remedial alternatives was submitted [Conestoga-Rovers & Associates (CRA), 1990a]. The RI/FS was submitted as two separate reports, an RI dated September 28, 1990 (CRA, 1990a), and an FS dated November 30, 1990 (CRA, 1990b). The RI/FS was the basis for the final remedial action plan as set forth in SCR Order No. 91-051 (Water Board, 1991) and the USEPA Record of Decision (USEPA, 1991). The final remedial action plan included GWET, groundwater monitoring, and institutional controls. A deed restriction that prevents the drilling of groundwater wells was recorded in December 1991, and the GWET system operated at the Site from 1987 to 2001.

SCR Order No. 91-051 (Water Board, 1991) established Final Cleanup Standards (FCSs) for the target VOCs. FCSs for the target VOCs are as follows:

- Trichloroethene (TCE)—5 micrograms per liter ($\mu\text{g/L}$)
- 1,1-dichloroethene (DCE)—6 $\mu\text{g/L}$
- 1,1-dichloroethane (DCA)—5 $\mu\text{g/L}$
- 1,1,1-trichloroethane (TCA)—200 $\mu\text{g/L}$
- Vinyl chloride—0.5 $\mu\text{g/L}$
- 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)—1,200 $\mu\text{g/L}$
- Trans-1,2-DCE—not established

In September 2000, the Water Board and Honeywell jointly evaluated continued operation of the GWET. On the basis of the findings of this joint evaluation, it was determined that the continued operation of the GWET was not warranted. Operation of the GWET had reduced the average concentration of TCE in the A- and B-aquifers by 93 and 99 percent, respectively (IT Corporation [IT], 2001). At that time, groundwater monitoring data indicated that VOC concentrations in monitoring wells and treatment system influent were approaching asymptotic levels, suggesting that further reduction of VOCs in groundwater using the GWET would not be feasible. In the *Proposed Monitored Natural Attenuation Investigation Work Plan, Synertek, Building 1, 3050 Coronado Drive, Santa Clara* (IT, 2000), a monitored natural attenuation (MNA) investigation was proposed to evaluate the effects of discontinuing operation of the GWET and the feasibility of implementing MNA as a method for controlling the migration of VOCs in groundwater and remediating the VOC plume at the site. This work plan was approved in a letter from the Water Board dated January 24, 2001 (Water Board, 2001).

The first 2 years of the MNA investigation were performed from 2001 through 2002. Investigation results indicated that natural attenuation of VOCs was occurring at the site. In the *Monitored Natural Attenuation Investigation 2002 Annual Summary Report, Synertek Building No. 1, 3050 Coronado Drive, Santa Clara, California* (CH2M HILL, 2003), it was recommended that the GWET remain shut down and that groundwater monitoring at the site be performed semiannually through the next five-year review period or until it could be confirmed that site closure criteria had been met.

In 2004, the Water Board provided the Modification to Self-monitoring Program for Order No. 91-051 SCRs (Water Board, 2004) that approved the recommendation to have the groundwater extraction system remain off and the MNA trial program continue. It further approved the recommendation for semiannual monitoring.

In the *Monitored Natural Attenuation Investigation 2005 Annual Summary Report, Synertek Building No. 1, 3050 Coronado Drive, Santa Clara, California* (CH2M HILL, 2006), it was recommended that monitoring of biodegradation parameters be reduced to focusing on dissolved oxygen (DO), pH, and oxidation-reduction potential (ORP) because biodegradation parameters are stable.

In 2013, the Water Board provided the Modification to Self-monitoring Program for Order No. 91-051, SCR (Water Board, 2013), that approved the 2008 recommendation to reduce the groundwater monitoring reporting schedule to annual.

Groundwater monitoring and sampling is being performed semiannually and reported annually, as outlined in the self-monitoring program in the 1991 Site Cleanup Requirement (SCR) Order No. 91-051 (Water Board, 1991), along with the Water Board-issued 2004 and 2013 modifications to the self-monitoring program (Water Board, 2004, 2013a).

On March 1, 2012, a VI evaluation for the onsite building was requested by the USEPA and the Water Board during a conference call to support the USEPA's protectiveness determination of the remedy at the site; the protectiveness determination of the remedy is reported in the five-year review report required in 2012 (USEPA, 2012).

A *Revised Vapor Intrusion Investigation Work Plan* was submitted in October 2012 (CH2M HILL, 2012) that was approved by the Water Board on February 19, 2013 (Water Board, 2013b). The results of this VI evaluation for the onsite building with the HVAC on are presented in the 2013 *VI Evaluation Report* (CH2M HILL, 2013) and indicate

that the VI pathway is not complete or significant under current building use and no further action is required. Although the low groundwater concentrations beneath the buildings at the site paired with the conclusions of the 2013 *VI Evaluation Report* (CH2M HILL, 2013) do not indicate that the VI pathway is not complete or significant under current building use and no further action should be required, the Water Board issued a letter on December 16, 2013 (Water Board, 2013c) to Honeywell requested an additional vapor intrusion investigation work plan for the Site to address new USEPA guidance (USEPA, 2013) and USEPA Region 9 VI guidance for the South Bay NPL sites (USEPA Region 9, 2013). This Additional VI Work Plan was prepared in response to the Water Board request.

1.2 Objectives

The SAP objectives are to maintain compliance with the groundwater monitoring program outlined in the Site Cleanup Requirements (SCR) Order, monitor the groundwater plume, evaluate the effectiveness of the groundwater remedy [EISB and monitored natural attenuation (MNA)], and evaluate the VI pathway for buildings located above the plume with TCE concentrations in groundwater exceeding 5 micrograms per liter. Table 1-1 lists the different sampling activities that will be performed, as well as the objective(s) that these activities satisfy.

TABLE 1-1
 Sampling Activities and Objectives
Former Synertek Building No. 1, Santa Clara, California

| Activity | Objective |
|---|---|
| Semiannual Groundwater Elevation Level Measurements | <ul style="list-style-type: none"> • Provide groundwater elevation contour map semiannually to be in compliance with the SCR Order. • Provide semiannual groundwater elevation levels in a tabular form to be in compliance with the SCR Order. • Evaluate and monitor hydro geological conditions at the site for each water bearing zone (the A- and B-Aquifer). |
| Groundwater Samples from Monitoring Wells | <ul style="list-style-type: none"> • Assess and monitor nature and extent of groundwater plume in A-, B-, and B1-aquifer. • Evaluate concentration levels for the purpose that they do not pose an immediate threat to health or the environment. • Evaluate the effectiveness of EISB and the MNA process that is occurring. |
| Indoor/outdoor air sampling | <ul style="list-style-type: none"> • Evaluate if indoor air concentrations of VOCs are above investigation screening levels and support a multiple lines of evidence evaluation of the vapor intrusion pathway |
| Subslab soil gas sampling | <ul style="list-style-type: none"> • Evaluate if subslab soil gas concentrations of VOCs are above investigation screening levels and support a multiple lines of evidence evaluation of the vapor intrusion pathway |

The QAPP presents the QA/QC requirements designed to ensure that environmental data collected for the site are of the appropriate quality to achieve the project objectives that are defined in the Work Plans and the groundwater monitoring requirements outlined in the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) *Modifications to Self-Monitoring Program for Order No. 91-051*, (Water Board, 2004) or the Vapor Intrusion guidelines outlined in the *External Review Draft –Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from the Subsurface to Indoor Air* (USEPA, 2013) and *Guidelines and Supplemental Information Needed for Vapor Intrusion Evaluations at South Bay National Priority List Sites (USEPA Region 9, 2013)*. The Work Plan discusses the specific protocols for sampling, handling of investigation-derived wastes, sample handling and storage, and field quality control. The QAPP specifies the requirements for laboratory analyses, data handling, data evaluation and assessment performance evaluations, chain-of-custody requirements, corrective actions, preventive maintenance of equipment, and additional information regarding sample handling and storage and field quality control.

The elements included in this QAPP are consistent with those specified in the USEPA *Requirements for Quality Assurance Project Plans, EPA QA/R-5* (USEPA, 2001). The objectives of the QAPP are to:

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

This QAPP is intended for use by CH2M HILL and its subcontractors who provide services associated with the environmental data collection effort. This QAPP supplements the Work Plan and any other project-specific documents.

Program Organization and Responsibility

This section identifies and describes the responsibilities of key project positions related to project management, field task management, QA/QC management, and data management. Contact information for the key staff is provided in Table 2-1.

2.1 Project Staff

2.1.1 Project Manager

The project manager's (PM) responsibilities include:

- Development and implementation of the project.
- Technical oversight of all investigative and routine monitoring and sampling.
- Schedule, financial status, technical status, and contract management.
- Overall project quality assurance.
- Interfacing with the client, field task manager (FTM), project chemist (PC), and data manager (DM).
- After a quality assurance review by an independent senior review team, the PM and senior review team will identify appropriate corrective action(s) to be initiated if quality assurance problems or deficiencies requiring special action are discovered.

2.1.2 Field Task Manager

The FTM's responsibilities include:

- Coordinating field schedules.
- Coordinating field personnel and subcontractors at the project site.
- Maintaining communication with the PC regarding scheduled sampling events and coordinating delivery of samples to the laboratory.
- Managing project tasks associated with sampling, general quality assurance, oversight of field personnel in sampling activities, coordination of sample collection, and coordinating sample submittal to the analytical lab.
- Collecting and reviewing all field task-related documents and archiving the documents in the project file.
- Coordinating with field personnel, the PC, and the DM to facilitate data transfer to the Environmental Information Management system (EIM) (project database).

2.1.3 Project Chemist

The PC's responsibilities include:

- Approving and maintaining adherence to QA/QC requirements specified in this QAPP.
- Providing guidance regarding environmental analytical chemistry methods and quality control procedures applicable to environmental analytical chemistry.
- Assist FTM with managing project tasks associated with the coordination of sample collection and analysis with the FTM; act as the liaison between the FTM and laboratories.
- Managing sample tracking, sample analysis, and data reporting from each laboratory.
- Coordinating or performing validation of the analytical data.

- Performing quality audits and surveillance, preparing quality assurance reports, implementing quality control activities, and suggesting corrective actions, as necessary.
- Communicating QA/QC issues to the PM, FTM, and DM.
- Recommending resolution for any anomalies or out-of-control events that arise during the analysis of samples.

2.1.4 Data Manager

The DM's responsibilities include:

- Maintaining overall management and control of all analytical and field data that will be used for decision-making and project reporting purposes.
- Coordination with Locus Technologies on EIM issues or enhancements to functionality.
- Coordinating with the FTM and the PC to facilitate data transfer into the project database.
- Coordinating the output of data from the database to the data users (e.g., PM and technical staff) and providing quality control for all data outputs.

2.1.5 Site Safety and Health Coordinator

The Site Safety and Health Coordinator's responsibilities include:

- Site safety and health for CH2M HILL and subcontracted personnel working on the project.
- Implementation of the Health and Safety Plan (HSP), contractor safety, and training.

TABLE 2-1

Project Staff

Honeywell Synertek, Quality Assurance Project Plan

| Title | Name/Address | Phone | Cell | Email |
|--|--|---------------------------------|----------------------|--|
| PM – CH2M HILL | Teresa Tamburello 155 Grand Avenue, Suite 800 Oakland, CA 94612 | (415) 513-5719 | (636) 575-4785 | Teresa.Tamburello@ch2m.com |
| Field Task Manager – CH2M HILL | Cynthia Schultz 1737 North 1 st St., Suite 300 San Jose, CA 95112 | (408) 436-4936 x37442 | | Cynthia.Schultz@ch2m.com |
| Field Task Manager – CH2M HILL | Oscar Correa 155 Grand Avenue, Suite 800 Oakland, CA 94612 | 510-587-7524 | (832) 498-3477 | oscar.correa@ch2m.com |
| PC – CH2M HILL | Berney Kidd 2525 Airpark Drive Redding, CA 96001 | (530)-229-3203 | (530)-339-3203 | Bernice.Kidd@ch2m.com |
| PC – Honeywell Technical Services | Peeyush Gupta | +91 80 26588360 ext 57561 | | Peeyush.Gupta@honeywell.com |
| Data Manager – Critigen | Wendi Gale | 1 541 768 3727 x23727 Direct | 1 541 752 0276 Fax | Wendi.Gale@critigen.com |
| Data Manager – Honeywell Technical Services | Rakesh Singh | +91 80 26588360 ext 57233 | | Rakesh.Singh2@honeywell.com |
| Site Safety and Health Coordinator – CH2M HILL | Jim Bushnell 1601 Fifth Ave. Suite 1100 Seattle, WA 98101 | (206) 470-2263 | (425) 468-3024 (fax) | Jim.Bushnell@ch2m.com |

2.2 Certification Requirements

All laboratories providing analytical services for the site will have current National Environmental Laboratory Accreditation Program (NELAP) and State of California certification. Each Laboratory Manager will be responsible for ensuring that all personnel have been properly trained and are qualified to perform their assigned tasks.

Data Quality Objectives and Quality Assurance Program

3.1 Data Quality Objectives

Data quality objectives (DQOs) are the basis for the design of the data collection plan and, as such, these DQOs specify the type, quality, and quantity of data to be collected and how the data are to be used to make the appropriate decisions for the project.

The objective of the groundwater remediation program is to use enhanced in situ bioremediation to reduce the residual mass of VOCs in the source area and thereby decrease the amount of time it will take for VOC concentrations to attenuate to below the FCSs throughout the plume. The objective of the VI sampling is to evaluate whether the VI pathway is complete and significant (e.g., VOCs in air exceed investigation screening levels [identified in the vapor intrusion work plan], vapor entry points are identified and potential non-subsurface sources are identified).

3.2 Quality Assurance Program

3.2.1 Precision, Accuracy, Representativeness, Completeness, Comparability

Data quality will be evaluated based on their precision, accuracy, representativeness, completeness, and comparability.

3.2.1.1 Precision

Precision refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms.

3.2.1.2 Accuracy

Accuracy refers to the degree of agreement between an observed value (such as sample results) and an accepted reference value. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits.

3.2.1.3 Representativeness

Representativeness describes the extent to which a sampling design adequately reflects the environmental conditions of a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations.

3.2.1.4 Completeness

Completeness is the amount of valid measurements compared to the total amount generated. It will be determined for each method, matrix, and analyte combination. The completeness goals of each project are optimized to meet the DQOs. The completeness goals for this program are 95 percent for each method/matrix/analyte combination.

3.2.1.5 Comparability

Comparability addresses the degree to which different methods or data agree or can be represented as similar. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.

3.2.2 Method Detection Limits, Reporting Limits, and Instrument Calibration Requirements

3.2.2.1 Method Detection Limits

The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero. Each participating laboratory will determine the MDL for each method, matrix, and analyte for each instrument that will be used to analyze samples. The MDLs will be initially determined before analyzing samples and will be redetermined at least once every 12 months.

1. Estimate the MDL using one of the following:
 - a. The concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5
 - b. The concentration equivalent of three times the standard deviation of replicate measurement of the analyte in reagent water
 - c. The region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve)
2. Prepare (i.e., extract, digest) and analyze seven samples of a matrix spike (ASTM Type II water for aqueous methods, Ottawa sand for soil methods, glass beads of 1 millimeter diameter or smaller for metals) containing the analyte of interest at a concentration three to five times the estimated MDL.
3. Determine the variance (S^2) for each analyte as follows:

$$S^2 = \frac{1}{n-1} \left[\sum_{i=1}^n (x_i - \bar{x})^2 \right] \quad (1)$$

where:

x_i = the n th measurement of the variable x .

\bar{x} = the average value of x .

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n x_i \quad (2)$$

4. Determine the standard deviation (s) for each analyte as follows:

$$s = (S^2)^{1/2} \quad (3)$$

5. Determine the MDL for each analyte as follows:

$$\text{MDL} = 3.14(s) \quad (4)$$

(Note: 3.14 is the one-sided t-statistic at the 99-percent confidence level appropriate for determining the MDL using seven samples.)

6. If the spike concentration used in Step 2 is more than 10 times the calculated MDL, repeat the process using a lower spiking concentration.

3.2.2.2 Reporting Limits

Reporting limits will be greater than two times the laboratory calculated MDL. Reporting limits used by the laboratory should not be greater than the reporting limit objectives listed in Tables 6-2 through 6-10.

Analytes at concentrations greater than the laboratory's MDL but less than the reporting limit will be reported with a "J" flag. Analytes that are not detected at or above the laboratory's reporting limit will be reported as not detected at the reporting limit and flagged "U."

Reporting limits and sample results will be reported to two significant figures if less than 10 and to three significant figures if 10 or greater. All quality control will be reported to three significant figures.

3.2.2.3 Instrument Calibration

Laboratory instruments will be calibrated by qualified personnel before sample analysis according to the procedures specified in each method. Calibration will be verified at method-specified intervals throughout the analysis sequence. The frequency and acceptance criteria for calibration are specified for each analytical method with supplemental requirements defined below for organic methodologies. When multi-point calibration is specified, the concentrations of the calibration standards should bracket those expected in the samples. Samples will be diluted, if necessary, to bring analyte responses to within the calibration range. Data that exceed the calibration range cannot be reported by the laboratory. The initial calibration curve will be verified as accurate with a standard purchased or prepared from an independent second source. The initial calibration verification involves the analysis of a standard containing all the target analytes, typically in the middle of the calibration range, each time the initial calibration is performed. Quantitation based on extrapolation is not desirable.

3.2.2.3.1 Initial Calibration Models for the Determination of Organic Compounds

Organic methodologies often provide multiple options for initial calibration curve fits and associated acceptance criteria for use. The following sections outline required “good laboratory practices” that will be employed by the laboratory. The hierarchy that the laboratory will use when selecting the calibration curve fit for use in quantitation of sample results is outlined below:

Calibration Techniques.

- Verify that correct instrument operating conditions and routine maintenance as specified in the method and laboratory standard operating procedures (SOP), are employed. All maintenance, activities will be documented in a laboratory notebook for troubleshooting and scheduling of future routine, periodic maintenance.
- Ensure that the instrument is free of contamination prior to calibration. Do NOT perform any blank subtraction.
- Perform the entire initial calibration before sample analyses. The calibration standards must be analyzed in a sequential order from the lowest to highest concentration. If **one** calibration standard fails to meet criteria it may be reanalyzed at the end of the calibration sequence. Justification for removing a calibration point from the curve fit selected includes such items as improper purge, injection failure, non-spiked level, or other obvious failures. The failure of multiple standards suggests an instrument problem or operator error and corrective action is required.
- Only the lowest calibration point or the highest calibration point can be removed from the calibration curve without justification. If the lowest standard is removed, the reporting limit for that compound increases to the level of the next lowest calibration standard. Approval to elevate reporting limits greater than the project-specific objectives MUST be approved by the PC. If the highest standard is removed, the linear range is shortened for that compound.
- The lowest standard in the calibration curve must be at or below the required reporting limit.
- The other standard concentrations must define the working range of the instrument or the expected range of concentrations found in the samples.
- Either external or internal calibration can be employed for methods not involving mass spectrometry detectors. Internal calibration must be used when a mass spectrometry detector is employed.
- A minimum of five calibration points must be used for the calibration curve for gas chromatography/mass spectrometry and high-pressure liquid chromatography methods.
- Most compounds tend to be linear and a linear approach will be favored when linearity is suggested by the calibration data. Non-linear calibration will be considered only when a linear approach cannot be applied.

Prior to using a non-linear calibration approach, the PC must be notified and provide approval. It is not acceptable to use an alternate calibration procedure when a compound fails to perform in the usual manner. When this occurs, it is indicative of instrument problem or operator error.

- If a non-linear calibration curve fit is employed, a minimum of six calibration levels must be used for second-order (quadratic) curves, and a third-order polynomial requires a minimum of seven calibration levels.
- When more than five levels of standards are analyzed in anticipation of using second- or third-order calibration curves, all calibration points MUST be used regardless of the calibration option employed. The highest or lowest calibration point may be excluded to narrow the calibration range and meet the requirements for a specific calibration option. Otherwise, unjustified exclusion of calibration data is expressly forbidden.

Calibration Options The following section outlines the acceptable calibration options and the hierarchy that the laboratory should use when selecting a specific option. The choice of calibration option may also be based on previous experience or a prior knowledge of detector response.

- **Linear calibration using average calibration or response factors.** Calibration factors for external calibrations or response factors for internal calibrations must have a relative standard deviation (RSD) not exceeding 15 percent. A minimum response factor of 0.05 for most target analytes and 0.01 for the least responsive target analytes must be achieved to ensure detectability.
- **Linear calibration using a linear regression equation ($y=mx+b$).** The correlation coefficient must equal 0.995 or better. The line should NOT be forced through the origin. The equation and a plot of the linear regression must be included in the raw data generated by the laboratory and made available in the data package upon the client's request.
- **A non-linear calibration.** This model may be a second-order or third-order polynomial. The model must be continuous without a break in the function and should NOT be forced through the origin. The coefficient of determination of the non-linear regression must be 0.99 or better. The equation and a plot of the non-linear regression must be included in the raw data generated by the laboratory, and made available in the data package upon the client's request.

3.2.2.3.2 Continuing Calibration

Periodic verification of the initial calibration is essential in generating analytical data of known quality. The continuing calibration verification analyses ensure that the instrument has not been adversely affected by the sample matrix or other instrument failures that would increase or decrease the sensitivity or accuracy of the method. The laboratory will perform continuing calibration for all methods according to the specific requirements in the method and laboratory SOPs.

Method SW8000B allows the use of the average of all analytes' percent-drift or recovery to meet the continuing calibration requirements for the method but is NOT allowed.

3.2.3 Elements of Quality Control

Laboratory quality control checks indicate the state of control that prevailed at the time of sample analysis. Quality control checks that involve field samples, such as matrix, surrogate spikes, and field duplicates, also indicate the presence of matrix effects. Field-originated blanks provide a way to monitor for potential contamination to which field samples are subjected. This QAPP specifies requirements for method blanks, laboratory control samples (LCS), surrogate spikes, and matrix spike/matrix spike duplicate (MS/MSD) that must be followed by laboratories participating in the data collection effort.

A laboratory quality control batch is defined as a method blank, LCS, MS/MSD, or a sample duplicate, depending on the method and 20 or fewer environmental samples of similar matrix that are extracted or analyzed together. For gas chromatography/mass spectrometry volatile analyses, a method blank, LCS, and MS/MSD must be analyzed in each 12-hour tune period. The number of environmental samples allowed in the laboratory quality control batch is defined by the remaining time in the method-prescribed 12-hour tune period divided by the

analytical run time. Each preparation or analytical batch will be identified in such a way as to be able to associate environmental samples with the appropriate laboratory quality control samples.

3.2.3.1 Quality Control Analyses/Parameters Originated by the Laboratory

3.2.3.1.1 Method Blank

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

3.2.3.1.2 Laboratory Control Sample

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

3.2.3.1.3 Surrogates

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

3.2.3.1.4 Internal Standards

Some methods require the use of internal standards to compensate for losses during injection or purging or losses due to viscosity. Internal standards are compounds that have similar properties as the analytes of interest but are not expected to occur naturally in the samples. A measured amount of the internal standard is added to the standards, samples, and quality control samples following preparation. When the internal standard results are outside the control limits, corrective action must be taken, including sample reanalysis, if appropriate.

3.2.3.1.5 Laboratory Sample Duplicate

A sample duplicate selected by the laboratory is called a laboratory sample duplicate. It is subjected to the same preparation and analytical procedures as the native sample. The relative per cent difference (RPD) between the results of the native sample and laboratory sample duplicate measures the precision of sample results. The data collected may also yield information regarding whether the sample matrix is heterogeneous.

3.2.3.1.6 Interference Check Samples

The interference check samples are used in inductively-coupled plasma (ICP) analyses to verify background and inter-element correction factors. They consist of two solutions: A and AB. Solution A contains the interfering analytes, and Solution B contains both the analytes of interest and the interfering analytes. Both solutions are analyzed at the beginning and at the end of each analytical sequence. When the interference check samples results are outside the control limits, corrective action must be taken, including sample reanalysis, if appropriate.

3.2.3.1.7 Retention Time Windows

Retention time windows for gas and liquid chromatographic analyses must be established by replicate injections of the calibration standard over multiple days, as described in SW846 8000B, analytical method, or appropriate

laboratory SOP. The absolute retention time of the calibration verification standard at the start of each analytical sequence will be used as the centerline of the window. For an analyte to be reported as positive, its elution time must be within the retention time window.

3.2.3.2 Quality Control Analyses Originated by the Field Team

Quality control samples will be collected to monitor accuracy, precision, and the presence of field contamination. All field quality control samples will be sent double-blind to the laboratory along with regular field samples with the exception of the MS/MSD. They will be labeled similar to regular field samples. These frequencies may vary according to the project needs. The frequency of collection of the quality control samples outlined below is recommended and may be updated for a particular sampling event.

3.2.3.2.1 Field Duplicate Samples

A field duplicate is an independent sample collected as close as possible to the original sample from the same source under identical conditions and is used to document sampling and analytical precision. Field duplicates will be collected at a minimum frequency of 10 percent or one per sampling event, whichever is more frequent, for each matrix and for each type of analysis.

Duplicate samples will be collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis.

3.2.3.2.2 Equipment Blanks

Equipment rinsewater blanks will be collected to evaluate field sampling and decontamination procedures by pouring deionized water over the decontaminated equipment. The field team reviews the historic water quality information for wells sampled during each days schedule and designates the well with the highest level of total volatile organic contamination as the location at which the equipment blank is to be collected. If a delay or change occurs in the field such that the designated well is not sampled on schedule, then an equipment blank is collected from the last well of the day. Equipment blanks will be collected for soil and water samples and will be collected at a rate of 1 in 20 (minimum of one per day). The equipment blanks will be analyzed for the same parameters specified for the corresponding matrix. Equipment blanks are not required for wells with dedicated equipment.

3.2.3.2.3 Ambient Blanks

Ambient blanks are collected in order to monitor for contamination from outdoor sources (i.e., active runways, engine test cells, and operating motor vehicles) during collection of soil and water samples for VOCs. For air, outdoor samples will be collected when site conditions indicate the necessity and will be addressed in the Work Plan. The ambient blank (outdoor air sample) is handled and analyzed in the same manner as the investigatory samples.

For groundwater, an ambient blank is prepared by opening a set of VOC sample containers upwind of the sampling location and downwind of the potential source of VOC contamination.

3.2.3.2.4 Trip Blanks

Trip blanks are used to monitor for contamination during sample shipping and handling, and for cross-contamination through VOC migration among the collected soil and water samples. They are prepared in the laboratory by pouring American Society for Testing and Materials (ASTM) Type II or deionized water into a VOC sample container. They are then sealed, transported to the field, remain sealed while VOC samples are taken, and transported back to the laboratory in the same cooler as the VOC samples. One trip blank should accompany each VOC sample cooler.

3.2.3.2.5 Matrix Spike/Matrix Spike Duplicate

A MS/MSD are a duplicate pair of samples- collected along with an investigatory sample to which the laboratory adds a spike containing all target analytes specified for each method in the QAPP at known concentrations to assess the effect of the sample matrix on the extraction and analysis method.

For every 20 field samples of soil and water collected from each site, one location will have sample volume collected in triplicate for each analysis required and designated on the chain-of-custody form as an MS/MSD.

MS/MSD samples may involve obtaining an independent pair of samples collected as close as possible to the original (parent) sample from the same source under identical conditions or prepared by the laboratory as part of their QA program and sub-sampled from an investigatory sample.

Independent MS/MSD samples will be collected simultaneously or in immediate succession, using identical recovery techniques as the parent sample, and treated in an identical manner during storage, transportation, and analysis. The sampling locations for the MS/MSD will be documented in the field logbook.

3.2.3.2.6 Temperature Blank

Temperature blanks will be used so that the laboratory can verify the temperature upon receipt of the samples. The temperature of the samples upon arrival will be annotated on the chain-of-custody form and also mentioned in the laboratory narrative that accompanies the analytical results. One temperature blank should accompany each sample cooler containing soil or water samples.

3.2.3.3 Additional Quality Control Requirements

3.2.3.3.1 Holding Time

The holding time requirements specified in this QAPP must be met. For methods requiring both sample preparation and analysis, the preparation holding time will be calculated from the time of sampling to the completion of preparation. The analysis holding time will be calculated from the time of completion of preparation to the time of completion of the analysis, including any required dilutions, confirmation analysis, and re-analysis. For methods requiring analysis only, the holding time is calculated from the time of sampling to completion of the analysis, including any required dilutions, confirmation analysis, and re-analysis.

3.2.3.3.2 Cleanup Procedures to Minimize Matrix Effects

To maintain the lowest possible reporting limits, appropriate cleanup procedures will be employed when it is indicated by the method to remove or minimize matrix interference. Methods for sample cleanup include, but are not limited to, gel permeation chromatography, silica gel, alumina, florisil, mercury (sulfur removal), sulfuric acid, and acid/base partitioning. Method blanks, MS/MSDs, and LCSs must be subjected to the same cleanup procedures performed on the samples to monitor the efficiencies of these procedures.

3.2.3.3.3 Sample Dilution

Dilution of a sample results in elevated reporting limits and ultimately affects the usability of data related to potential actions at the sampling site. It is important to minimize dilutions and maintain the lowest possible reporting limits. When dilutions are necessary because of high concentrations of target analytes, lesser dilutions should also be reported to fully characterize the sample for each analyte. The level of the lesser dilution will be such that it will provide the lowest possible reporting limits without having a lasting deleterious effect on the analytical instrumentation.

When a sample exhibits characteristics of matrix interference that are identified through analytical measurement or visual observation, appropriate cleanup procedure(s) must be proven ineffective or inappropriate before proceeding with dilution and analysis.

3.2.3.4 Standard Materials and Other Supplies and Consumables

Standard materials must be of known high purity and traceable to an approved source. Pure standards must not exceed the manufacturer's expiration date or 1 year following receipt, whichever comes first. Solutions prepared by the laboratory from the pure standards must be used within the expiration date specified in the laboratory's SOP.

All other supplies and consumables must be inspected prior to use to ensure that they meet the requirements specified in the appropriate SOP. The laboratory's inventory and storage system should ensure their use within the manufacturer's expiration date and that the supplies are stored under proper conditions.

3.2.3.5 Manual Integration

The laboratory is required to provide all analysts performing methods that rely on interpretation of chromatographic data with training on appropriate software or manual-integration practices. The laboratory also

will make every effort to minimize the use of manual integration of data. If the need arises to use manual integration to correct a software auto-integration error, the manual integration will be clearly identified in the instrument data. Before- and after-enlargements of the region of the chromatogram where the manual integration was performed will be provided on an appropriate scale to allow an independent reviewer to evaluate the need and quality of the manual integration. The analyst will also document the reason for the manual integration on the chromatogram along with their date and initials. The laboratory manager or designee will approve the manual integration by dating and initialing the chromatogram.

3.2.3.6 Laboratory Quality Assurance Program

The laboratory will maintain a Quality Assurance Manual or equivalent document. The Quality Assurance Manual will define the laboratory's internal QA/QC procedures including:

- Quality assurance policies, objectives, and requirements.
- Organization and personnel.
- Document control.
- SOPs (analytical methods and administrative).
- Data generation.
- Software verification.
- Quality assurance.
- Quality control.
- Non-conformance/corrective action procedures.
- Data review.

3.2.3.6.1 Laboratory Standard Operating Procedures

The laboratory will maintain SOPs for all analytical methods and laboratory operations. The format for SOPs will conform to the following references:

- *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, SW-846* (latest edition and updates)
- *Good Laboratory Practices in Principles and Guidance to Regulations for Ensuring Data Integrity in Automated Laboratory Operations* (USEPA 1995)

All SOPs must have a unique identification number that is traceable to previous revisions of the same document.

3.2.3.6.2 Demonstration of Capability

Laboratory quality assurance department personnel will maintain records documenting the ability of each analyst to perform applicable method protocols. Documentation will include annual checks for each method and analyst. In addition, internal, blind performance evaluation samples for each method and matrix demonstrating overall laboratory performance must be submitted annually. The laboratory may receive additional blind performance evaluation samples in conjunction with this program.

Sampling Procedures

4.1 Sampling Procedures

4.1.1 Groundwater Water Level and Total Depth Measuring

Water levels will be measured in the existing 36 monitoring wells during the semiannual groundwater sampling event. In addition, one round of total depth measurements will be completed each year (for consistency, this is planned for April each year).

An electric water-level probe will be used to measure the depth to groundwater below the datum to the nearest 0.01 foot. Sufficient time will be allowed for wells to reach equilibrium after removing the well cap, and the water level reading will be taken when the well is fully stabilized. The sampling personnel will obtain previous depths to water measurements prior to going into the field. **Measurements from the current round will be compared with the previous data to identify significant deviations that might indicate a measurement error.** Total depth will be measured using a tape measure or equivalent. The total depth measurement should be done after the sampling to avoid disturbances.

4.1.2 Groundwater Sampling

On March 20, 1991, the Water Board issued Site Cleanup Requirements (SCR) Order No. 91-051 (the SCR Order; Water Board, 1991) for the site, which outlined a self-monitoring program (SMP) for groundwater monitoring and reporting. In 2004, the Water Board provided the Modification to SMP (Water Board, 2004). The current semiannual groundwater monitoring program for the site, based on the 2004 and 2013 SMP Modifications, is provided in the Groundwater Monitoring and Sampling Summary Report (completed January of each year).

All groundwater monitoring wells are purged using micropurge procedures as described in the U.S. Environmental Protection Agency (USEPA) guidance for low flow groundwater sampling (Puls and Barcelona, 1996). Micropurge procedures employed the use of peristaltic pumps and tubing. Tubing is dedicated to each well. The procedure involves the withdrawal of groundwater from the middle portion of the well screen at low flow rates (100 to 500 milliliters per minute [mL/min]) until field parameters (pH, conductivity, turbidity, temperature, oxidation-reduction potential, and dissolved oxygen) measured with a flow-through cell stabilize, along with the water level. Stabilization is confirmed when three consecutive readings are within the following limits: ± 3 percent change in conductivity; ± 0.1 pH units; and ± 10 percent change for dissolved oxygen and/or oxidation reduction potential. After parameter stabilization, the groundwater sample is collected.

Groundwater samples will be transferred directly into the containers according to USEPA sampling guidance procedures. Sample containers will be dated, numbered, and labeled according to the sample designations. All sample containers will be placed in an ice chest filled with ice to achieve and maintain a sample temperature of 4 degrees Celsius. A chain-of-custody form listing all the samples in each cooler will be placed inside of the cooler in a Ziploc™ bag. For low-yield wells that cannot sustain a 100 ml/min purge rate, the sample will be collected after the well has been pumped dry and has recovered 80 percent or 24 hours after the well has been purged dry, whichever is sooner. QA/QC samples will be collected as described in the QAPP.

Field measurements of carbon dioxide, sulfate, sulfide, ferrous iron, and manganese will be collected using a Hach®. These parameters will only be collected during analyses of natural attenuation parameters.

4.1.3 Vapor Intrusion Sampling

Vapor intrusion samples will be taken in accordance with VI workplans and VI specific SOPs included with the workplans.

4.2 Decontamination Procedures

This section describes the decontamination procedures to be followed in preparing field sampling equipment for use at the site. Decontamination is used to minimize the potential for transfer of potentially-contaminated materials to uncontaminated areas, to minimize the exposure of personnel to hazardous substances, and to reduce the possibility of cross-contamination between samples.

4.2.1 Personal Protective Equipment

Personal protective equipment shall be worn in accordance with the site-specific health and safety plan (CH2M HILL, 2013).

4.2.2 Equipment Decontamination

All non-dedicated sampling and test equipment that will contact the sampling medium will be thoroughly cleaned before each use. Based on the types of sample analyses to be conducted, the following cleaning protocol will be used:

- Wash with potable water and phosphate-free laboratory detergent (e.g., Liquinox®).
- Rinse with potable water.
- Rinse with distilled or deionized water.

Any deviations from these procedures will be documented in the field logbook. Decontamination rinseate will be stored in DOT-approved 55-gallon drums (see Investigation-derived Waste section).

4.3 Investigation-derived Waste

Purge water will be stored in Department of Transportation (DOT)-approved 55-gallon drums and will be labeled. The drums will be labeled with respect to their contents, date generated, and site address and generator information. The drums will be temporarily stored in a secure location onsite. Appropriate waste characterization samples (which, for this project, is expected to be a summary of analytical data from wells sampled) will be collected of the IDW to determine ultimate disposal measures.

4.4 Equipment Decontamination Procedures

Decontamination of sampling equipment will be required prior to collecting samples from each location. Equipment used for sampling will be steam-cleaned or alternatively decontaminated in the following order:

1. Potable water rinse
2. Alconox detergent wash
3. Distilled/deionized water rinse
4. Dry
5. Wrap in aluminum foil for storage

Disposable equipment or materials used for sampling will be packaged properly and disposed of in accordance with USEPA guidelines. Wash waters associated with decontamination will be collected and properly disposed of in accordance with USEPA guidelines.

4.5 Field Materials

The following subsections comprise a general list of materials that should be easily accessible during field work to execute an efficient sampling program. Additional field supplies or equipment may be required depending on the exact scope, nature, and duration of the sampling event. It is the responsibility of the field team leader or

designee to ensure that the field team is equipped with all appropriate supplies. Sample containers should be requested in accordance with the analytical program described in the event-specific work plan.

4.5.1 Documents

Documents outlined in this section are commonly used during the implementation of a field sampling program. Depending on the size and complexity of individual field efforts, a subset of the documents below may be used. Conversely, large-scale field efforts may require additional paperwork or additional support documents. Project needs regarding field-related documents will be evaluated on a project-by-project basis. Any additions that are deemed necessary will be noted in the event-specific work plan. At a minimum, documents that will be maintained and accessible to field teams include the following:

- Event-specific Work Plan, Quality Assurance Project Plan, Waste Management Plans, and project-specific Health and Safety Plan
- Material safety data sheets for chemicals brought onsite
- Field logbook

4.5.2 Supplies and Hand Tools

Supplies will be procured and inventoried prior to commencing field activities to minimize delays during field work. The following list will be used as a guide for identifying items that are necessary for a particular task, although these items may or may not be required, depending on the event-specific scope of work:

- Laboratory supplied sampling containers
- Calibration gases for field equipment
- Sample tracking supplies (sample labels and chain-of-custody forms)
- Packaging materials if shipping offsite to a fixed-based laboratory (bubble wrap, tape, custody seals, coolers, and FedEx forms)
- Decontamination equipment (deionized water, buckets, spray bottles, brushes, and phosphate-free detergent such as LiquiNox or Alconox)
- Health and safety equipment such as personal protective equipment, fire extinguisher, blood-borne pathogen and first aid kit (refer to event-specific Health and Safety Plan for detailed requirements)
- Miscellaneous consumables (waterproof pens, paper towels, aluminum foil, plastic re-sealable bags, and plastic garbage bags)
- Digital or disposable camera
- Site map to ensure correct well location. Also include previous water level and total depth data to verify correct well is being sampled
- Folding table to facilitate processing samples

4.5.3 Instruments

Instrument needs will vary depending on the type of sampling program. The instruments commonly used for groundwater sampling include the following:

- Photoionization detector (calibrated)

Field instruments must be inspected and calibrated prior to use. Acquisition of calibration gases for air monitoring equipment will be included in the instrument procurement process. All instruments will be operated by field personnel who have been properly trained in the maintenance and use of each respective field instrument. Documentation of calibration and inspection must be maintained in accordance with the procedures discussed in the soil management plan.

Laboratory-supplied sample containers will be used during all sampling activities. Sample containers will be stored in a secured area. The field team leader will affix a self-adhesive label to each container before collecting samples if a label is not provided on the sample container. At a minimum, the sample label will contain the following:

- Project Site and associated project number
- Sample identification
- Time and date of collection
- Analysis to be run
- Preservation (if any)
- Sampler's initials

Immediately after collecting each sample, the sample container will be labeled, sealed in an individual plastic bag, and placed into a cooler that contains sufficient ice to ensure that the proper temperature is maintained. Each cooler will be packed in a manner to prevent damage to the sample containers. Chain-of-custody forms completed at the time of sample collection will accompany the samples inside the cooler for delivery to the offsite laboratory. The sampling team member will indicate relinquishment of the samples on the chain-of-custody form, and these forms will be sealed in a ziplocked plastic bag. A member of the field sampling team will place a custody seal on each cooler and will initial and date the custody seal if the samples are shipped via commercial delivery service for overnight delivery or hand-delivered to the offsite analytical laboratory.

4.6 Sample Designation and Location

Each sample will be assigned a unique sample tracking designation using the basic format described below. Each sample tracking designation will consist of the following:

- The Site code – “SYN” for Honeywell Synertek
- The media code – “GW” for groundwater, “SS” for surface soil samples, “SP” for stockpile samples
- The sample sequence (for example, 1, 2, 3)
- The date (month/day/year) on which the sample was collected

4.7 Field Documentation

In addition to the documentation previously described, a description of the physical characteristics of each sample collected for analyses will be recorded into the sampling field notebook. The description will document readily observable characteristics of the sample, such as color, texture, moisture content, detectable concentrations of COCs using the photoionization detector, and other notable characteristics. Field documentation will also include a photographic record of the sampling activities. Photographs will be taken using a digital camera. Pertinent information for each photograph (such as a description of the subject of the photograph and related location or sample identification information, date of photograph, and name of person taking the photo) will be recorded into a photograph log, at the time the photographs are uploaded from the digital camera, to provide an index for reference use.

The field notebook will also record the following:

- Date of entry
- Project name and location
- Time that sampling started
- Summary of weather conditions
- Identification of sampling locations
- Equipment calibration
- Sampling activities

The bottom of each page of the field log book will be signed or initialed and each entry dated in order to show that notes are being taken on a daily basis.

A line-through will be placed on any portion of a log book page that is unused. One line strike-through will be used to show corrections to entries. The strike-through will be initialed and dated. No correction fluid may be used.

In addition, the same information will be documented in the daily report.

4.8 Sample Documentation and Tracking

Vital information regarding the collection of each sample will be recorded in a field logbook. A separate logbook will be used for this site. It will be bound with consecutively-numbered pages. All entries will be legibly written in black ink and signed and dated by the individual making the entries. Factual and objective language will be used. All entries will be complete and accurate enough to allow reconstruction of each field activity. Information recorded during the collection of each sample will include:

- Sample location and description. (Sketch and measured distances from reference points will be recorded if there is no established identification for the sample location.)
- Sample identification.
- Sampler's name.
- Date and time of sampling.
- Sample designation as composite or grab.
- Sample matrix.
- Type and identification of sampling equipment used.
- Field measurement data (pH, temperature, conductivity, etc).
- Field observations that may be relevant to the analysis or sample integrity (odor, color, weather conditions).
- Associated quality control blanks.
- Preservative used.
- Lot numbers of sample containers, chain-of-custody number, and custody seal number.
- Shipping arrangement.
- Destination laboratory.

SECTION 5

Sample Handling and Custody

5.1 Containers and Preservatives

Laboratories will provide the required sample containers for all environmental and associated quality control samples. All containers will be certified free of the analytes of concern for this project. No sample containers will be reused. The contracted laboratory will add preservatives, if required, prior to shipping the sample containers to the field. The containers, minimum sample quantities, required preservatives, and maximum holding times for many parameters are shown in Table 5-1 and Table 5-2.

TABLE 5-1

Sample Containers, Preservation, and Holding Times
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Method | Container and Minimum Quantity | Preservation | Holding Time |
|----------------------|----------------------|--------------------------------|--|---|
| VOC | SW8260B | 3 x 40-mL /G-TLC | Add HCl to pH<2; chill to 4°C | 14 days (preserved); 7 days (unpreserved) |
| Metals | E200.7/E200.8/E245.1 | 500 ml polyethylene | Add HNO ₃ to pH<2; chill to 4°C | 180 days (mercury 28 days) |
| Dissolved Gases | RSK175 | 2 x 40-mL /G-TLC | Chill to 4°C | 14 days |
| Total Organic Carbon | SM5310C | 250 ml amber G | Add H ₂ SO ₄ to pH<2; chill to 4°C | 28 days |
| Orthophosphate | SM4500P-E | 500 ml polyethylene | Chill to 4°C | 48 hours |
| Sulfide | SM4500S2-D | 500 ml polyethylene | NaOH to pH>12 + 2mls zinc acetate | 7 days |
| Alkalinity | SM2320B | 500 ml polyethylene | Chill to 4°C | 14 days |
| Anions | E300.0 | 500 ml polyethylene | Chill to 4°C | 28 days for all except nitrate and nitrite 48 hours |

°C = degrees Celsius

G = glass

G-TLC = glass with Teflon-lined cap

HCL = hydrochloric acid

HNO₃ = nitric acidH₂SO₄ = sulfuric acid

ml = milliliter

NaOH = sodium hydroxide

VOC = volatile organic compound

TABLE 5-2

Sample Containers, Preservation, and Holding Times for Soil Gas and Air Samples

| Analyte | Method | Container and Minimum Quantity | Preservation | Holding Time |
|---------|-----------|--------------------------------|--------------|--------------|
| VOC | TO-15-SIM | 6-L Summa Canister | None | 28 days |
| VOC | TO-15 | 6-L Summa Canister | None | 28 days |

L = liter

VOC = volatile organic compound

5.2 Chain of Custody

Collecting data of known quality begins at the point of sample collection. Legally-defensible data are generated by adhering to proven evidentiary procedures. These procedures are outlined in the following sections and must be followed to preserve and ensure the integrity of all samples from the time of collection through analysis. Sample custody records must be maintained both in the field and in the subcontractor laboratory. A sample is considered to be in someone's custody if it is either in his or her physical possession or view, locked up, or kept in a secured and restricted area. Until shipment, sample custody will be the responsibility of the sampling team leader.

Chain-of-custody records document sample collection and shipment to the laboratory. A chain-of-custody form will be completed for each sampling event. The original copy will be provided to the laboratory with the sample shipping cooler, and a copy will be retained in the field documentation files. The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. All chain-of-custody forms will be signed and dated by the responsible sampling team personnel. The "relinquished by" box will be signed by the responsible sampling team personnel, and the date, time, and air bill number will be noted on the chain-of-custody form. The laboratory will return the executed copy of the chain-of-custody with the hardcopy report.

The shipping coolers containing the samples will be sealed with a custody seal any time the coolers are not in an individual's possession or view before shipping. All custody seals will be signed and dated by the responsible sampling team personnel.

At a minimum, the chain-of-custody form must contain:

- Site name
- PM, PC and DM names, telephone numbers, and fax numbers
- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, sample type, and matrix)
- Number of containers
- Designation of MS/MSD
- Preservative used
- Analyses required
- Name of sampler
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratories
- Bill of lading or transporter tracking number (if applicable)
- Turnaround time
- Lab name, address, and contact information
- Initial and final canister pressures for collection of air samples
- Any special instructions

Erroneous entries on chain-of-custody records will be corrected by drawing a line through the error and entering the corrected information. The person performing the correction will date and initial each change made on the chain-of-custody form.

5.2.1 Laboratory Responsibilities

Once the samples reach the laboratory, they will be checked against information on the chain-of-custody form for anomalies. The condition, temperature, and appropriate preservation of samples will be checked and documented on the chain-of-custody form. Checking an aliquot of the sample using pH paper is an acceptable procedure (precautions must be taken to avoid contamination of the sample). Samples requesting VOC analyses should not undergo preservation verification until the time of analysis. The occurrence of any anomalies in the received samples and their resolution will be documented in laboratory records. All sample information will then be entered into a tracking system, and unique analytical sample identifiers will be assigned. A copy of this information will be reviewed by the laboratory for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. **Samples not preserved or analyzed in accordance with the requirements in this QAPP or the project-specific Work Plan will be resampled and analyzed at no additional cost to CH2M HILL.** Laboratory analyses will be documented on the chain-of-custody form. Procedures ensuring internal laboratory chain of custody will also be implemented and documented by the laboratory. Ideally, sample custody will be maintained using an internal custody system that requires samples to be kept in a secured and restricted area when not in use and to be checked out and checked back in by the analysts who use the samples. Internal custody records must be maintained by the laboratory as part of the documentation file for each sample. Specific instructions concerning the analysis specified for each sample will be communicated to the analysts. Analytical batches will be created, and laboratory quality control samples will be introduced into each batch.

While samples are stored in the laboratory, samples will be stored in limited-access, temperature-controlled areas. Refrigerators, coolers, and freezers will be monitored for temperature seven days a week. Acceptance criterion for the temperature of the refrigerators and coolers is $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. All of the cold-storage areas will be monitored by thermometers that have been calibrated with a National Institute of Standards and Technology-traceable thermometer. As indicated by the findings of the calibration, correction factors will be applied to each thermometer. Records that include acceptance criteria will be maintained. Samples for volatile organics determination will be stored separately from other samples, standards, and sample extracts. Samples will be stored after analysis (samples will be stored as defined in the project Statement of Work or Honeywell Master Services Agreement, whichever is longer) until disposed of in accordance with applicable local, state, and federal regulations. Disposal records will be maintained by the laboratory.

Along with sample receipt documentation, the following information will be documented on sample receipt forms by the sample custodian:

- Date samples received
- CH2M HILL sample identification number
- Laboratory sample identification number
- Analytical tests requested for the sample batch
- Sample matrix
- Number of samples in the batch
- Container description and location in the laboratory
- Verification of sample preservation

SOPs describing sample control and custody will be maintained by the laboratory.

When samples that are designated as “HOLD” on the chain-of-custody are released for analysis by the PC, an official letter must be submitted to the laboratory, and the chain-of-custody should be resubmitted to the DM and PC with relevant release notification. The Laboratory will also submit appropriate documentation to PC and DM confirming the samples that will be released for analysis

5.3 Sample Packaging and Transport

The following sections contain guidelines for sample packaging and transport.

5.3.1 Sample Container Preparation

- Container lids will be checked for tightness, and if the container is not full, the outside of the container will be marked with indelible ink at the sample volume level.
- Sample bottles will be double-bagged in heavy-duty plastic. Glass containers will be covered with bubble wrap to prevent breakage.

5.3.2 Shipping Cooler Preparation

- All previous labels used on the sample-shipping cooler will be removed.
- The drain plugs will be sealed with fiberglass tape (outside and inside) to prevent melting ice from leaking.
- A cushioning layer of packing material such as bubble wrap will be placed at the bottom of the cooler (approximately 1 inch thick) to prevent breakage during shipment.
- The cooler will be lined with a large plastic bag (same type used to contain samples).
- All ice will be double-bagged in a zip-locked plastic bag.

5.3.3 Placing Samples in the Cooler

- The chain-of-custody form will be placed in a zip-locked bag.
- Samples will be placed in an upright position in the cooler.
- Ice will be placed on top of samples and between samples. Ideally, ice will be placed in resealable plastic bags in duplicate to minimize leakage of ice melt into the cooler.
- Void space between samples will be filled with packing material.

5.3.4 Closing the Cooler

- The cooler lid will be taped with strapping tape, encircling the cooler several times.
- Custody seals may also be affixed to the cooler lid to further ensure the integrity of the samples.

5.3.5 Transport

- Sample coolers will be transported to the laboratory (an overnight courier may be used) immediately after sample collection. Intermediate stops will be avoided, with the exception of emergencies only, in which case, the situation will be noted in the field notebooks.
- The laboratory will be notified that samples are being shipped.

SECTION 6

Analytical Methods and Quality Control

Tables 6-2 through 6-10 contain lists of target analytes, the methods to be used, and the reporting limit objectives specific to this project. The reporting limits included herein reflect quantifiable levels that are attainable with a specified degree of confidence using the specified methods.

The accuracy and precision limits are listed in Table 6-11 through 6-19. Calibration and quality control requirements are specified in Tables 6-20 through 6-29.

TABLE 6-1

Extraction and Digestion Methods

Honeywell Synertek, Quality Assurance Project Plan

| Analytical Method | Parameter | Preparatory Methods |
|-------------------|----------------------|---------------------|
| SW8260B | VOC | SW5030B |
| E200.7/E200.8 | Metals | See method |
| E245.1 | Mercury | See method |
| SM2320B | Alkalinity | See method |
| SM4500P-E | Orthophosphate | See method |
| SM4500S2-D | Sulfide | See method |
| RSK175 | Dissolved Gases | See method |
| SM5310C | Total organic carbon | See method |
| E300.0 | Anions | See method |

TABLE 6-2

Reporting Limit Objectives for Volatile Organic Compounds by SW8260B

Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limits (µg/L) |
|-----------------------------|-------------------------|
| 1,1,1,2-Tetrachloroethane | 0.5 |
| 1,1,1-Trichloroethane | 0.5 |
| 1,1,2,2-Tetrachloroethane | 0.5 |
| 1,1,2-Trichloroethane | 0.5 |
| 1,1-Dichloroethane | 0.5 |
| 1,1-Dichloroethene | 0.5 |
| 1,1-Dichloropropene | 0.5 |
| 1,2,3-Trichlorobenzene | 0.5 |
| 1,2,3-Trichloropropane | 0.5 |
| 1,2,4-Trichlorobenzene | 0.5 |
| 1,2,4-Trimethylbenzene | 0.5 |
| 1,2-Dibromo-3-Chloropropane | 2 |
| 1,2-Dibromoethane | 0.5 |
| 1,2-Dichlorobenzene | 0.5 |

TABLE 6-2
Reporting Limit Objectives for Volatile Organic Compounds by SW8260B
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limits (µg/L) |
|-------------------------|----------------------------|
| 1,2-Dichloroethane | 0.5 |
| 1,2-Dichloropropane | 0.5 |
| 1,3,5-Trimethylbenzene | 0.5 |
| 1,3-Dichlorobenzene | 0.5 |
| 1,3-Dichloropropane | 0.5 |
| 1,4-Dichlorobenzene | 0.5 |
| 2,2-Dichloropropane | 0.5 |
| 2-Chlorotoluene | 0.5 |
| 4-Chlorotoluene | 0.5 |
| Benzene | 0.5 |
| Bromobenzene | 0.5 |
| Bromochloromethane | 0.5 |
| Bromodichloromethane | 0.5 |
| Bromoform | 1 |
| Bromomethane | 1 |
| Carbon Tetrachloride | 0.5 |
| Chlorobenzene | 0.5 |
| Chloroethane | 1 |
| Chloroform | 0.5 |
| Chloromethane | 1 |
| cis-1,2-Dichloroethene | 0.5 |
| cis-1,3-Dichloropropene | 0.5 |
| Dibromochloromethane | 0.5 |
| Dibromomethane | 0.5 |
| Ethylbenzene | 0.5 |
| Freon 113 | 2 |
| Freon 12 | 1 |
| Hexachlorobutadiene | 2 |
| Isopropylbenzene | 0.5 |
| m,p-Xylenes | 0.5 |
| Methylene Chloride | 10 |
| Naphthalene | 2 |
| n-Butylbenzene | 0.5 |
| o-Xylene | 0.5 |
| para-Isopropyl Toluene | 0.5 |
| Propylbenzene | 0.5 |
| sec-Butylbenzene | 0.5 |
| Styrene | 0.5 |
| tert-Butylbenzene | 0.5 |

TABLE 6-2
Reporting Limit Objectives for Volatile Organic Compounds by SW8260B
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limits (µg/L) |
|---------------------------|----------------------------|
| Tetrachloroethene | 0.5 |
| Toluene | 0.5 |
| trans-1,2-Dichloroethene | 0.5 |
| trans-1,3-Dichloropropene | 0.5 |
| Trichloroethene | 0.5 |
| Vinyl Chloride | 0.5 |

TABLE 6-3
Reporting Limit Objectives for Metals by E200.7/E200.8/E245.1
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limits (µg/L) |
|------------|----------------------------|
| Antimony | 10 |
| Arsenic | 5 |
| Barium | 5 |
| Beryllium | 2 |
| Cadmium | 5 |
| Cobalt | 5 |
| Copper | 5 |
| Chromium | 5 |
| Lead | 5 |
| Mercury | 0.2 |
| Molybdenum | 5 |
| Nickel | 5 |
| Selenium | 10 |
| Silver | 5 |
| Thallium | 10 |
| Vanadium | 5 |
| Zinc | 20 |

TABLE 6-4
Reporting Limit Objectives for Dissolved Gases by RSK175
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limits (mg/L) |
|---------|----------------------------|
| Methane | 0.005 |
| Ethane | 0.005 |
| Ethene | 0.005 |

TABLE 6-5
Reporting Limit Objective for Total Organic Carbon by SM5310C
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limit (mg/L) |
|----------------------|------------------------|
| Total Organic Carbon | 0.5 |

TABLE 6-6
Reporting Limit Objective for Orthophosphate by SM4500P-E
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limit (mg/L) |
|----------------|------------------------|
| Orthophosphate | 0.04 |

TABLE 6-7
Reporting Limit Objective for Orthophosphate by SM4500S2-D
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limit (mg/L) |
|---------|------------------------|
| Sulfide | 0.05 |

TABLE 6-8
Reporting Limit Objectives for Anions by E300.0
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limits (mg/L) |
|---------|-------------------------|
| Bromide | 0.25 |
| Sulfate | 0.5 |
| Nitrate | 0.05 |

TABLE 6-9
Reporting Limit Objectives for Alkalinity by SM2320B
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limits (mg/L) |
|--|-------------------------|
| Alkalinity, Bicarbonate | 5 |
| Alkalinity, Carbonate | 5 |
| Alkalinity, Hydroxide | 5 |
| Alkalinity, Total as CaCO ₃ | 5 |

TABLE 6-10
Reporting Limit Objectives (unadjusted for dilution factor) for Volatile Organic Compounds by TO-15/TO-15 SIM
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | Reporting Limits TO-15 (µg/m ³) | Reporting Limits TO-15 SIM (µg/m ³) |
|---------------------------------------|---|---|
| 1,1,1-Trichloroethane | 1 | 0.025 |
| 1,1,2-Trichloroethane | 1 | 0.025 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1 | 0.025 |
| 1,1-Dichloroethane | 1 | 0.025 |
| 1,1-Dichloroethene | 1 | 0.025 |
| 1,2-Dichloroethane | 1 | 0.025 |
| Acetone | 5 | 0.025 |
| Benzene | 1 | 0.1 |
| Cis-1,2-Dichloroethene | 1 | 0.025 |
| Dichlorodifluoromethane | 1 | 0.025 |
| Ethylbenzene | 1 | 0.1 |
| Methylene Chloride | 1 | 0.1 |
| Tetrachloroethene | 1 | 0.025 |
| Toluene | 1 | 0.1 |
| Trans-1,2-Dichloroethene | 1 | 0.025 |
| Trichloroethene | 1 | 0.025 |
| Vinyl Chloride | 1 | 0.025 |
| Xylenes (Total) | 1 | 0.1 |

µg/m³ = micrograms per cubic meter.
 Reporting limits do not include dilution factor.

TABLE 6-11
Accuracy and Precision Limits for Volatile Organic Compounds by SW8260B
Honeywell Synertek, Quality Assurance Project Plan

| Analyte | LCS %R | LCS RPD | MS %R | MS RPD |
|-----------------------------|--------|---------|--------|--------|
| 1,1,1,2-Tetrachloroethane | 70-130 | 20 | 70-130 | 20 |
| 1,1,1-Trichloroethane | 70-130 | 20 | 70-130 | 20 |
| 1,1,2,2-Tetrachloroethane | 70-130 | 20 | 70-130 | 20 |
| 1,1,2-Trichloroethane | 70-130 | 20 | 70-130 | 20 |
| 1,1-Dichloroethane | 70-130 | 20 | 70-130 | 20 |
| 1,1-Dichloroethene | 70-130 | 20 | 70-130 | 20 |
| 1,1-Dichloropropene | 70-130 | 20 | 70-130 | 20 |
| 1,2,3-Trichlorobenzene | 70-130 | 20 | 70-130 | 20 |
| 1,2,3-Trichloropropane | 70-130 | 20 | 70-130 | 20 |
| 1,2,4-Trichlorobenzene | 70-130 | 20 | 70-130 | 20 |
| 1,2,4-Trimethylbenzene | 70-130 | 20 | 70-130 | 20 |
| 1,2-Dibromo-3-Chloropropane | 70-130 | 20 | 70-130 | 20 |
| 1,2-Dibromoethane | 70-130 | 20 | 70-130 | 20 |
| 1,2-Dichlorobenzene | 70-130 | 20 | 70-130 | 20 |
| 1,2-Dichloroethane | 70-130 | 20 | 70-130 | 20 |
| 1,2-Dichloropropane | 70-130 | 20 | 70-130 | 20 |
| 1,3,5-Trimethylbenzene | 70-130 | 20 | 70-130 | 20 |
| 1,3-Dichlorobenzene | 70-130 | 20 | 70-130 | 20 |
| 1,3-Dichloropropane | 70-130 | 20 | 70-130 | 20 |
| 1,4-Dichlorobenzene | 70-130 | 20 | 70-130 | 20 |
| 2,2-Dichloropropane | 70-130 | 20 | 70-130 | 20 |
| 2-Chlorotoluene | 70-130 | 20 | 70-130 | 20 |
| 4-Chlorotoluene | 70-130 | 20 | 70-130 | 20 |
| Benzene | 70-130 | 20 | 70-130 | 20 |
| Bromobenzene | 70-130 | 20 | 70-130 | 20 |
| Bromochloromethane | 70-130 | 20 | 70-130 | 20 |
| Bromodichloromethane | 70-130 | 20 | 70-130 | 20 |
| Bromoform | 70-130 | 20 | 70-130 | 20 |
| Bromomethane | 70-130 | 20 | 70-130 | 20 |
| Carbon Tetrachloride | 70-130 | 20 | 70-130 | 20 |
| Chlorobenzene | 70-130 | 20 | 70-130 | 20 |
| Chloroethane | 70-130 | 20 | 70-130 | 20 |
| Chloroform | 70-130 | 20 | 70-130 | 20 |
| Chloromethane | 70-130 | 20 | 70-130 | 20 |
| cis-1,2-Dichloroethene | 70-130 | 20 | 70-130 | 20 |
| cis-1,3-Dichloropropene | 70-130 | 20 | 70-130 | 20 |
| Dibromochloromethane | 70-130 | 20 | 70-130 | 20 |
| Dibromomethane | 70-130 | 20 | 70-130 | 20 |
| Ethylbenzene | 70-130 | 20 | 70-130 | 20 |
| Freon 113 | 70-130 | 20 | 70-130 | 20 |
| Freon 12 | 70-130 | 20 | 70-130 | 20 |
| Hexachlorobutadiene | 70-130 | 20 | 70-130 | 20 |
| Isopropylbenzene | 70-130 | 20 | 70-130 | 20 |
| m,p-Xylenes | 70-130 | 20 | 70-130 | 20 |
| Methylene Chloride | 70-130 | 20 | 70-130 | 20 |
| Naphthalene | 70-130 | 20 | 70-130 | 20 |
| n-Butylbenzene | 70-130 | 20 | 70-130 | 20 |

TABLE 6-11

Accuracy and Precision Limits for Volatile Organic Compounds by SW8260B*Honeywell Synertek, Quality Assurance Project Plan*

| | | | | |
|---------------------------|--------|----|--------|----|
| o-Xylene | 70-130 | 20 | 70-130 | 20 |
| para-Isopropyl Toluene | 70-130 | 20 | 70-130 | 20 |
| Propylbenzene | 70-130 | 20 | 70-130 | 20 |
| sec-Butylbenzene | 70-130 | 20 | 70-130 | 20 |
| Styrene | 70-130 | 20 | 70-130 | 20 |
| tert-Butylbenzene | 70-130 | 20 | 70-130 | 20 |
| Tetrachloroethene | 70-130 | 20 | 70-130 | 20 |
| Toluene | 70-130 | 20 | 70-130 | 20 |
| trans-1,2-Dichloroethene | 70-130 | 20 | 70-130 | 20 |
| trans-1,3-Dichloropropene | 70-130 | 20 | 70-130 | 20 |
| Trichloroethene | 70-130 | 20 | 70-130 | 20 |
| Vinyl Chloride | 70-130 | 20 | 70-130 | 20 |
| Surrogates | | | | |
| 1,2-Dichloroethane-d4 | 70-130 | | | |
| Bromofluorobenzene | 70-130 | | | |
| Dibromofluoromethane | 70-130 | | | |
| Toluene-d8 | 70-130 | | | |

TABLE 6-12

Accuracy and Precision Limits for Metals by E200.7/E200.8/E245.1*Honeywell Synertek, Quality Assurance Project Plan*

| Analytes | LCS %R | LCS RPD | MS %R | MS RPD |
|-----------------|---------------|----------------|--------------|---------------|
| Antimony | 80-120 | 20 | 80-120 | 20 |
| Arsenic | 80-120 | 20 | 80-120 | 20 |
| Barium | 80-120 | 20 | 80-120 | 20 |
| Beryllium | 80-120 | 20 | 80-120 | 20 |
| Cadmium | 80-120 | 20 | 80-120 | 20 |
| Cobalt | 80-120 | 20 | 80-120 | 20 |
| Copper | 80-120 | 20 | 80-120 | 20 |
| Chromium | 80-120 | 20 | 80-120 | 20 |
| Lead | 80-120 | 20 | 80-120 | 20 |
| Mercury | 85-115 | 20 | 85-115 | 20 |
| Molybdenum | 80-120 | 20 | 80-120 | 20 |
| Nickel | 80-120 | 20 | 80-120 | 20 |
| Selenium | 80-120 | 20 | 80-120 | 20 |
| Silver | 80-120 | 20 | 80-120 | 20 |
| Thallium | 80-120 | 20 | 80-120 | 20 |
| Vanadium | 80-120 | 20 | 80-120 | 20 |
| Zinc | 80-120 | 20 | 80-120 | 20 |

TABLE 6-13

Accuracy and Precision Limits for Dissolved Gases by RSK-175*Honeywell Synertek, Quality Assurance Project Plan*

| Analytes | LCS %R | LCS RPD | MS %R | MS RPD |
|----------|--------|---------|--------|--------|
| Methane | 70-130 | 20 | 70-130 | 20 |
| Ethane | 70-130 | 20 | 70-130 | 20 |
| Ethene | 70-130 | 20 | 70-130 | 20 |

TABLE 6-14

Accuracy and Precision Limits for Total Organic Carbon by SM5310C*Honeywell Synertek, Quality Assurance Project Plan*

| Analyte | LCS %R | LCS RPD | MS %R | MS RPD |
|----------------------|--------|---------|--------|--------|
| Total Organic Carbon | 80-120 | 20 | 75-125 | 20 |

TABLE 6-15

Accuracy and Precision Limits for Orthophosphate by SM4500P-E*Honeywell Synertek, Quality Assurance Project Plan*

| Analyte | LCS %R | LCS RPD | MS %R | MS RPD |
|----------------|--------|---------|--------|--------|
| Orthophosphate | 80-120 | 20 | 75-125 | 20 |

TABLE 6-16

Accuracy and Precision Limits for Sulfide by SM4500S2-D*Honeywell Synertek, Quality Assurance Project Plan*

| Analyte | LCS %R | LCS RPD | MS %R | MS RPD |
|---------|--------|---------|--------|--------|
| Sulfide | 80-120 | 20 | 75-125 | 20 |

TABLE 6-17

Accuracy and Precision Limits for Anions by E300.0*Honeywell Synertek, Quality Assurance Project Plan*

| Analytes | LCS %R | LCS RPD | MS %R | MS RPD |
|----------|--------|---------|--------|--------|
| Bromide | 80-120 | 20 | 75-125 | 20 |
| Sulfate | 80-120 | 20 | 75-125 | 20 |
| Nitrate | 80-120 | 20 | 75-125 | 20 |

TABLE 6-18
Accuracy and Precision Limits for Alkalinity by SM2320B
Honeywell Synertek, Quality Assurance Project Plan

| Analytes | LCS %R | LCS RPD | MS %R | MS RPD |
|--|--------|---------|--------|--------|
| Alkalinity, Bicarbonate | 80-120 | 20 | 75-125 | 20 |
| Alkalinity, Carbonate | 80-120 | 20 | 75-125 | 20 |
| Alkalinity, Hydroxide | 80-120 | 20 | 75-125 | 20 |
| Alkalinity, Total as CaCO ₃ | 80-120 | 20 | 75-125 | 20 |

TABLE 6-19
Accuracy and Precision Limits for Volatile Organic Compounds by TO-15/TO-15SIM
Honeywell Synertek, Quality Assurance Project Plan

| Analytes | LCS %R | LCS RPD |
|---------------------------------------|--------|---------|
| 1,1,1-Trichloroethane | 70-130 | 30 |
| 1,1,2-Trichloroethane | 70-130 | 30 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 70-130 | 30 |
| 1,1-Dichloroethane | 70-130 | 30 |
| 1,1-Dichloroethene | 70-130 | 30 |
| 1,2-Dichloroethane | 70-130 | 30 |
| Acetone | 70-130 | 30 |
| Benzene | 70-130 | 30 |
| Cis-1,2-Dichloroethene | 70-130 | 30 |
| Dichlorodifluoromethane | 70-130 | 30 |
| Ethylbenzene | 70-130 | 30 |
| Methylene Chloride | 70-130 | 30 |
| Tetrachloroethene | 70-130 | 30 |
| Toluene | 70-130 | 30 |
| Trans-1,2-Dichloroethene | 70-130 | 30 |
| Trichloroethene | 70-130 | 30 |
| Vinyl Chloride | 70-130 | 30 |
| Xylenes (Total) | 70-130 | 30 |

TABLE 6-20

Calibration and Quality Control Requirements for Volatile Organic Compounds by SW8260B*Honeywell Synertek, Quality Assurance Project Plan*

| Quality Control Check | Frequency | Criteria | Corrective Action |
|---|---|---|--|
| BFB Tuning | Prior to initial calibration and calibration verification (every 12 hours). | Refer to criteria listed in the method. | Retune instrument and verify. |
| Multi-point initial calibration (minimum five points) | Prior to sample analysis, or when calibration verification fails. | SPCCs average RF $\geq 0.30^a$ and %RSD for RFs for CCCs $\leq 30\%$ and one option below: Option 1: %RSD for each analyte $\leq 15\%$ if using average RRFs Option 2: Least squares regression $r^2 \geq 0.995$ Average RF for all non-SPCCs >0.05 (0.01 for poor performers) | Correct the problem and repeat the initial calibration. |
| Second-source calibration verification | Once for each multi-point initial calibration. | All analytes within $\pm 25\%$ of expected value. | Repeat If still out, identify and correct problem and repeat If still out, repeat initial calibration.. |
| CCV | At the start of each analytical sequence and every 12 hours thereafter. | SPCCs average RF $\geq 0.30^a$ and %D for RFs for CCCs $\leq 20\%$ All other analytes within + 20% of expected value | Reanalyze CCV. If still out, identify problem. Recalibrate and reanalyze all samples since last valid CCV. |
| Retention time window calculated for each analyte | Each analyte. | Relative retention time of each analyte within + 0.06 relative retention time units of the continuing calibration verification. | Not applicable (used for identification of analyte). |
| Internal standards | Every standard, sample, method blank, MS/MSD and LCS. | Retention time of the continuing calibration verification within ± 30 seconds from retention time of the mid-point standard of the most recent initial calibration curve. Retention time of the samples within ± 30 seconds from retention time of the daily continuing calibration verification standard. EICP area of the continuing calibration verification within -50% to $+100\%$ of the mid-point standard of the most recent initial calibration curve EICP area of the samples within -50% to $+100\%$ of the daily continuing calibration verification standard. | Inspect mass spectrometer and gas chromatography for malfunctions; reanalyze all affected samples. |
| Method blank | At least one per analytical batch. | No analytes detected at or above the reporting limit. | Correct the problem, then re-prep and reanalyze all associated samples. |

TABLE 6-20

Calibration and Quality Control Requirements for Volatile Organic Compounds by SW8260B*Honeywell Synertek, Quality Assurance Project Plan*

| Quality Control Check | Frequency | Criteria | Corrective Action |
|-----------------------|---|---|--|
| Surrogate spike | Every standard, sample, method blank, MS/MSD and LCS. | All surrogates within limits specified in Accuracy and Precision table. | Correct the problem and reanalyze (re-prep if necessary). |
| MS/MSD | One set per 20 project-specific samples. | Within limits specified in Accuracy and Precision table. | None. |
| LCS/LCSD | At least one per analytical batch. | Within limits specified in Accuracy and Precision table. | Correct the problem, then re-prep and reanalyze the LCS and all samples in the analytical batch. |

aSPCC average RRF ≥ 0.10 for bromoform, chloromethane, 1,1-dichloroethane.

%RSD = percent relative standard deviation

BFB = Bromofluorobenzene

CCC = calibration check compounds.

EICP = extracted ion current profile

LCS/LCSD = laboratory control sample/laboratory control sample duplicate

MS/MSD = matrix spike/matrix spike duplicate

RF = response factor

RRF = relative response factor

SPCC = system performance check compounds

TABLE 6-21

Calibration and Quality Control Requirements for Metals by E200.7*Honeywell Synertek, Quality Assurance Project Plan*

| Quality Control Check | Frequency | Criteria | Corrective Action |
|---|---|--|--|
| Initial calibration (a blank and at least one standard) | Before sample analysis, every 24 hours, whenever modifications are made to the system, or when continuing calibration verification fails. | If more than one standard is used, correlation coefficient must be > 0.995 . | N/A |
| Second-source calibration verification | Immediately following each initial calibration. | All analytes within $\pm 5\%$ of expected value. | Correct problem and repeat initial calibration. |
| Calibration blank | After every second-source or continuing calibration verification analysis. | No analytes detected at or above the reporting limit. | Correct the problem, then reanalyze previous 10 samples. |
| Continuing calibration verification | After every 10 samples and at the end of the analysis sequence. | All analytes within $\pm 10\%$ of expected value. | Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification. |
| Method blank | At least one per analytical batch. | No analytes detected at or above the reporting limit. | Correct the problem and re-prep and reanalyze all associated samples. |

TABLE 6-21
Calibration and Quality Control Requirements for Metals by E200.7
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Frequency | Criteria | Corrective Action |
|---|--|---|--|
| Interference check standard | At the start and end of each analytical sequence or twice during an 8-hour period, whichever is more frequent. | All analytes within $\pm 20\%$ of expected value. | Correct the problem, recalibrate, reanalyze ICS and all affected samples. |
| MS/MSD | One set per 20 project-specific samples. MSD is optional if a laboratory sample duplicate is performed. | All analytes within limits specified in accuracy and precision table. | None. |
| Laboratory sample duplicate | Once per analytical batch if MSD not performed. | Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD >20%. One sample result < the reporting limit and a difference of ± 2 times the reporting limit. | None. |
| LCS | At least one per analytical batch. | All analytes within limits specified in Accuracy and Precision table. | Correct the problem, and re-prepare and reanalyze the LCS and all samples in the analytical batch. |
| Dilution test | Each new sample matrix. | Result from 1:5 dilution must be within $\pm 10\%$ of the undiluted sample result (applies only if undiluted sample result is at least 25 times the reporting limit). | Perform post-digestion spike addition. |
| Linear range calibration check standard | Once per quarter. | All analytes within $\pm 10\%$ of expected value. | Correct problem then reanalyze or re-set linear range. |
| Post-digestion spike addition | When dilution test fails. | Recovery within 75-125% of expected value. | None. |

TABLE 6-22
Calibration and Quality Control Requirements for Metals by E200.8
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Frequency | Criteria | Corrective Action |
|---|--|--|--|
| Tuning | Prior to initial calibration | Mass calibration ≤ 0.1 amu from the true value; resolution < 0.9 amu full width at 10% peak height; for stability, RSD $< 5\%$ for at least four replicate analytes | Retune instrument then reanalyze tuning solutions. |
| Initial calibration (a blank and at least one standard) | Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails. | N/A | N/A |
| Second-source calibration verification | Immediately following each initial calibration. | All analytes within $\pm 10\%$ of expected value. | Correct problem and repeat initial calibration. |
| Calibration blank | After every second-source or continuing calibration verification analysis. | No analytes detected at or above the reporting limit. | Correct the problem, then reanalyze previous 10 samples. |
| Continuing calibration verification | After every 10 samples and at the end of the analysis sequence. | All analytes within $\pm 10\%$ of expected value. | Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification. |
| Method blank | At least one per analytical batch. | No analytes detected at or above the reporting limit. | Correct the problem and re-prep and reanalyze all associated samples. |
| Interference check standard | At the start and end of each analytical sequence or twice during an 8-hour period, whichever is more frequent. | All analytes within $\pm 20\%$ of expected value. | Correct the problem, recalibrate, reanalyze interference check standard and all affected samples. |
| Internal standard | Every sample | IS intensity within 30-120% of intensity of the IS in the initial calibration | Perform corrective action as described in Method. |
| MS/MSD | One set per 20 project-specific samples. MSD is optional if a laboratory sample duplicate is performed. | All analytes within limits specified in accuracy and precision table. | None. |
| Laboratory sample duplicate | Once per analytical batch if MSD not performed. | Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD $> 20\%$. One sample result $<$ the reporting limit and a difference of ± 2 times the reporting limit. | None. |
| LCS | At least one per analytical batch. | All analytes within limits specified in accuracy and precision table. | Correct the problem, and re-prep and reanalyze the LCS and all samples in the analytical batch. |
| Dilution test | Each new sample matrix. | Result from 1:5 dilution must be within $\pm 10\%$ of the undiluted sample result (applies only if undiluted sample result is at least 25 times the reporting limit). | Perform post-digestion spike addition. |
| Post-digestion spike addition | When dilution test fails. | Recovery within 75-125% of expected value. | None. |

TABLE 6-23
Calibration and Quality Control Requirements for Mercury by E245.1
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Frequency | Criteria | Corrective Action |
|---|--|--|--|
| Multi-point initial calibration (a blank and at least five standards) | Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails. | Correlation coefficient of linear regression is ≥ 0.995 . | Correct the problem and repeat the initial calibration. |
| Second-source calibration verification | Immediately following each initial calibration. | All analytes within $\pm 20\%$ of expected value. | Correct the problem and repeat initial calibration. |
| Calibration blank | After every second-source or continuing calibration verification analysis. | No analytes detected at or above the reporting limit. | Correct the problem, then reanalyze previous 10 samples. |
| Continuing calibration verification | After every 10 samples and at the end of the analysis sequence. | All analytes within $\pm 20\%$ of expected value. | Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification. |
| Method blank | At least one per analytical batch. | No analytes detected at or above the reporting limit. | Correct the problem and re-prep and reanalyze all associated samples. |
| MS/MSD | One set per 20 project-specific samples. MSD is optional if a laboratory sample duplicate is performed. | All analytes within limits specified in accuracy and precision table. | None. |
| Laboratory sample duplicate | Once per analytical batch if MSD not performed. | Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD $> 20\%$. One sample result $<$ the reporting limit and a difference of ± 2 times the reporting limit. | None. |
| LCS | At least one per analytical batch. | All analytes within limits specified in accuracy and precision table. | Correct the problem, and re-prep and reanalyze the LCS and all samples in the analytical batch. |
| Dilution test | Each new sample matrix. | Result from 1:5 dilution must be within $\pm 10\%$ of the undiluted sample result (applies only if undiluted sample result is at least 25 times the reporting limit). | Perform recovery test. |
| Recovery test | When dilution test fails. | Recovery within 85-115% of expected value. | Analyze all samples by MSA. |

TABLE 6-24

Calibration and Quality Control Requirements for Dissolved Gases by RSK175*Honeywell Synertek, Quality Assurance Project Plan*

| Quality Control Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|--|--|---|--|
| Initial multipoint calibration for all analytes (minimum five standards) | Prior to sample analysis | One of the options: 1. RSD for each analyte $\leq 20\%$ 2. Least squares regression $r^2 > 0.995$ for each analyte. Calibration <u>MUST</u> meet acceptance criteria prior to sample analysis. | Correct problem then repeat initial calibration. |
| ICV | Immediately after calibration and before sample analysis. Must be a second source or independently prepared standard | All analytes within $\pm 30\%$ of expected value | Repeat ICV. If still out, identify and correct problem and repeat ICV. If still out, repeat initial calibration. |
| Retention time window | Every standard, sample, method blank, MS/MSD, and LCS | All analytes must fall within established retention time window | Correct problem then reanalyze. |
| CCV | Daily, before sample analyses unless ICAL performed on same day and every 12 hours of analysis time | All analytes within $\pm 20\%$ of expected value | Reanalyze CCV. If still out, identify problem. Recalibrate and reanalyze all samples since last valid CCV. |
| Method blank | One per analytical batch | No analytes detected at or above the reporting limit. | Correct the problem, then re-prepare and reanalyze all associated samples. |
| LCS/LCSD | One LCS/LCSD per analytical batch | Within limits specified in Accuracy and Precision table. | Correct the problem, then re-prepare and reanalyze the LCS and all samples in the analytical batch. |

CCV = continuing calibration verification

ICV = initial calibration verification

LCS/LCSD = laboratory control sample/laboratory control sample duplicate

RSD = relative standard deviation

TABLE 6-25
Calibration and Quality Control Requirements for Total Organic Carbon by SM5310C
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Frequency | Acceptance Criteria | Corrective Action |
|--|--|--|--|
| Initial calibration (a blank and at least three standards) | Daily initial calibration prior to sample analysis | Least squares regression $r^2 > 0.995$. Calibration <u>MUST</u> meet acceptance criteria prior to sample analysis | Correct problem and repeat initial calibration. |
| Duplicate analysis | Each sample analyzed in duplicate with average reported | RPD $\leq 20\%$ | Repeat analysis. |
| ICV | Once for each initial calibration | All analytes within $\pm 10\%$ of expected value | Repeat ICV. If still out, identify and correct problem and repeat ICV. If still out, repeat initial calibration. |
| CCV | One per 10 samples and at the end of each batch. | All analytes within $\pm 10\%$ of expected value | Reanalyze CCV. If still out, identify and correct problem. Recalibrate, and reanalyze affected samples. All data should be bounded between compliant CCVs. |
| Method blank | One per preparation batch and analytical batch | No analytes detected at or above the reporting limit. | Correct the problem, then re-prep and reanalyze all associated samples. |
| LCS/LCSD | One LCS per preparation batch and analytical batch; LCSD if no laboratory duplicate analyzed | Within limits specified in Accuracy and Precision table. | Correct the problem, then re-prep and reanalyze the LCS and all samples in the analytical batch. |
| MS/MSD | One MS/MSD per every 20 project samples per matrix | Within limits specified in Accuracy and Precision table. | None |
| Laboratory duplicate | One per preparation batch or 1 per 20 samples, whichever is more frequent | RPD $\leq 25\%$ | Repeat analysis |

CCV = continuing calibration verification

ICV = initial calibration verification

LCS/LCSD = laboratory control sample/laboratory control sample duplicate

MS/MSD = matrix spike/matrix spike duplicate

RPD = relative percent difference

RSD = relative standard deviation

TABLE 6-26

Calibration and Quality Control Requirements for Orthophosphate by SM4500-P E and Sulfide by SM4500-S2 D*Honeywell Synertek, Quality Assurance Project Plan*

| Quality Control Check | Frequency | Acceptance Criteria | Corrective Action |
|--|---|---|--|
| Initial calibration | Daily (prior to sample analysis) | Correlation coefficient (r) ≥ 0.995 Calibration MUST meet acceptance criteria prior to sample analysis | Correct problem and repeat initial calibration. |
| ICV | Daily, immediately after calibration and before sample analysis. Must be a second source or independently prepared standard | All analytes within $\pm 15\%$ of expected value | Repeat ICV. If still out, identify and correct problem and repeat ICV. If still out, repeat initial calibration. |
| CCV | Daily, before sample analysis, after every 10 samples, and at the end of each batch | All analytes within $\pm 20\%$ of expected value | Reanalyze CCV. If still out, identify problem. Recalibrate and reanalyze all samples since last valid CCV. |
| One per preparation batch and analytical batch | No analytes detected at or above the reporting limit. | Correct the problem, then re-prepare and reanalyze all associated samples. | One per preparation batch and analytical batch |
| LCS | One per preparation and analytical batch | Within limits specified in Accuracy and Precision table. | Correct the problem, then re-prepare and reanalyze the LCS and all samples in the analytical batch. |
| MS/MSD | One MS/MSD per every 20 project samples per matrix | Within limits specified in Accuracy and Precision table. | None |

CCV = continuing calibration verification standard

ICV = initial calibration verification standard

LCS = laboratory control sample

MS/MSD = matrix spike/matrix spike duplicate

r = regression

TABLE 6-27
Calibration and Quality Control Requirements for Anions by E300.0
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Frequency | Acceptance Criteria | Corrective Action |
|-----------------------------|---|---|--|
| Initial calibration | Daily, prior to sample analysis | Correlation coefficient $r^2 \geq 0.995$ Calibration <u>MUST</u> meet acceptance criteria prior to sample analysis | Correct problem and repeat initial calibration. |
| ICV | Once for each initial calibration | All analytes within $\pm 10\%$ of expected value | Repeat ICV. If still out, identify and correct problem and repeat ICV. If still out, repeat initial calibration. |
| CCV | Every 10 samples; must be a second source or independently prepared standard. | All analytes within $\pm 10\%$ of expected value | Reanalyze CCV. If still out, identify and correct problem. Recalibrate and reanalyze CCV and all affected samples. |
| Method blank, ICB, and CCBs | One per analytical batch and per preparation batch | No analytes detected at or above the reporting limit. | Correct the problem, then re-prep and reanalyze all associated samples. |
| LCS/LCSD | One per preparation batch and per analytical batch | Within limits specified in Accuracy and Precision table. | Correct the problem, then re-prep and reanalyze the LCS and all samples in the analytical batch. |
| MS/MSD | One MS/MSD per every 20 project samples per matrix | Within limits specified in Accuracy and Precision table. | None |
| Retention time window | Every standard, sample, method blank, MS/MSD, and LCS | All analytes must fall within established retention time window | Correct problem then reanalyze. |

CCB = continuing calibration blank

CCV = continuing calibration verification

ICB = initial calibration blank

ICV = initial calibration verification

LCS/LCSD = laboratory control sample/laboratory control sample duplicate

MS/MSD = matrix spike/matrix spike duplicate

RSD = relative standard deviation

TABLE 6-28
Calibration and Quality Control Requirements for Alkalinity by SM2320B
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Frequency | Acceptance Criteria | Corrective Action |
|---|--|--|--|
| Electrode calibration | Daily | Slope = -59.2 mV/pH \pm 5 mV/pH | Correct problem and repeat initial calibration. |
| Titrant standardization (in duplicate against sodium carbonate) | Initially upon making the titrant and monthly thereafter. | RPD < 5% | Repeat standardization. |
| Standardization verification | At the end of each analytical batch, for auto titration methods. | All analytes within \pm 10% of expected value | For performance outside of acceptance criteria: <ul style="list-style-type: none"> • Reanalyze standardization verification. • If still out, identify and correct problem. • Reanalyze all samples since last valid standardization verification. |
| Method blank | One per preparation and analytical batch | No analytes detected at or above the reporting limit. | Correct the problem, then re-prepare and reanalyze all associated samples. |
| LCS/LCSD | One per preparation and analytical batch | Within limits specified in Accuracy and Precision table. | Correct the problem, then re-prepare and reanalyze the LCS and all samples in the analytical batch. |
| MS/MSD | One MS/MSD per every 20 project samples per matrix | Within limits specified in Accuracy and Precision table. | None |

LCS/LCSD = laboratory control sample/laboratory control sample duplicate

MS/MSD = matrix spike/matrix spike duplicate

TABLE 6-29
Calibration and Quality Control Requirements for TO-15 and TO-15 SIM
Honeywell Synertek, Quality Assurance Project Plan

| QC Check | Frequency | Criteria | Corrective Action |
|---|--|--|---|
| BFB Tune Check | Once per 24 hour tune window | Must meet the method tune criteria | Re-tune |
| Multi-point initial calibration (minimum five points) | Prior to sample analysis, or when calibration verification fails | %RSD of $\leq 30\%$ | Reanalyze one point or two points if six points are included in the initial calibration. Correct the problem and repeat the initial calibration. |
| Initial Calibration Verification (ICV) | Once following each initial calibration | Analytes within $\pm 30\%$ of expected value | Reanalyze. If still unacceptable, correct the problem and repeat the initial calibration. |
| CCV | At the start of each analytical sequence | Analytes within $\pm 30\%$ of expected value | Reanalyze. Correct the problem, then recalibrate and reanalyze all samples. |
| Method Blank | At least one per analytical batch | No analytes detected at or above the RL | Reanalyze. If still unacceptable, reanalyze the blank and all samples in the analytical batch. If still unacceptable, flag all associated data in the analytical batch. |
| Surrogate spike | Every standard, sample, method blank, and LCS | All surrogates in samples, method blank, and LCS within 70-130% recovery | Reanalyze. If still unacceptable, flag all associated data in the analytical batch. |
| LCS | At least one per analytical batch | Within limits specified in Accuracy and Precision table | Reanalyze. If still unacceptable, correct the problem and reanalyze the LCS and all samples in the analytical batch. If still unacceptable, flag all associated data in the analytical batch. |
| Lab Duplicate | At least one per analytical batch | Within limits specified in Accuracy and Precision table | Reanalyze. If still unacceptable, flag all associated data in the analytical batch. |

Calibration Procedures and Frequency

7.1 Field Calibration Procedures

Field equipment will be calibrated before the start of work and at the end of the sampling day. Any instrument drift from prior calibration will be recorded in the field notebook. Calibration will be in accordance with procedures and schedules outlined in the particular instrument's operations manual and the information included within the Work Plan.

Calibrated equipment will be uniquely identified by using either the manufacturer's serial number or other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment (e.g., showing the equipment identification) will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in the logbook.

Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility of using properly-functioning equipment. If an individual suspects an equipment malfunction, the device will be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel notified so that a recalibration can be performed or substitute equipment can be obtained.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of calibration. Such equipment will be repaired and satisfactorily recalibrated. Equipment that cannot be repaired will be replaced.

7.2 Laboratory Calibration Procedures

Qualified personnel will appropriately calibrate laboratory instruments prior to sample analysis. The requirements specified in each method and Section 3.2.2.3 will be followed. Only certified standards of known purity may be used for calibration. Calibration will be verified at specified intervals throughout the analysis. The frequency and acceptance criteria for calibration are specified for each analytical method in Tables 6-20 through 6-29. When multi-point calibration is specified, the concentrations of the calibration standards should bracket those expected in the samples. Samples must be diluted, if necessary, to bring analyte responses within the calibration range. The laboratory may only report those data that result from quantitation within the demonstrated working calibration range. Quantitation based on extrapolation is not acceptable. Section 3.2.2.3 addresses initial and continuing calibration requirements in greater detail.

Data Reduction, Validation, and Reporting

8.1 Laboratory Data Management

Data reduction will be performed manually or by using appropriate application software. Quantitation procedures specified for each method must be followed. If data reduction is performed manually, the documentation must include the formulas used. Any application software used for data reduction must have been verified previously by the laboratory for accuracy. Documentation of the software's verification must be maintained on file in the laboratory. All documentation of data reduction must allow re-creation of the calculations.

All data will undergo a minimum of three levels of review at the laboratory prior to release. The analyst performing the tests will initially review 100 percent of the data. After the analyst's review has been completed, 100 percent of the data will be reviewed independently by a senior analyst or by the section supervisor for accuracy; compliance with calibration, quality control requirements, and holding times; and completeness. Analyte identification and quantitation must be verified. Calibration and quality control results will be compared with the applicable control limits. Reporting limits will be reviewed to make sure they meet the project objectives. Results of multiple dilutions will be reviewed for consistency. Any discrepancies must be resolved and corrected. Laboratory qualifiers will be applied when there are non-conformances that could potentially affect data usability. These qualifiers must be properly defined as part of the deliverables. All issues that are relevant to the quality of the data must be addressed in a case narrative. The laboratory quality control manager will review a minimum of 10 percent of data or deliverables generated for this program against the project-specific requirements. A final data review will be conducted by the Laboratory Manager or Client Service Representative to ensure that all required analyses were performed on all samples and that all documentation is complete.

The hardcopy and electronic laboratory reports for all samples and analyses will contain the information necessary to perform data evaluation.

Four types of reporting deliverables may be used depending upon the DQOs of the individual project. Following is a brief synopsis of when it is appropriate to use each deliverable:

| | |
|---------|--|
| Level 1 | Appropriate for screening sample results. Non-critical project decisions are made using these data. |
| Level 2 | Appropriate for investigative samples results that will be replaced with confirmatory data or results used for disposal purposes. Less-critical project decisions are made using these data. |
| Level 3 | Appropriate for investigative, confirmatory, or closure results. Critical project decisions may be made using these data. |
| Level 4 | Appropriate for investigative, confirmatory, or closure results. Critical decisions may be made using these data and will be used for projects that require a high degree of confidence in the accuracy of the data. |

Hardcopy deliverables, in summary format, containing the necessary information to perform data evaluation/data validation are required. Reporting formats similar to those specified in the latest versions of USEPA Contract Laboratory Program Statements of Work for Organics and Inorganics Analyses are preferred (USEPA 1999, 2002). The laboratory data report will be organized in format that facilitates identification and retrieval of data. Alternate reporting formats require approval from the PC. A Level 1 will include, at a minimum (when applicable):

- Cover letter complete with:
 - Title of report and laboratory unique report identification (Sample Delivery Group Number).
 - Project name and location.
 - Name and location of laboratory and subcontracted laboratory.

- Client name and address.
- Statement of authenticity and official signature and title of person authorizing report release.
- Table of contents.
- Summary of samples received that correlates field sample IDs with the laboratory IDs.
- Laboratory qualifier flags and definitions.
- Field identification number.
- Date received.
- Date prepared.
- Date analyzed (and time of analysis if the holding time is less than or equal to 48 hours).
- Preparation and analytical methods.
- Result for each analyte.
- Dilution factor (provide both diluted and undiluted results when available).
- Sample-specific reporting limit adjusted for sample size, dilution/concentration.
- Sample-specific MDL adjusted for sample size, dilution/concentration (when project objectives require reporting less than the reporting limit).
- Units.

A Level 2 report will consist of all the elements included in a Level 1 deliverable plus:

- Case Narrative that addresses the following information, at a minimum:
 - Sample receipt discrepancies, such as bubbles in VOC samples and temperature exceedances.
 - Descriptions of all non-conformances in the sample receipt, handling, preparation, analytical and reporting processes and the corrective action taken in each occurrence.
 - Identification and justification for sample dilution.
- Surrogate percent recoveries.
- MS/MSD and LCS spike concentrations, native sample results, spiked sample results, percent recoveries, and RPDs between the MS/MSD and LCS results. Associated quality control limits must also be provided.
- Method blank results.
- Analytical batch reference number that cross references samples to quality control sample analyses.
- Executed chain of custody and sample receipt checklist.

A Level 3 report will consist of all of the elements included in Level 1 and 2 reports plus:

- Analytical sequence or laboratory run log that contains sufficient information to correlate samples reported in the summary results to the associated method quality control information, such as initial and continuing calibration analyses.
- Confirmation results.
- Calibration blank results for inorganic analyses (required in hardcopy format only).
- Internal standard recovery and retention time information, as applicable.

- Initial calibration summary, including standard concentrations, response factors, average response factors, RSDs or correlation coefficients, and calibration plots or equations, if applicable (required in hardcopy format only).
- Continuing calibration verification summary, including expected and recovered concentrations and percent differences (required in hardcopy format only).
- Instrument tuning and mass calibration information for gas chromatography/mass spectrometry and ICP/mass spectrometry analyses.
- Any other method-specific quality control sample results.

A Level 4 report will include all elements outlined above for the Level 1, 2, and 3 report formats and all of the associated raw data. It is imperative that the chromatographic and other instrument data be supplied in a scale that facilitates review from hardcopy. Sufficient “blow ups” of complex areas of sample chromatograms will be provided. Additional information to be supplied will include:

- Sample preparation logs that include the following information:
 - Preparation start and end times.
 - Beginning and ending temperatures of water baths and digestion blocks.
- Example calculation for obtaining numerical results from at least one sample for each matrix analyzed (provide algorithm).
- Reconstructed total ion chromatograms or selected ion current profiles for each sample (or blank) analyzed and mass spectra(s) for each compound identified including:
 - Raw compound spectra.
 - Enhanced or background spectra.
 - Laboratory-generated library spectra (for tentatively identified compounds provide the reference mass spectra(s) from software spectra library).

8.1.1 Hardcopy and Electronic Deliverables

Within the timeframe specified in the laboratory statement of work, contract, or purchase order from sample receipt, the laboratory will deliver hardcopy reports as specified in the laboratory Statement of Work and the electronic data in the format specified in Appendix A (or the most recent version of these requirements).

All electronic data files will match the final hardcopy results. Receipt of final hardcopy results in conjunction with submittal of electronic files is required.

All raw data will be maintained on file in the laboratory and will be available on request by project management. Complete documentation of sample preparation and analysis and associated quality control information will be maintained in a manner that allows easy retrieval in the event that additional validation or information is required. All data generated using gas chromatography/mass spectrometry must be maintained on a retrieval format and will be made available upon request. All documentation must be retained for a minimum of 10 years after data acquisition.

The primary responsibility for the implementation of these procedures within the laboratory will reside with the Laboratory Manager or equivalent. The laboratory manager will approve laboratory reports before transferring the information to the client.

8.2 Data Validation and Verification

Depending on the project-specific objectives, the analytical results of the data collection effort will be validated. In general, there will be four levels of validation employed for the program that correspond to the reports described

in Section 8.1. Levels I and II may be performed by the PC or other program team members. Level III and IV validation will always be performed by the PC or his/her designee.

| | |
|-----------|--|
| Level I | Verification that samples were analyzed for the methods requested and review of the data for outliers and anomalies. |
| Level II | Verification that samples were analyzed for the methods requested, review of the laboratory case narrative for events in the laboratory that affect the accuracy or precision of the data, review of quality control indicator data and a “reasonableness” review of the data. |
| Level III | Validation of the analytical data as described below without review of any raw data or analyte verification. |
| Level IV | Validation of the analytical data will be performed as described below, including review of the analytical raw data. |

8.2.1 Level II, III and IV Validation Procedures

Personnel involved in the data validation function will be independent of any data generation effort. The PC will have responsibility for oversight of the data validation effort. Data validation will be carried out when the data packages are received from the laboratory. It will be performed on an analytical batch basis using the summary results of calibration and laboratory quality control, as well as those of the associated field samples. Data packages will be reviewed for all constituents of concern. Raw data will be reviewed when deemed necessary by the PC. Level II data validation will most often be performed and the data validation procedures will include:

- A review of the data set narrative to identify any issues that the lab reported in the data deliverable;
- A check of sample integrity (sample collection, preservation, and holding times);
- An evaluation of basic QC measurements used to assess the accuracy, precision and representativeness of data including QC blanks, LCS, MS/MSD, surrogate recovery when applicable, and field or laboratory duplicate results.
- A review of sample results, target compound lists, and detection limits to verify that project analytical requirements are met.
- Initiation of corrective actions, as necessary, based on the data review findings.
- Qualification of the data using appropriate qualifier flags, as necessary, to reflect data usability limitations.
- For air samples, review of the canister vacuums throughout the sampling and laboratory receipt process to determine if any leakage occurred.
- For air samples, review of the canister certifications to verify equipment cleanliness.

Level II validation may be performed using the automated data validation tool in the project database. The Level II Data Validation SOP describes Level II validation procedures and instructions for using the automated validation tool.

Level III validation procedures will also include review of;

- Evaluation of calibration and quality control summary results against the project requirements.
- Other method specific QC requirements

Level IV validation will include a review of sample chromatograms and,

- Verification of analyte identification and calculations for at least 10 percent of the data.

Data validation will be patterned after the USEPA *Contract Laboratory National Functional Guidelines for Inorganic Data Review* (2002) and *Contract Laboratory National Functional Guidelines for Organic Data Review* (1999),

substituting the calibration and quality control requirements specified in this QAPP for those specified in the Guidelines. The flagging criteria in Tables 8-1 and 8-2 will be used.

8.2.2 Data Validation Qualifiers and Reasons

Qualifier flags, if required, will be applied to the electronic sample results. If multiple flags are required for a result, the most severe flag will be applied to the electronic result. The hierarchy of flags from the most severe to the least severe will be as follows: R, UJ, U, and J. The qualifier flags are defined in Table 8-3.

Validation reasons must be applied to all results qualified. Reason codes are defined in Table 8-4.

8.3 Data Quality Assessment and Usability

All data generated for this project will be evaluated according to the quality assurance acceptance criteria specified in Tables 6-11 through 6-29. Limitations on data usability will be assigned, if appropriate, as a result of the validation process described in this section.

TABLE 8-1

Flagging Conventions for Organic Methods

Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Evaluation | Flag | Samples Affected |
|---|--|---|-------------------------------|
| Holding Time | Holding time exceeded for extraction or analysis | J positive results UJ non-detects | Affected samples |
| | Holding time exceeded for extraction or analysis by a factor of two | J positive results R non-detects | Affected samples |
| Temperature | temperature exceedance >10C if received within 24 hr temperature exceedance >6C if received > 24 hr | J positive results UJ non-detects | Affected samples |
| Sample Integrity (volatiles) | Professional Judgment on sample condition | J positive results/professional judgment | Affected samples |
| | Example: Bubbles in VOA vial used for analysis or leaking air canister | UJ or R non-detects/professional judgment | |
| GC/MS Instrument Performance Check | Mass assignment in error and laboratory cannot reprocess data | R all results | All samples in batch |
| | Ion abundance criteria not met | R all results if critical ions involved, use judgment otherwise | All samples in batch |
| Initial Calibration | RRF <0.050 (0.01 for poor performers) | J positive results UJ non-detects | Analyte in associated samples |
| | %RSD > 30% for CCCs or >15% for all other analytes and no calibration curve used or linear calibration curve used and R2 < 0.995 | J positive results UJ non-detects | Analyte in associated samples |
| Continuing Calibration Verification (Second Source and CCV) | RRF <0.050 (0.01 for poor performers) | J positive results UJ non-detects | Analyte in associated samples |
| | % difference or % drift >UCL with high recovery | J positive results | Analyte in associated samples |
| | % difference or % drift >UCL with low recovery | J positive results UJ non-detects | Analyte in associated samples |

TABLE 8-1
Flagging Conventions for Organic Methods
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Evaluation | Flag | Samples Affected |
|-----------------------|--|--|-------------------------------------|
| LCS/LCSD | %R >UCL | J positive results | Analyte in associated samples |
| | RPD >UCL | J positive results | Analyte in associated samples |
| | %R <LCL but >10% | J positive results UJ non-detects | Analyte in associated samples |
| | %R <LCL but <10% | J positive results R non-detects | Analyte in associated samples |
| Retention Time | Analyte outside of retention time window | J positive results UJ non-detects Use professional judgment for R flags | Analyte in associated samples |
| Method Blank | multiply highest blank value by 5 (by 10 for common lab contaminants) | U positive results < 5 x highest blank concentration (<10 x for common contaminants) | All associated samples in batch |
| Equipment Blank | multiply highest blank value by 5 (by 10 for common lab contaminants) | U positive results < 5 x highest blank concentration (<10 x for common contaminants) | All associated samples in batch |
| Trip Blank | Multiply highest blank value by 5 (by 10 for common lab contaminants) | U positive results < 5 x highest blank concentration (<10 x for common contaminants) | All associated samples in batch |
| MS/MSD | %R >UCL | J positive results | Associated analyte in parent sample |
| | %R <LCL but >10% | J positive results UJ non-detects | Associated analyte in parent sample |
| | %R <LCL but <10% | J positive results R non-detects | Associated analyte in parent sample |
| | RPD >UCL | J positive results | Associated analyte in parent sample |
| Surrogates | %R >UCL | J positive results | Associated analytes in sample |
| | %R <LCL but >10% | J positive results UJ non-detects | Associated analytes in sample |
| | %R <LCL but <10% | J positive results R non-detects | Associated analytes in sample |
| Internal Standards | Area > UCL | J positive results UJ non-detects | Associated analytes in sample |
| | Area < LCL | J positive results | Associated analytes in sample |
| Laboratory Duplicates | Both sample results >5 times RL and RPD>UCL | J positive results | Laboratory duplicate pair |
| | One or both samples <5 times RL and a difference between results of + 2 times RL | J positive results UJ non detects | Laboratory duplicate pair |
| Field Duplicates | Both sample results >5 times RL and RPD>UCL | J positive results | Field duplicate pair |
| | One or both samples <5 times RL and a difference between results of + 2 times RL | J positive results UJ non detects | Field duplicate pair |

TABLE 8-2
Flagging Conventions for Inorganic Methods
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Evaluation | Flag | Samples Affected |
|-----------------------|--|--|-------------------------------------|
| Holding Time | Holding time exceeded for extraction or analysis | J positive results UJ non-detects | Affected samples |
| | Holding time exceeded for extraction or analysis by a factor of two | J positive results R non-detects | Affected samples |
| Temperature | Temperature exceedance >10C if received within 24 hrs) | J positive results UJ non-detects | Affected samples |
| | Temperature exceedance >6C if received > 24 hr) | | |
| Sample Preservation | Sample not preserved properly (no flagging required if preserved upon arrival at laboratory) | J positive results UJ non-detects | Affected samples |
| Initial Calibration | %RSD > 20% (RSK175 only) | J positive results UJ non-detects | Analyte in associated samples |
| | R ² < 0.995 | J positive results UJ non-detects | Analyte in associated samples |
| ICV and CCV | % difference or % drift >UCL with high recovery | J positive results | Analyte in associated samples |
| | % difference or % drift >UCL with low recovery | J positive results UJ non-detects | Analyte in associated samples |
| LCS/LCSD | %R >UCL | J positive results | Analyte in associated samples |
| | RPD >UCL | J positive results | Analyte in associated samples |
| | %R <LCL but $\geq 10\%$ | J positive results UJ non-detects | Analyte in associated samples |
| | %R <LCL but $\leq 10\%$ | J positive results R non-detects | Analyte in associated samples |
| Retention Time | Analyte outside of retention time window | J positive results UJ non-detects Use professional judgment for R flags | Analyte in associated samples |
| Method Blank | Multiply highest blank value by 5 | U positive results < 5 x highest blank concentration (<10 x for common contaminants) | All associated samples in batch |
| Equipment Blank | Multiply highest blank value by 5 | U positive results < 5 x highest blank concentration (<10 x for common contaminants) | All associated samples in batch |
| MS/MSD | %R >UCL | J positive results | Associated analyte in parent sample |
| | %R <LCL but $\geq 10\%$ | J positive results UJ non-detects | Associated analyte in parent sample |
| | %R <LCL but $\leq 10\%$ | J positive results R non-detects | Associated analyte in parent sample |
| | RPD >UCL | J positive results | Associated analyte in parent sample |
| Laboratory | Both sample results >5 times RL and RPD>UCL | J positive results | Laboratory duplicate pair |

TABLE 8-2
Flagging Conventions for Inorganic Methods
Honeywell Synertek, Quality Assurance Project Plan

| Quality Control Check | Evaluation | Flag | Samples Affected |
|-----------------------|--|--------------------------------------|---------------------------|
| Duplicates | One or both samples <5 times RL and a difference between results of ± 2 times RL | J positive results | Laboratory duplicate pair |
| | | UJ non detects | |
| Field Duplicates | Both sample results >5 times RL and RPD>UCL | J positive results | Field duplicate pair |
| | One or both samples <5 times RL and a difference between results of ± 2 times RL | J positive results UJ non detects | Field duplicate pair |

TABLE 8-3
Qualifier Flag Definitions
Honeywell Synertek, Quality Assurance Project Plan

| Flag | Definition |
|------|---|
| J | Analyte was present but reported value may not be accurate or precise. |
| R | This result has been rejected. |
| U | This analyte was analyzed for but not detected at the specified detection limit. |
| UJ | The analyte was not detected above the detection limit objective. However, the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. |

TABLE 8-4
Validation Qualifier Reason Codes
Honeywell Synertek, Quality Assurance Project Plan

| Reason | Definition |
|--------|---|
| ABH | Ambient blank concentration greater than the RL |
| ABL | Ambient blank concentration less than the RL |
| Bubble | Bubbles in VOA vials |
| CCBH | Continuing calibration blank concentration greater than the RL |
| CCBL | Continuing calibration blank concentration less than the RL |
| CCC | Calibration check compound failed method criteria |
| CCRRF | Continuing calibration relative response factor less than lower control limit |
| CCVH | Continuing calibration verification recovery greater than upper control limit |
| CCVL | Continuing calibration verification recovery less than lower control limit |
| CCV | Continuing calibration verification outside limit |
| CFP | Confirmation dual column precision exceeded |
| CO | Coelution |
| EBH | Equipment blank concentration greater than the RL |
| EBL | Equipment blank concentration less than the RL |
| EMPC | Estimated maximum possible concentration |
| FBH | Field blank concentration greater than the RL |
| FBL | Field blank concentration less than the RL |

TABLE 8-4
Validation Qualifier Reason Codes
Honeywell Synertek, Quality Assurance Project Plan

| Reason | Definition |
|--------|--|
| FD | Field duplicate exceeds RPD criteria |
| HTA | Analytical Holding Time exceeded |
| HTP | Preparation Holding Time exceeded |
| HTG | Holding time for prep or analysis grossly exceeded |
| ICBH | Initial calibration blank concentration greater than the RL |
| ICBL | Initial calibration blank concentration less than the RL |
| ICR2 | Initial calibration exceeded the R2 for the first order regression |
| ICRRF | Initial calibration relative response factor less than lower control limit |
| ICRSD | Initial calibration RSD exceeded |
| ICSH | Interference check sample recovery greater than upper control limit |
| ICSL | Interference check sample recovery less than lower control limit |
| ICVRRF | Initial calibration check relative response factor less than lower control limit |
| ICVSH | Initial calibration verification recovery greater than upper control limit |
| ICVSL | Initial calibration verification recovery less than lower control limit |
| ICV | Initial calibration linearity outside limit |
| INT | Interference during analysis |
| ISH | Internal standard response exceeded upper control limit |
| ISL | Internal standard response exceeded lower control limit |
| LBH | Laboratory blank contamination greater than the RL |
| LBL | Laboratory blank contamination less than the RL |
| LCSDH | LCSD recovery greater than criteria |
| LCSDL | LCSD recovery less than the criteria |
| LCSH | LCS recovery greater than criteria |
| LCSL | LCS recovery less than the criteria |
| LCSP | LCS/LCSD RPD criteria exceeded |
| LDP | Laboratory Duplicate Precision out |
| LR | Concentration above linear calibration range |
| MSDH | Matrix spike duplicate recovery criteria greater than the upper limit |
| MSDL | Matrix spike duplicate recovery criteria less than the lower limit |
| MSDP | Matrix Spike Duplicate RPD criteria exceedance |
| MSH | Matrix spike recovery criteria greater than the upper limit |
| MSL | Matrix spike recovery criteria less than the lower limit |
| PEL | Performance evaluation sample reported below limits |
| PEH | Performance evaluation sample reported above limits |
| PEM | Performance evaluation mixture recovery outside limit (pesticides) |
| PEMD | Performance evaluation mixture degradation exceeds limit (pesticides) |
| PEMR | Performance evaluation mixture resolution outside limit (pesticides) |
| PH | Sample pH out. Not properly preserved |
| PM | Sample percent moisture exceeds EPA guideline |
| PSH | Post spike recovery greater than upper control limit |
| PSL | Post spike recovery less than lower control limit |
| QLSH | Quantitation Limit Standard recovery above limits |

TABLE 8-4
Validation Qualifier Reason Codes
Honeywell Synertek, Quality Assurance Project Plan

| Reason | Definition |
|--------|---|
| QLSL | Quantitation Limit Standard recovery less than limits |
| RCM | Resolution check mixture requirement not met (pesticides) |
| RE | Sample was re-extracted and reanalyzed |
| RT | Result is outside the laboratory determined retention time window |
| SDIL | Serial dilution RPD exceeds the upper control limit |
| SP | Sample preservation/collection does not meet method requirement |
| SPCC | SPCC failure |
| SSH | Surrogate recovery greater than upper control limit |
| SSL | Surrogate recovery less than lower control limit |
| SSR | Surrogate spike recovery <10% |
| TBH | Trip blank concentration greater than the RL |
| TBL | Trip blank concentration less than the RL |
| TD | Total concentration less than dissolved concentration |
| TEMP | Cooler temperature out upon arrival |
| TIC | Tentatively indentified compound |
| TN | GC/MS tune does not meet criteria |
| X-DL | Data not used due to dilution, another value is more appropriate |
| XLCS | No LCS in analytical batch. |
| X-RE | Data not used due to re-analysis, another value is more appropriate |

Performance Evaluations

To assess sample and data collection procedures, performance evaluations will be conducted and will consist of technical systems audits and performance audits.

9.1 Technical Systems Audits

9.1.1 Laboratory Audits

The laboratories participating in the data collection effort will have been pre-qualified by Honeywell and the project team. Honeywell maintains a surveillance audit program that requires technical systems audits to be performed on a defined basis. Laboratory pre-qualification and the surveillance audits may also be undertaken by the regulatory agencies. Laboratory pre-qualification audits may be performed as either onsite audits, desk audits, or a combination of both.

9.1.2 Field Audits

Field audits will be performed once a year to verify the execution of field procedures. Procedures to be evaluated include:

- Sample containers and preservatives
- Sample collection and identification procedures
- Sample custody, handling, and shipping procedures
- Equipment decontamination procedures
- Calibration of field instruments and performance of field tests
- Documentation of field activities, maintenance of field records, and document control

9.2 Performance Audits

9.2.1 Performance Evaluations

Laboratories are required to participate in a performance evaluation program. Any method or analyte failure in a performance evaluation program that affects the certification status of the laboratory with the NELAP or the State of California must be immediately communicated to the PC.

9.2.2 External Audits

Announced and unannounced audits of the field operations and of the laboratories may be conducted during any stage of the project.

9.2.3 Internal Audits

Annual audits of the laboratory will be conducted by the laboratory's quality assurance officer. The audits will verify, at a minimum, that written SOPs are being followed; standards are traceable to certified sources; documentation is complete; data review is being performed effectively and is properly documented; and data reporting, including electronic and manual data transfer, is accurate and complete. All audit findings will be documented in quality assurance reports to management. Necessary corrective actions will be taken within a reasonable time frame. The quality assurance officer will verify that such actions are effective and complete and will document their implementation in an audit closeout report to management.

Preventive Maintenance

The primary objective of a preventive maintenance program is to promote the timely and effective completion of a measurement effort. The maintenance program will be designed to minimize the downtime of crucial sampling and/or analytical equipment from expected or unexpected component failure. In implementing this program, efforts will be focused in:

- Establishing maintenance responsibilities
- Establishing maintenance schedules for major and/or critical instrumentation and apparatus
- Establishing an adequate inventory of critical spare parts and equipment

10.1 Maintenance Responsibilities

Laboratory instrument maintenance is the responsibility of the participating laboratory. Generally, the Laboratory Manager or Supervisor is responsible for the instruments in his or her work area. This responsible person will establish maintenance procedures and schedules for each instrument.

Maintenance responsibilities for field equipment are assigned to the FTL for specific sampling tasks. However, the field team using the equipment is responsible for checking the status of the equipment prior to use and reporting any problems encountered. The field team is also responsible for ensuring that critical spare parts are included as part of the field equipment checklist. Non-operational field equipment will be removed from service, and a replacement will be obtained. All field instruments will be properly protected against inclement weather conditions during the field investigation.

10.2 Maintenance Schedules

The effectiveness of any maintenance program depends, to a large extent, on adherence to specific maintenance schedules for each piece of equipment. Other maintenance activities are conducted as needed. Manufacturers' recommendations should provide the primary basis for establishing maintenance schedules. Manufacturers' service contracts may be used for implementing the scheduled maintenance.

Each analytical instrument will be assigned an instrument logbook. All maintenance activities will be documented in this logbook. The logbook should contain:

- Date of service
- Person performing service
- Type of service performed and reason for service
- Replacement parts installed (if appropriate)
- Date of next scheduled service
- Any other useful information

10.3 Spare Parts

In addition to a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. The inventory includes those parts and supplies that:

- Are subject to frequent failure
- Have limited useful lifetimes
- Cannot be obtained in a timely manner should failure occur

Field managers and the respective laboratory managers are responsible for maintaining an adequate inventory of spare parts. In addition to spare parts and supply inventories, an in-house source of backup equipment and instrumentation will be available.

Corrective Action

Corrective action may be required as a result of deviations from field or analytical procedures. Deficiencies identified in audits and data quality evaluations may also call for corrective action. All project personnel have the responsibility, as part of the normal work duties, to identify, report, and solicit approval of corrective actions for conditions adverse to data quality.

This QAPP has specified the corrective action to be taken when deviations from calibration and quality control acceptance criteria occur. These are listed in Tables 6-20 through 6-29. Field and laboratory staff may encounter conditions that require immediate corrective action that are not addressed in the Work Plan or QAPP. These personnel will document conditions and the results of corrective actions in a field logbook or laboratory non-conformance report and communicate their actions as soon as feasible to the FTL, Laboratory Supervisor, and if necessary, the PC, for immediate input. A mechanism must be established to allow for supervisory review and/or client input for all deviations or deficiencies. A corrective action reporting system that requires immediate documentation of deviations or deficiencies and for supervisory review of the actions taken to correct them will be established. At a minimum, the corrective action report should include:

- The type of deviation or deficiency
- The date of occurrence
- The impact of the deviation or deficiency, such as samples affected
- The corrective action taken
- Documentation that the process has been returned to control

The only time that a corrective action report may be waived is when a deviation or deficiency is immediately corrected and its impact is precluded. An example would be an unacceptable initial calibration that is correctly calibrated before samples are analyzed.

Each corrective action report must be reviewed and approved by a person of authority, such as the FTL or Laboratory Supervisor. The ultimate responsibility for the laboratory corrective action process is the Quality Control Manager, who must ensure that proper documentation, approval, and close out of all out-of-control or non-conformance events is performed. A non-conformance report will summarize each non-conformance condition. Corrective action reports that could potentially affect data quality must be brought to the attention of the PC. Report disposition will be the responsibility of the PC. The PM may be notified about a particular report at the PC's discretion. Copies of corrective action reports must be maintained in the laboratory or field project files.

SECTION 12

Data Quality Reports

A data quality report will be submitted by the PC to the PM at the end of each sampling interval. The report will summarize the results of the data validation and the data assessment. The results will be presented in a manner that facilitates decision making. Any significant quality problems and recommended solutions will be included in the report. Limitations on data usability that were identified during data validation will be highlighted.

Data Management

The electronic data will be used to generate validation reports, risk assessment calculations, modeling results, data summary tables, maps, and other figures. This program will follow CH2M HILL standard procedures for environmental data collection. All environmental data collected for the program will follow the policies, procedures, and protocols as required in the *Honeywell Program Data Management Plan*. These protocols give data users simple procedures to rapidly access stored data; ensure consistency among all field activities; provide methods of data entry with known accuracy and efficiency; apply well-documented validation procedures to an electronic database; manage sample data using unique sample identification numbers; establish a sample inventory of new data collected and provide methods of sample inventory reconciliation; store and provide sample-specific attributes, including location identifiers, sample type and media, and sample date; and provide reporting and delivery formats to support data analysis and reduction.

13.1 Archiving

Hardcopy and electronic versions will be archived in project files and on electronic archive tapes for the duration of the project, 10 years, or as specified in contractual agreements.

13.2 Data Flow and Transfer

The data flow from the laboratory and field to the project staff and data users will be sufficiently documented to ensure that data are properly tracked, reviewed, and validated before use.

13.3 Record Keeping

In addition to the data management procedures outlined in Section 7.1 for analytical data, the laboratory will ensure that they maintain electronic and hardcopy records sufficient to recreate each analytical event. The minimum records the laboratory will keep contain the following:

- Raw data, including instrument printouts, bench work sheets, and/or chromatograms with compound identification and quantitation reports.
- Laboratory-specific written SOPs for each analytical method and QA/QC function in place at the time of analysis of project samples.
- Record keeping requirements for non-analytical data are included in the *Honeywell Program Data Management Plan*.

SECTION 14

References

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**Attachment D1
Laboratory Electronic Data Deliverable
Requirements**



Analytical and Environmental Services, Inc.
503 Oakdale Avenue
Glencoe, Illinois 60022
e-mail: renesurgi@aol.com

847.835.0983

facsimile 847.835.9404

Date: April 5, 2006

To: Honeywell Analytical Laboratory Partners

From: Rene Surgi

CC: Chris French

RE: Honeywell EDD Specifications

I. Introduction

As many of you may know, Honeywell adopted its original standard Electronic Data Deliverable (EDD) format for use with Locus Technologies' (www.locustec.com) EIM™ environmental data management system on August 31, 2003. Honeywell selected this standardized approach to increase process efficiencies and reduce overall data management costs. The standard EDD will allow Honeywell to:

- Standardize electronic data validation and reduce the cost excepting selected aspects of all but the highest levels of validation (i.e., level 4);
- View the data immediately after upload to EIM™;
- Locate data with simple queries rather than having to sort through voluminous hardcopies;
- Locate past experiences and results to extrapolate to future project planning.

Honeywell is replacing this original 42-field EDD (**EIM**) with EIM53 that has 11 additional key fields. For laboratories submitting electronic data to California, and following the Geotracker EDF format, there will be a separate EDD called EIMEDF. EIMEDF is required for CA submissions only. A summary is provided below.

Table 1. Summary of Honeywell Database Formats

| Format | # Fields | Effective Date |
|---------------|-----------------|--|
| EIM | 42 | Current. Replaced by EIM53 by May 15, 2006. |
| EIM53 | 53 | Effective on May 15, 2006. |
| EIMEDF | 64 | Effective on May 15, 2006. Required for CA submissions only. |

For the Honeywell standard EDD process to work effectively, it is essential to enter unambiguous information in the Honeywell EDDs, which will be uploaded to EIM™. This memo specifies the laboratory and consultant responsibilities to provide correct and timely uploads to EIM. To this end we are providing rigorously defined data fields, format, content and required QC. These instructions are designed to eliminate problems associated with EDD production, eliminate errors in the data and upload process, and ensure seamless operations for future data handling.

The following sections:

- Outline Honeywell’s requirements for the Honeywell Standard EDD;
- Provide a method for laboratories to self-test EDDs for acceptability; and
- Include a laboratory certification of ability to comply with the requirements set forth herein.

For your convenience, all of the referenced tables are presented at the end of the document. Electronic data files are also included with this distribution to aid in adapting to laboratory LIMs systems. Generally, there are a maximum of 64 fields – up from the 42 fields for the previous EDD. You will also see shaded fields (#54 - #64). These fields are required, as indicated, only for those labs that are required to produce the CA Geotracker EDF. If you are producing a report for submission to CA, this EDF is a requirement. Both your Geotracker EDF and your Honeywell EIM EDD requirements will be satisfied by the production of this single EDD. Two EDDs will no longer be required. Information and pertinent locations of critical valid values are summarized in Table 2 below.

Table 2. Summary of Valid Value Files and Locations

| Description | Status (Locked/ Supervised) | Location (on EIM Server) | File Name (attached hereto and on EIM Server) THIS FILE HAS FIVE SHEETS | EIM Fields Affected (Field Number and Field Name) |
|--|-----------------------------|--|---|---|
| CAS # | Locked | Any site specific data base to which lab has access. | LabID_Methods_Parameter Codes 02-24-06 1213.xls | #5 [PARAMETER_CODE] |
| Parameter names & codes (parameters without CAS#s) | Supervised | Any site specific data base to which lab has access. | LabID_Methods_Parameter Codes 02-24-06 1213.xls | #5 [PARAMETER_CODE] |
| Laboratory IDs | Locked | Any site specific data base to which lab has access | LabID_Methods_Parameter Codes 02-24-06 1213.xls | #2 [LAB_ID] |
| Method codes | Locked | Any site specific data base to which lab has access | LabID_Methods_Parameter Codes 02-24-06 1213.xls | #3 [ANALYTICAL_METHOD] |

Locked means that no deviation will be acceptable – the EIM Data Checker will give an error, the lab will be unable to upload and the lab must make the repair. The lab is ultimately responsible for updating all associated reports (i.e. particularly the hardcopy). **Supervised** means that an alternative may be used ONLY IF THERE IS NOT A VALID VALUE already listed. The data management team will tentatively review laboratory submitted valid values. AESI will review laboratory submissions from labs/data managers prior to final upload to EIM and accept or reject laboratory proposals. The timing of AESI review will not affect your turnaround time calculations as regards deliverables.

The general changes from the previous EDD can be summarized as follows.

- a) Fields #1 - #45, #53: Generally similar with some minor changes over last edition;
- b) Fields #46 - #50: TAT, confirmation of rush charges, on-time delivery metrics;
- c) Fields #51 - #52: Tracks subcontracting laboratories;
- d) Fields #54 - #64: CA Geotracker EDF fields (labs submitting CA packages only).

II. Honeywell EDD Requirements

A. Implementation Date

All laboratories providing data to Honeywell will be required to submit analytical results in the Honeywell EDD format as indicated in Table 1 beginning May 15, 2006. There are no exceptions to the laboratories' requirements to provide EIM Electronic Data Deliverable, unless written authorization is provided by Honeywell.

B. Required QC

All EDDs are required to contain the applicable QC that are necessary for EIM™ to validate the electronic dataset. Table 4 contains the list of QC valid values that EIM™ uses to validate uploaded analytical data files. Table 3 contains the list of required fields that are to be included in Honeywell EDDs. The shaded fields are only required for those labs submitting data subject to the Geotracker EDD format requirements.

Honeywell requires analytical laboratories to report any QC parameter in hardcopy that is reported electronically although the hardcopy may contain QC parameters that are not reported electronically (i.e. calibration and tuning information). For those common fields, the hardcopy QC and hardcopy analytical result must be identical with the EDD in every respect for all deliverables.

Data are to be batched for analytical preparation in groups of, at most, 20 field samples. Honeywell is requiring the laboratory to have, at a minimum, all project-required QC for every batch – even if the batch consists of one sample.

The Honeywell Laboratory Services Contract requires analyses of a Honeywell specific MS/MSD at no additional charge to Honeywell if the batch contains at least 10 Honeywell samples. If there is insufficient sample, a batch MS/MSD must be reported to Honeywell – at no additional charge. “Batch QC” means the QC that was part of the same digestion batch, digested at the same time as the samples to which it is applicable and not a QC sample prepared on a different day or as part of a different digestion batch. If your LIMS limitations prevent your lab from reporting batch QC (i.e. non Honeywell samples as MS/MSD) with the Honeywell EDD, you must use a Honeywell specific MS/MSD at no additional charge to Honeywell.

C. EDD Format Requirements

To facilitate data loading, the following electronic file formats must be observed:

- The file format must be ASCII with no header or footer, and with each record alike with respect to format.
- Every analytical result is to be a single record.
- No field will be enclosed in quotation marks.

- Every field must be separated by a semi-colon (a comma must not be used – owing to its frequent appearance in chemical names).
- Each record must be terminated with a carriage return (except the last record).

D. Example Acceptable ASCII Files

The example below shows an excerpt from an acceptable ASCII file in semicolon-delimited form. Note that this example has 64 fields – each separated by the semicolon - that directly corresponds to those fields identified in Table 3. Note also that Fields #54 - #64 are unique to labs submitting packages in accordance with CA

```
1298901;CTBERK;SW8260;11/11/2005;67-64-1;TRG;10;ug/l;10;WATER;161723-
001;22:37;U;;1;SW5030;11/10/2005;76742;2.5;
g;wet;161723;QC195469;;Acetone;INIT;N;N;;;;;;2;;REG;;;;;;;11/9/2005;10:25;11/25/20
05;N;11/28/2005;;;WET;;;161732;N;PR;CS1;PQL;;;NA <carriage return>
```

Shaded fields (#54 - #64) are Geotracker requirements (CA only).

Geotracker requirements. Also note that there is no semicolon after the 64th field as the record is ended with a carriage return. This represents one record or one sample from the ASCII file (EIM_Example_EDD64.txt) supplied along with this memo. Note that fields #53 and #64 are required fields.

In instances where a CAS number does not exist, Honeywell has defined the nomenclature that must be used. Those definitions are attached to this memo in Excel file named “Lab ID_Method_Parameter Codes 02-24-06 1213.xls”. In the future, this file will be available for downloading from the Locus web site and can be distinguished by its time (1213) and date (02-24-06) stamps. The remaining parameters should have CAS numbers. It is the laboratory’s responsibility to supply the correct CAS number.

E. Handling of Historical Data

Some portion of the EDDs requested by Honeywell will be termed “historical” indicating that these analyses have already been completed by the laboratory. For laboratories where historical data are being requested, Honeywell will provide a specific memo with instructions on how this exercise will be handled, as we understand that historical data may involve a reasonable amount of repair.

F. Handling of Future Data

Samples submitted and EDDs delivered after the date of this EIM™ EDD implementation will require this nomenclature and data format. Honeywell requires laboratories produce EDDs that are consistent and error-free and must be uploaded to the site specific holding table, by the lab on or before the due date. Failure to upload and error-free EIM EDD by the due date may result in penalties as specified in your Master-Service Agreement with Honeywell. The process is described below for labs uploading the EIM EDD to the holding table for the site specific database, obtaining and error report and sending an email indicating such to the parties as stipulated below.

G. Common EDD Errors to Avoid and the Role of the Consultant

There are some data that the laboratory will have and some data that the consultant will have. The laboratory will, for example have the results, method names and QC, while the consultant will have the field data such as location ID and field sampling point. The instrument to link these important sets of information is the chain of custody

(COC). The COC will provide the link between the sample ID and the lab ID – as it does now. There are two electronic COC possibilities: a) the Sample Planning Module in Locus EIM and b) the E-COC (maintained by AESI). Both provide electronic COCs with standard fields (for field information) that can be uploaded to EIM electronically. The E-COC outputs a text and an Excel file that can be used for electronic log-in by the laboratory, saving time associated with manual log-in and subsequent correction of transcription errors.

When entering data, it is important to remain consistent. The most common requirements that are often overlooked in the assembly of the EDD ASCII file are:

- 1. First row header problems** - There should be no header in the first row.
- 2. Use of quotes** - Do not use quotes (this sometimes occurs if the EDD is produced from an Access data base).
- 3. Using comma as a delimiter** - Do not use a comma delimiter – a **semicolon is required**.
- 4. Improper reporting of a non-detect** - If the analytical result is non-detect (ND) at the laboratory MDL – put the laboratory reporting limit in this field – Field #7. If the result is between the MDL and the RL, report the result and use a “J” flag (EIM Field #13).
 - a) A “U” (EIM Field #13) is used for results below the MDL and a “J” (EIM Field #13) for results between the MDL and RL (with the actual result entered into EIM Field #7).**
 - b) If the result is below the MDL, the RL goes into EIM Field #7, even though we estimate to the MDL.**
 - c) Note that Fields #7 (RESULT), #13 (QUALIFIER), #9 (REPORTING LIMIT) and #35 (METHOD DETECTION LIMIT) work together.**
 - d) In some cases, labs may be required to report only to the RL and not the MDL so a result under the RL, but above the MDL would be destined as “U” instead of a “J” (EIM Field #13) in these cases.**
- 5. Inconsistent valid values** - Honeywell has established a list of required valid values for both data qualifiers and analyte names (in cases where no CAS number exists). These valid values are provided in an Excel file (Lab ID_Method_Parameter Codes 02-24-06 1213.xls) that accompanies this memo and can be filtered. From time to time, these valid values will require updates. The updates will be posted in EIM and will be accessible through your EIM Data Checker window using your lab name and password. Usually these valid value updates provide new values and rarely, if ever, will affect previous valid values. The file name will contain the time and date stamp, following the structure of the name above.
- 6. The EIM field #1: FIELD_SAMPLE_ID** – The consultant, not the lab, must independently complete this prior to the EDD being checked/uploaded by the lab. This is one of the first things a consultant must do to preserve the efficiency of using the EIM database. If not done in this sequence, errors will be significant and numerous. Since this is the responsibility of the consultant, it will not be counted against the laboratory EDD. It is our intent to remove from the Laboratory EIM Error Summary those errors not attributable to the lab.
- 7. Combining qualifiers and other valid values.** Do not combine valid values. Unless the combination is explicit in EIM – the combination will generate an error message “Entry not in the list of valid values”. One example is the combination of “J” and “B”. We have added “BJ” explicitly as a valid value. If you were to combine these to form “BJ”, without this explicit addition to EIM, you would receive the error message concerning the valid value entry not in the list. If a valid value is not on the list and you feel you require it, discuss it with your data managers. If the problem persists, or no valid value can be located, contact Rene Surgi (847-835-0983 or renesurgi@aol.com) so it can be added.

8. Dissolved analytes. When analyzing for dissolved and/or total analytes, please include the adjective “dissolved” in the parameter name (EIM Field #25); (i.e. Iron, dissolved; use the proper CAS # for iron) and BE CERTAIN THAT THE FILTERED FLAG (EIM Field # 27) IS SET TO “Y”.

9. Volatile analytes. There are two instances in which volatile analytes are at issue: a) the measurement of volumetric analytes (i.e. those analytes whose concentrations are measured in volumetric units (ug/m³)) and b) those analytes measured as part of a method known as AVS-SEM (acid volatile sulfides-simultaneously extractable metals). In both of these cases, add a “V” to the CAS# or pseudoCAS # in Parameter Code (EIM Field #5). For example iron, analyzed ancillary to the AVS-SEM, protocol would post a CAS # of 7439-89-6V and benzene analyzed by an EPA TO method would post a CAS# of 71-43-2V.

H. Valid Values

As indicated above, Honeywell has identified a set of standard valid values for laboratories to follow. These include use of CAS numbers when they exist; use of Honeywell defined valid values when CAS numbers do not exist, method codes and a list of standard data qualifiers. All of these valid values are included with this memo and the current list can be found in EIM [[Locus > Reference > EIM Reference > Client Specific SOPs > LabID_Methods_ParameterCodes 02-24-06 1213.xls](#)] Remember, updates (designated by the date (02-24-06 and time stamp (1213)) will add new valid values and rarely change the previous ones. Honeywell may be adding Laboratory Qualifiers from time to time to make for a more comprehensive validation and to make the EDD more acceptable to regulatory agencies. Honeywell will not actively communicate these changes to the laboratories and consultants as they are developed, but they will be reviewed monthly and the updates posted on EIM. They will be accessible simultaneously to all the labs through their respective EIM Data Checker windows. Valid values are of two types: locked and supervised.

- Locked means that deviations cannot be uploaded – the lab will get an error message in instances where deviations are used.
- Supervised means labs may select alternates as long as a suitable valid value does not exist in the current valid value list.

The current valid value list must be consulted first, prior to using a valid value not in the current list. Selection of new valid values alternatives is to be only an occasional happenstance and does not take the place of judicious searching for suitable valid values. If the adaptation of a valid value is in question contact your data managers. AESI (847-835-0983; renesurgi@aol.com) can provide clarification of any new valid value(s) should the need arise. The consultant may correct only nominal errors – those errors defined as requiring less than an hour to repair and as noted above, will be done in EIM. If the consultant makes any repairs, he will return a copy of the repaired EDD so the lab can take corrective action to prevent any recurrence. Excessive consultant time expended in such EIM EDD repair of laboratory errors will be reviewed by AESI and may be charged back to the labs in a manner consistent with your MSA. Consultant related errors will not be counted against the lab.

Table 2 lists specifically which fields are the responsibility of the consultant and which fields are the responsibility of the laboratory. In such cases, the consultant or AESI may be contacted for assistance and to provide missing data, but it is the responsibility of the laboratory to successfully deliver an error-free EDD, on time, as measured by the EIM data checker. The laboratory’s time stamp for the delivery of an error free EDD is the date of the autonotify memo (discussed herein) from EIM, which is consistent with the time stamp denoting the last upload of the EDD in question.

H. Managing TICs in EIM

TICS are tentatively identified compounds. These are compounds detected in samples that are not target compounds, internal standards or surrogate standards. Up to a specified number of peaks are subjected to mass spectral library searches for tentative identification. The assigned identity may be inaccurate, as well as any quantitation. The number of TICs reported at a site is typically determined by regulatory requirements. TICs are stored in EIM with a unique identification. Result Type will be labeled TIC and the parameter code will be TIC. The parameter name will be reported by the laboratory – uniqueness is established by using the parameter name and retention time for the result. TICs can be filtered in output results when performing chemistry queries or when creating custom queries.

- **RET_TIME** must be populated in EDD for all TICs.
- **RES_TYPE** must be "TIC" to differentiate from other data records.
- **Parameter_Code** will be labeled "TIC". The individual records will be unique because the Retention time reported on the EDD will keep records unique.
- **Parameter Name** must be populated by the analytical laboratory so that EIM knows what compounds were identified. These will not match the valid values in Locus EIM as TICs are not included in the list of valid values. Contact the project analytical laboratory prior to sampling to ensure the lab can produce an EDD with the TIC identification requirements identified above.

III. EDD Self-Test and Data Upload Process

A. Revised EDD Upload Process

To facilitate compliance with the requirements outlined in this memo, Honeywell has established a **NEW** process for laboratories to test and upload an error free EDD to EIM™. **The process is described below and differs from previous processes in that the labs will upload directly to a site specific database. Appendix A contains screen shots that show the process and its location within Locus.**

1. The labs will be uploading to a holding table and that upload will be to a site specific database. Locus will provide the needed access to the Honeywell site. If you experience problems in accessing your site, call or email Rene Surgi and the Locus EIM Help Desk (EIMHelp@Locustec.com).
2. As in the past, the labs must review the Error Report, but now it will be site specific. Locus will add one additional column to the site-specific error report to the labs. This column will tell the user if the error is attributable to the lab or to the consultant and there will be less errors we now classify as ambiguous (i.e. "Method not in list of valid values" which can be due either to the lab typographical error or the consultant not assigning the Method to the lab/site.) A site specific data base should have these assignments already in place. If there are any questions, contact your site manager to ensure your site is established in EIM.
3. Rather than using a generic data checker for the Honeywell EIM EDD, you will be uploading to a specific site. By using the site-specific EIM Data Checker, you will be uploading your EIM EDD into the holding table, from which a site-specific error report will be generated. The lab should continue the process of correcting errors and using the Data Checker (using the tab

“UPLOAD DATA SET”) until no errors are listed in the error report. Once there are no errors listed in the error report, your delivery of an error free EDD is complete. If during this process, you encounter errors you believe are attributable to the consultant, contact them to discuss the error report.

4. Closure by the labs is evidenced by **EIM Autotify**: this is the email generated after you have uploaded the dataset and want to inform the consultant and AESI that you have submitted your final EDD. You may upload your EDD as many times as you wish prior to sending this email, but it is this email that will serve as your time stamp. Honeywell will benchmark both your delivery time and the number of errors in your final EDD submission. This autotify will contain the site and dataset # so a detailed error report can be accessed.

5. To recap. The lab will upload the **completed EDD** via the site specific database into the holding table which performs validation checks on the data. Applicable EIM interfaces have been captured and are provided infra. We expect the labs upload until there are no errors attributable to the labs – this may take many attempts on the part of the lab. Once successful, the lab stops and sends the **Autotify memo**. This will serve as an active testimonial on the part of the lab that the EDD production is complete and all parties will have documentation of an error-free EDD. The error report (and all upload attempts) will be stored in EIM for review. An Autotify memo sent regarding an EDD still found to have errors will be returned to the lab (by the reviewing consultant). Since we are able to track this in EIM, repeated offenses by the same lab will warrant a corrective action plan be submitted to AESI by the laboratory. There is no penalty for the number of upload attempts by the lab prior to the Autotify memo date. As discussed above, AESI, the Locus Help Desk and the consultants are here to advise and assist the lab in the EDD. Upon final delivery of the EDD, the consultant can download the EDD from the holding table in order to store an archival copy in their project files.

Remember that one of Honeywell’s metrics for laboratory performance is the delay in the laboratory providing the error-free EDD. Laboratories must submit the EDD by the due date or incur penalties associated with the MSA then in effect. The laboratory is advised to retain error reports from EIM™ in the event there is a

| |
|-----------------------------|
| USER NAME: LAB_NAME: |
| PASSWORD: |

discussion attributing errors in EDDs. The EIM™ data checker is accessible at the Locus web site and will now be associated with specific Honeywell sites. You will no longer be using a generic EDD checker; the checker will now be site specific. To access the data checker and to upload to the site specific holding table, enter the confidential laboratory name and password indicated in the box above. Current

laboratories have an individual password and user name. New laboratories will be provided a username and password by AESI. Please protect your passwords to help ensure the security of the EIM™ data checker program.

Because you will be uploading to a site-specific data base, there will no longer be the generic self-test as in the past. The EDD example above is provided as an example of the form, but will not upload successfully to any particular site.

B. EDD Self- Test Instructions

The EDD self-test instruction for Honeywell projects is described below and summarized in Figure 1. The self-test will be use actual site data. The numbering below corresponds to the numbers in Figure 1.

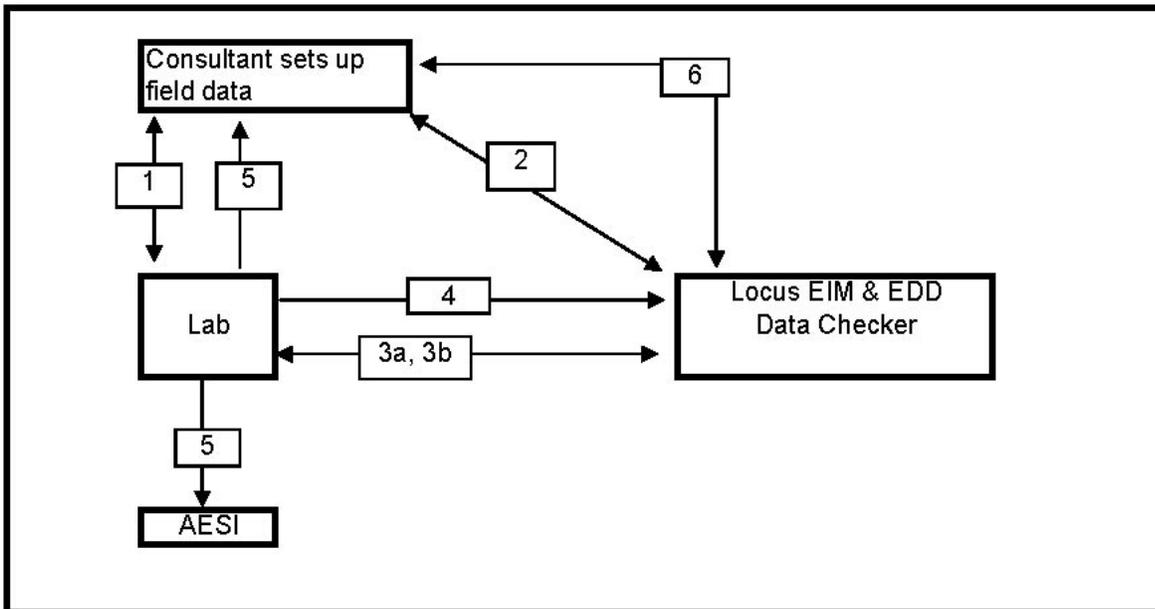


Figure 1. EDD Upload Process

1. The consultant communicates the project needs to the laboratory and establishes/confirms any use of valid values and instructs Locus (through the Locus Help Desk) to grant access to site specific data bases. Your laboratory EDD will be verified against site-specific databases. The lab obtains the list of valid values from the Locus web site. We suggest the lab check for valid values at least weekly.
2. The consultant sets up their portion of the EIM™ database. This includes site-specific data, field sample IDs and COC information.
- 3a. The laboratory submits an EDD to the site specific web-based data checker for evaluation.
- 3b. The laboratory obtains an error report and fixes their errors. At this point the laboratory may submit another amended EDD to the EIM™ data checker if desired and may do so as often as desired prior to submitting the final EDD and the autonotify email to the consultants and AESI. For EDD problems of a persistent nature, the EIM Help desk, the consultant and AESI are available to assist the labs.
4. The laboratory uploads the final error-free EDD to the site specific data base (access having previously been given by Locus). The laboratory's final EDD is now in the holding table.
5. The Lab submits the autonotify email and the error report to the consultant and to AESI
6. Consultant reviews the error report and accesses the actual error free EIM EDD. Periodic discussion between AESI, the consultant and Honeywell will address ongoing defects. The consultant submits the EDD to any further validation or review and places the EDD into the permanent EIM table.

This process should drastically reduce future EDD errors. Please note that Field #1 [FIELD_SAMPLE_ID] (as shown in Table 3) is the key link between laboratory-supplied information and consultant-supplied information (i.e., key database field) and must be unique.

It is the responsibility of the Honeywell consultant to generate this unique ID and provide that information to the laboratory when requesting analyses. Please refer to Table 3 for a complete list of required fields, who is responsible for them (C = consultant; L = lab) and if these fields must be established ahead of time (A) or can be submitted with the EDD submission (S).

Honeywell utilizes an electronic COC (E-COC) that makes many of the COC fields available to the lab in either a text file or an Excel file. To save significant time and avoid transcription errors, the lab is highly advised to request this text (or Excel) file from the consultant for upload to the lab LIMS during sample log-in. Table 2 contains a listing of the fields that are available from both the text or Excel file. The text or Excel file will be named using the COC number.

IV. CA Geotracker Requirements

As discussed throughout this memo, labs that must submit the CA Geotracker EDD and the Honeywell EIM EDD can now do so through one EDD: EIMEDF. Note that Fields #54 - #63 are unique to labs submitting packages to pursuant to this protocol. Also note that in Table 3, we list the field length for the Honeywell EIMEDF, but in addition, there are shaded texts that limit the number of characters when a Geotracker EDD is involved. **For example 25 characters are allowed in EIMEDF, Field #1, but not in Geotracker. When submitting the single EDD for both Honeywell and Geotracker, this field must be limited to 12 characters. Similarly, field #11 must be limited to 12 characters and fields #18 and #31 must be limited to 10 characters.**

CA Geotracker also has the requirement that batch QC be submitted – something EIM53 also requires. This can be particularly important for MS/MSD samples. If you use a non-client (NC in Field #60) sample for the MS/MSD, and are reporting Geotracker fields, you must report all related fields for this non-client sample in the Honeywell EDD. Fields that are particularly important are:

- a) Field #1. When reporting non-client samples as the MS/MSD or replicate, this field need not contain the non-client field sample ID.
- b) Field #7. The concentration in the unspiked sample used as the non-client or “batch” QC must be included.
- c) Field #63. This field is described above in Table 3.
- d) Field #60. This field will contain the valid value NC for a non-client sample used as “batch” QC.

V. Certification and Agreement

Laboratories must affirm, below, their ability to produce an ASCII file like the excerpt provided in this memo, upload a properly prepared file to the EIM™ data checker and access the EIM™ error report.

Honeywell requires is the laboratory to be certain they can produce an EDD to meet Honeywell EDD specifications outlined in this memo, be able to use the web-based EIM™ data checker, and obtain an error report from the data checker. Since this process is site specific, there is no “generic” EDD; you will be testing the process using live data. Therefore, you should begin as soon as possible, taking advantage of the time prior to April 30, 2006. A template file is provided (Example_64Field_EDD.txt) for you to examine, but it may not upload to a site specific database.

Adherence to Honeywell’s EDD requirements has been incorporated into the Honeywell Laboratory Services Agreement entered into between your laboratory and Honeywell. Honeywell and AESI will complete the review of laboratory affirmations and laboratory feedback/comments WITHIN 30 DAYS OF RECIEPT OF THIS MEMO. Laboratory comments and the affirmation should be sent to:

Rene Surgi
AESI
503 Oakdale Avenue
Glencoe, Illinois 60022 Telephone: 847-835-0983 Fax: 847-835-9404
e-mail renesurgi@aol.com

Affirmations must be signed and e-mailed as a PDF file. Comments may be submitted via email. Honeywell appreciates your efforts to help streamline and improve Honeywell's environmental data management process.



Rene Surgi, Ph.D.
AESI
503 Oakdale Ave.
Glencoe, IL 60022
Attachments
Appendix A1: LabID_Methods_ParameterCodes 02-24-06 1213.xls
Appendix A2: EIM_Example_EDD64.txt (electronic attachment)
Appendix A3: Screen Captures for Laboratory Uploads

Affirmation

I affirm that _____ analytical laboratory

(Name of laboratory)

can meet the requirements for the Honeywell EDD and EDD data submission requirements as outlined in the memo from Analytical and Environmental Services, Inc., dated March 1, 2006

_____ (_____)

Signature of Laboratory Director

(Date)

Name of Laboratory Director (Please Print)

Table 2. Order and Available Fields from E-COC as Text or as Excel Files

| COC Field # | Field Description | Locus User | Lab EIM |
|--------------------|------------------------------|-------------------|----------------|
| 1 | FIELD_SAMPLE_ID | EIM | 1 |
| 2 | LOCATION_ID | EIM | |
| 3 | SITE_ID | EIM | |
| 4 | SAMPLE_DATE | EIM | |
| 5 | SAMPLE_TIME | EIM | |
| 6 | SAMPLE_PURPOSE | EIM | 37 |
| 7 | SAMPLE_TYPE | EIM | |
| 8 | SAMPLE_MATRIX | EIM | 10 |
| 9 | SAMPLE_START_DEPTH | EIM | |
| 10 | SAMPLE_END_DEPTH | EIM | |
| 11 | SAMPLE_DEPTH_UNITS | EIM | |
| 12 | SAMPLING_COMPANY | EIM | |
| 13 | SAMPLERS | EIM | |
| 14 | COC_NUMBER | EIM | |
| 15 | TEST_NAME | EIM | |
| 16 | LAB_JOB_NUMBER | LAB | |
| 17 | PRESERVATIVE | EIM | |
| 18 | LAB_PROJECT_NUMBER | LAB | |
| 19 | GRAB/COMPOSITE | EIM | |
| 20 | TAT-Agreed # Days | EIM | |
| 21 | FILTERED_FLAG | EIM | 27 |
| 22 | SITE- INVESTIGATION PHASE | EIM | |
| 23 | SAMPLING_PROGRAM | EIM | |
| 24 | LAB_ID | EIM | 2 |

Table 3. Honeywell EDD Required fields (bold) and Other fields. Geotracker California fields in shaded rows.

| Field | Field Name | When (A = Ahead); S = with data) | Who (L = lab; C = consultant) | Level | Length | Field Contents |
|-------|--------------------------|--|---|-------|--------|--|
| 1 | FIELD_SAMPLE_ID | A | C | 2 | C25 | Field Sample number or identifier. Can be left blank for lab-originated samples. This field is required of the consultant and must be on the COC. For labs producing the CA Geotracker EDD, this field is limited to 12 characters. |
| 2 | LAB_ID | A | L | 2 | C10 | Code or identifier for a lab. Lab names are assigned as valid values by AESI and are rigorous (locked). Valid values can be found in Appendix A1 (electronic file). |
| 3 | ANALYTICAL_METHOD | A | L | 2 | C30 | Analytical method used. Must conform to the list of valid values maintained by AESI. See Appendix A1 (electronic file) for valid values. Deviations or new analytical methods will be supervised by AESI. |
| 4 | ANALYSIS_DATE | S | L | 2 | Date | Date of analysis, MM/DD/YYYY or DD-MON-YY |
| 5 | PARAMETER_CODE | A | L | 2 | C12 | Analyte CAS Number or the Assigned valid value (see Appendix A1 (electronic file)) for analyses having no CAS numbers (i.e., alkalinity, pH). These must conform to the list of valid values in Appendix A1. New codes can be added only if they are not in the current list. AESI will review lab submissions for non-conformance on a monthly basis and issue appropriate corrective actions. |
| 6 | RESULT_TYPE_CODE | A | L | 2 | C5 | Code identifying the result. See Table 4. Lab tells consultant which fields it will be providing. Must conform to HONEYWELL list of valid values. |
| 7 | LAB_RESULT | S | L | 2 | C10 | Analytical Result (see also Field #53 BASIS). If nondetect, <i>below the MDL</i> , enter the laboratory reporting limit here. <i>If detected above the MDL and below the reporting limit, enter the result – a “J” flag will also be used as stipulated in Field #13. Some facilities may specify reporting only to the reporting limit and not to the MDL. For these cases, enter the laboratory reporting limit and a “U” flag in Field #13 if the result is below the laboratory reporting limit.</i> |
| 8 | LAB_UNITS | A | L | 2 | C10 | Unit of measure of the result. Must conform to the valid value list. See Table 4. |

| Field | Field Name | When (A = Ahead; S = with data) | Who (L = lab; C = consult- tant) | Level | Length | Field Contents |
|-------|---------------------------|---|---|-------|--------|---|
| 9 | LAB_REPORTING_LI MIT | S | L | 2 | C10 | Actual Reporting Limit realized by the lab, adjusted for preparation, dilution, etc. |
| 10 | LAB_MATRIX | S | L | 2 | C10 | Matrix of Sample. See Table 4 . Must conform to the valid value list. |
| 11 | LAB_SAMPLE_ID | S | L | 2 | C20 | Internal ID assigned by lab to track a sample within the lab. For labs producing the CA Geotracker EDD, this field is limited to 12 characters. |
| 12 | ANALYSIS_TIME | S | L | 2 | Time | Time of analysis (HH:MM), military time. |
| 13 | LAB_QUALIFIER | S | L | 2 | C10 | Laboratory Qualifier. See Table 4 . |
| 14 | RETENTION_TIME | S | L | 2 | Time | Retention time required for TICS only. For others enter NA or leave blank, MM:SS |
| 15 | DILUTION_FACTOR* | S | L | 2 | C7 | Dilution factor if the sample was diluted. |
| 16 | PREP_METHOD | S | L | 2 | C20 | Preparation method (if applicable) |
| 17 | PREP_DATE* | S | L | 2 | Date | Date of preparation MM/DD/YYYY (if applicable) |
| 18 | ANALYSIS_LOT_ID | S | L | 2 | C20 | Laboratory analysis batch number or ID. For labs producing the CA Geotracker EDD, this field is limited to 10 characters. |
| 19 | PREP_AMOUNT | S | L | 2 | C10 | Amount of sample used in the preparation. |
| 20 | PREP_UNITS | S | L | 2 | C10 | Unit or measure of sample preparation amount. See Table 4 . Must conform to the list of valid values. |
| 21 | PREP_AMT_BASIS | S | L | 2 | C5 | The basis of the weight of the amount of the sample prepared: W or Dry are the only valid values (W = wet; D = dry). |
| 22 | SAMPLE_DELIVERY_ GROUP | S | L | 2 | C20 | Laboratory sample delivery group |
| 23 | LAB_BLANK_SAMPLE _ID | S | L | 2 | C20 | ID of laboratory blank associated with the sample identified in the FIELD_SAMPLE_ID and/or LAB_SAMPLE_ID fields. |

| Field | Field Name | When (A = Ahead); S = with data) | Who (L = lab; C = consult- tant) | Level | Length | Field Contents |
|-------|------------------------|--|---|-------|--------|---|
| 24 | ERROR | S | L | 2 | C10 | +/- 2-sigma error (pertains to radiological results only) |
| 25 | PARAMETER_NAME | S | L | 2 | C60 | Name of parameter. Any correct synonym is acceptable (i.e., Methylene ketone, 2-Butanone, etc.) However, Field #5 must have the correct CAS# or Honeywell assigned valid value. |
| 26 | ANALYSIS_TYPE_CODE | A | L | 2 | C5 | Type of analysis. See Table 4. |
| 27 | FILTERED_FLAG | S | L | 2 | C1 | Flag to identify whether sample was filtered or not. The only valid values are Y, N. |
| 28 | LEACHED_FLAG | S | L | 2 | C1 | Flag to identify whether sample was leached prior to being analyzed. See Table 4. The only valid values are Y, N. |
| 29 | LEACHATE_METHOD | S | L | 2 | C20 | Method used to leach a sample (if applicable) |
| 30 | LEACHATE_DATE | S | L | 2 | Date | Sample leachate date MM/DD/YYYY (if applicable) |
| 31 | LEACHATE_TIME | S | L | 2 | Time | Sample leachate time (if applicable) HH:MM, military time. |
| 32 | SAMPLE_PREP_LOT_ID* | S | L | 2 | C20 | Laboratory prep lot number or ID (if applicable), military time. For labs producing the CA Geotracker EDD, this field is limited to 10 characters. |
| 33 | LEACHATE_LOT_ID | S | L | 2 | C20 | Laboratory leachate lot number or ID (if applicable) |
| 34 | PREP_TIME | S | L | 2 | Time | Time of preparation HH:MM (if applicable). |
| 35 | METHOD_DETECTION_LIMIT | S | L | 2 | C10 | Method detection limit. This is the result of the annual MDL study. |
| 36 | SAMPLE_DATE* | S | L | 2 | Date | Date Sample was created in the lab: MM/DD/YYYY, Should be left blank for field originated samples (see discussion below for SAMPLE_PURPOSE) |

| Field | Field Name | When (A = Ahead); S = with data) | Who (L = lab; C = consultant) | Level | Length | Field Contents |
|-------|----------------------------|--|--|-------|--------|--|
| 37 | SAMPLE_PURPOSE* | A | C (if a field designation) L (if a lab designation) | 2 | C5 | The purpose of the sample. REG is the valid value for field-originated samples (i.e. regular, trip blank, field blank, field duplicate, and rinsate blanks). Should be populated for matrix spikes and duplicates, method blanks, blank spikes and duplicates, lab duplicates, and any other lab originated or transformed samples. See Table 4. |
| 38 | ORIGINAL_LAB_RESULT | S | L | 2 | C10 | The concentration of the analyte in the original (unspiked) sample. |
| 39 | SPIKE_ADDED | S | L | 2 | C10 | Amount of spike added to sample |
| 40 | SPIKED_RESULT | S | L | 2 | C10 | Concentration of the analyte in the spiked sample |
| 41 | SPIKE_RECOVERY* | S | L | 2 | C10 | Percent recovery |
| 42 | RPD* | S | L | 2 | C10 | Calculation of relative percent difference (for duplicates only) |
| 43 | RPD_LIMIT* | S | L | 2 | C10 | Upper limit for RPD (percent) (for duplicates only) |
| 44 | UPPER_LIMIT* | S | L | 2 | C10 | Upper control limit (percent) for spike recovery (for spikes and spike duplicates, surrogates, laboratory control samples, and any spiked samples only) |
| 45 | LOWER_LIMIT* | S | L | 2 | C10 | Lower control limit (percent) for spike recovery (for spikes and spike duplicates, surrogates, laboratory control samples, and any spiked samples only) |
| 46 | LAB_ARRIVAL_DATE | S | L | 2 | Date | Enter the date the sample arrived at the lab (mm/dd/yyyy) |
| 47 | LAB_ARRIVAL_TIME | S | L | 2 | Time | Enter the time the sample arrived at the lab (HH:MM). This is used to compute TAT compliance. |
| 48 | REP_DATE | S | L | 2 | Date | Date of Hardcopy lab report. The time stamp in Locus EIM will be used to record the date and time EDD delivered. Use the shortest time requested (i.e., level 2 in 5 days and full report in 12 days; use 5 days in this field). |
| 49 | RUSH_TAT | S | L | 2 | C1 | Sample was submitted as "Rush" – valid values for this field are Y, N. |

| Field | Field Name | When (A = Ahead); S = with data) | Who (L = lab; C = consult- tant) | Level | Length | Field Contents |
|-------|----------------------------|--|---|--------|--------|---|
| 50 | DUE_DATE | S | L | 2 | Date | Enter earliest date (mm/dd/yyyy) a deliverable is due. For example a 2-day TAT requires the level 2 hardcopy be delivered in 48 hours and the EIM EDD be delivered in 10 days. In this case enter the 2-day TAT. |
| 51 | SUBCONTRACT* | S | L | 2 | C1 | Y= yes, analysis subcontracted; field can be left blank if sample not subcontracted. |
| 52 | SUBCONTRACT_LAB_ID* | S | L | 2 | C10 | Code or identifier for a subcontract lab. Subcontract lab names are assigned as valid values (Appendix A1) (electronic file). |
| 53 | BASIS | S | L | 2 | C3 | Basis for reporting the result. See Table 4. |
| 54 | APPRVD: | S | L | CA-All | C3 | Initials of individual approving lab report. This field is not required. |
| 55 | CLCODE | S | L | CA-All | C4 | Quality control limit type. See Table 4. |
| 56 | CLREVDATE | S | L | CA-All | Date | Date a control limit established. |
| 57 | LABWO | S | L | CA-All | C10 | Lab work order number. Use the Lab SDG to confine the data management to 20 samples + associated QC. This helps limit the QCCODE appendix to "1" – i.e., BS1, CD1, CS1, etc. and makes mapping the EIM EDD (controlled by SDG #) to Geotracker EDF easier because it limits the size of the laboratory Work Order to the size of the SDG. |
| 58 | MODPARLIST | S | L | CA-All | C1 | A field indicating whether the parameter list of an analytical method has been modified – valid values for this field are Y, N. |
| 59 | PVCCODE | S | L | CA-All | C2 | A code identifying whether a sample result is a primary or a confirmatory value. The most commonly used values are "PR" and "SR". See Table 4. |
| 60 | QCCODE | S | L | CA-All | C3 | Code identifying the type of sample (e.g., laboratory-generated, environmental, etc.). See Table 4. |

| Field | Field Name | When (A = Ahead); S = with data) | Who (L = lab; C = consultant) | Level | Length | Field Contents |
|-------|-------------------|--|---|--------|--------|--|
| 61 | REPDLVQ | S | L | CA-All | C3 | Code identifying type of reporting limit. See Table 4. Most common values are “PQL” and “NA”. |
| 62 | RUN_NUMBER | S | L | CA-All | C20 | Numeric laboratory run number code distinguishing multiple or repeat analysis of a sample by the same method on the same day. |
| 63 | LAB_REF_ID | S | L | CA-All | C12 | The laboratory reference sample ID is the laboratory assigned sample ID of the sample ID upon which the QC sample is referenced in order to calculate the QC result. This field may not be left blank when QCCODE = MS, MSD or LR and MUST be left blank in all other cases. Enter the LAB_SAMPLE_ID (EIM Field #11) of the client sample that was spiked or replicated in this field. This field is applicable when batch QC is being reported. For example if client A has its own MS and MSD (i.e., A, A-MS and A-MSD) these would be entered in field #11 of client A’s EIM EDD. For this MS/MSD to be used for Honeywell samples, this field (#63) would contain A for the MS and A for the MSD because A is the ID of the sample upon which the QC is based. |
| 64 | SRM | S | L | CA-All | C10 | Code identifying the standard reference material used in the analysis. Usually this is entered manually for most laboratories. See Table 4. |

a. Fields in Bold Regular font are required (e.g., **LAB_ID**). Some fields have an asterisk following them (e.g., **DILUTION_FACTOR** and **SAMPLE_PREP_LOT_ID**). This signifies that the field can be left blank if it is not applicable. In the case of Sample Prep Lot ID in particular, a value needs to be provided for this field only if it is different than the ANALYSIS_LOT_ID.

b. Fields in Regular font are optional

c. Fields In ***Bold Italic fonts*** are required for laboratory QC samples (e.g., ***SAMPLE_PURPOSE***). Several of these fields have an asterisk following them. This indicates the field is required only if it is applicable. For example, ***RPD*** and ***RPD_LIMIT*** can be left blank for all but laboratory control, blank spike, and matrix spike duplicates.

d. If you use a non-client (NC in Field #60) sample for the MS/MSD, and are reporting Geotracker fields, you must report the all related fields for this non-client sample in the Honeywell EIM EDD. For example, the concentration in the unspiked sample must be reported, but the Field_Sample_ID is not necessary. If you laboratory LIMS is unable to associate a non-client QC sample with a Honeywell sample(s), you must run a Honeywell specific QC sample (i.e. MS, MSD) at no charge to Honeywell.

Table 4. List of Valid Values Referred to in Table 3.

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|---|
| ANALYSIS_TYPE_CODE (26) | INIT | Initial analysis. |
| | REANL | Reanalysis (without reextraction). |
| | REAN2 | Second reanalysis (without reextraction) |
| | REAN3 | Third reanalysis (without reextraction) |
| | REEXT | Reextraction (presumes reanalysis). |
| | REEX2 | Second reextraction (presumes reanalysis) |
| | REEX3 | Third reextraction (presumes reanalysis) |
| | DIL | Dilution |
| | CONF | Confirmatory analyses |
| | DIL2 | Second dilution |
| FILTERED_FLAG (27) | Y | Yes, the sample was filtered. |
| | N | No, the sample was not filtered. |
| LAB_UNITS (8) | ug/L | micrograms/liter |
| | mg/L | milligram/liter |
| | ug/kg | micrograms/kilogram |
| | mg/kg | milligrams/kilogram |
| | Wt % | Weight percent |
| | Eq | Equivalents |
| | Meq | Milliequivalents |
| | g | grams |
| | mg | milligrams |
| | L | Liter |
| | ml | Milliliters |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|-------------------|---|
| | s.u. | standard units |
| | deg C | Degrees C |
| | deg F | Degrees F |
| | g/ml | grams/milliliter |
| | mV | Millivolts |
| | Ratio | Unitless ratio (numerator and denominator possess the same units) |
| | umoles/g | micromoles/gram |
| | ppmV | Parts per million – volume (air measurements) |
| | ppbV | Parts per billion – volume (air measurements) |
| | mg/m ³ | milligrams/cubic meter (air measurements) |
| | ug/m ³ | micrograms/cubic meter (air measurements) |
| | mg/m ² | milligrams/square meter (wipes or area measurements) |
| | ug/m ² | micrograms/square meter (wipes of area measurements) |
| | ntu | Turbidity units |
| | % | Percent recovery |
| | megohm/cm | Mega ohms per centimeter |
| | meq/kg | Milliequivalents per kg |
| | MFL | Million fibers per liter (asbestos) |
| | MHOS | Mhos – units of conductivity |
| | mm/sec | Millimeters per second; units of ignitability |
| | pCi/g | Picocuries per gram |
| | pCi/L | Picocuries per liter |
| | Pos/Neg | Positive/negative result (Positive = 1; Negative = 0 in Field #7. |
| | ug/Wipe | Micrograms per wipe |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|---|
| | Yes/No | Yes/No results (Yes = 1; No = 0 in Field #7) |
| LAB_MATRIX (10) | AIR | Air sample. |
| | LIQUID | Any liquid phase not adequately described by other valid values. |
| | SOLID | Any solid phase not adequately described by other valid values. |
| | WASTE | Waste sample: covers remaining non-aqueous samples. |
| | SOIL | Soil sample. |
| | WATER | Water sample. |
| | DNAPL | Dense non-aqueous phase liquid. |
| | LNAPL | Light non-aqueous phase liquid. |
| | BIOTA | Biological samples. |
| | GAS | Gas |
| | LEACHATE | Leachate |
| | SLUDGE | Sludge |
| | VAPOR | Vapor |
| WIPE | Wipe | |
| LAB_QUALIFIER (13) | B | Analyte was detected in the associated method blank. |
| | N | There is presumptive evidence that the compound is present, but it has not been confirmed. The analyte is tentatively identified. All quality control criteria necessary for identification were not met. |
| | E | Concentration exceeds the calibration range and therefore result is semi-quantitative. |
| | DIL | Dilution and reporting limit raised. |
| | H | Sample analysis performed past method-specified holding time. |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|--|
| | J | Estimated value. Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL). The user of this data should be aware that this data is of unknown quality. |
| | UJ | Analyte is undetected. Estimated value. Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL). The user of this data should be aware that this data is of unknown quality. |
| | BJ | Estimated value. Blank contamination. |
| | NJ | There is presumptive evidence that the compound is present, but it has not been confirmed. The analyte is tentatively identified. All quality control criteria necessary for identification were not met. Estimated value. Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL). The user of this data should be aware that this data is of unknown quality. |
| | MS-NR | There was no MS/MSD analyzed with this batch due to insufficient sample volume (NR = not reported). See Blank Spike/Blank Spike Duplicate. |
| | DIL-MX | The sample required a dilution due to matrix interference. Because of this dilution, the matrix spike concentrations in the sample were reduced to a level where the recovery calculation does not provide useful information. See Blank Spike (LCS). |
| | MS-FR | Matrix Spike recovery was outside the method control limits (FR = recovery failure). |
| | LCS-FR | LCS failed recovery. |
| | S | Analyzed by standard addition. |
| | U | Analyte is undetected |
| | SURR-FR | Surrogate recovery outside method criteria or lab statistical criteria (FR = recovery failure). |
| | LR-RPD | Duplicate analysis precision not within control limits. This valid value should be used for all RPD limits (including QC such as MS/MSD; LCS/LCSD; sample/sample duplicate) |
| | P | GC/HPLC target analytes where there is a greater than 40% difference for detected concentration between the primary and confirmation results. |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|---|
| | BD | Radiological: Target parameter below the minimum detectable concentration or for low tracer recovery. |
| | UI | Radiological: Flag indicates uncertainty for gamma spectroscopy. |
| | I | Dioxin: This flag is used to indicate labeled standards have been interfered with on the GC column by co-eluting, interfering peaks. The interference may have caused the standard's area to be overestimated. All quantitation relative to this standard, therefore, may be underestimated. |
| | K | Dioxin: EMPC. Ion abundance ratios associated with a particular compound are outside QC limits. This is the estimated maximum possible concentration for the associated compound. |
| | PR | Dioxin: A GC peak is poorly resolved. The concentrations reported for such peaks are most likely overestimated |
| | Q | Dioxin: Indicates the presence of QC ion instabilities caused by quantitative interferences |
| | RO | Dioxin: This qualifier is used to indicate a labeled standard has an ion abundance ratio that is outside of the acceptable QC limits, most likely due to a co-eluting interference. This may have caused the percent recovery of the standard to be overestimated, therefore, all quantitation associated with this standard may be underestimated. |
| | V | Dioxin: A 'V' flag is used to indicate that, although the percent recovery of a labeled standard may be below a specific QC limit, the signal to noise ratio of the peak is greater than ten-to-one. The standard is reliably quantifiable, and all quantitations derived from the standard are considered valid as well. |
| | X | Dioxin: This flag is used to indicate that a polychlorodibenzofuran (PCDF) peak has eluted at the same time as the associated diphenyl ether (DPE) and that the DPE peak intensity is at least ten percent of the total PCDF peak intensity. Total PCDF values are flagged 'X' if the total DPE contribution to the total PCDF value is greater than ten percent. All PCDF peaks that are significantly influenced by the presence of DPE peaks are either reported as "estimated maximum possible concentration (EMPC) values without regard to the isotopic abundance ratio, or are included in the detection limit value depending upon the analytical method. |
| LEACHED_FLAG | Y | Yes, the sample was leached prior to being analyzed. |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|---|
| (28) | N | No, the sample was not leached prior to being analyzed. |
| RESULT_TYPE_CODE (6) | IS | Internal Standard. |
| | SPK | Spiked compounds. |
| | SUR | Surrogate. |
| | TIC | Tentatively Identified Compound. |
| | TRG | Target Analyte. |
| SAMPLE_PURPOSE (37) | BS | Blank Spike. |
| | BSD | Blank Spike Duplicate. |
| | LCS | Laboratory Control Spike. |
| | LCSD | Laboratory Control Spike Duplicate. |
| | MB | Method Blank. |
| | MS | Matrix Spike. |
| | MSD | Matrix Spike Duplicate. |
| | LR | Lab Replicate.. |
| | QCS | Quality Control Sample. |
| | AS | Analytical Spike |
| | REG | Regular sample |
| | AB | Ambient blank |
| | DUP | Duplicate |
| | EB | Equipment blank |
| | FD | Field duplicate |
| | TB | Trip Blank |
| | MSI | Matrix spike insoluble spike (i.e., Cr(VI) analyses) |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|--|
| | LCSI | Laboratory control sample insoluble spike (i.e., Cr(VI) analyses). |
| | MSDI | Matrix spike duplicate insoluble spike (i.e., Cr(VI) analyses). |
| | LCSDI | Laboratory control sample duplicate insoluble spike (i.e., Cr(VI) analyses). |
| | FB | Field blank |
| SRM (64) | ABSSTD | Absolute Standards |
| | ACCUSTD | AccuStandard |
| | ALDRICH | Aldrich Chemical Co. |
| | ALPHA AESAR | Alpha Aesar |
| | APG | Analytical Products Group |
| | BURJAC | Burdick & Jackson |
| | CPI | CPI, Santa Rosa, CA |
| | CAMBRIDGE | Cambridge Isotope Labs |
| | CHEMSERV | Chem Services, Inc. |
| | EMSCIENCE | EM Science |
| | ERM | ERM, Inc. |
| | KODAK | Eastman Kodak Co. |
| | ENVEXPR | Environmental Express |
| | EMSL | Environmental Monitoring Systems Laboratory (EMSL), Las Vegas, NV |
| | ERAS | Environmental Research Associated Standards |
| | ETHYLCORP | Ethyl Corp. |
| | FISHER | Fisher Scientific |
| | HCRINEER | H.C. Rineer & Sons, Inc. |
| | HACH | HACH Chemical |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|--|
| | HPS | High-Purity Standards |
| | INVENT | Inorganic Ventures |
| | JTBAKER | J. T. Baker |
| | LEEMAN | Leeman Laboratories |
| | MALLINBKRO | Mallinbkrodt |
| | MAZOLA | Mazola (R) Corn Oil |
| | NA | Not Applicable |
| | OIA | OI Analytical |
| | PLASMA | Plasma Chem, Inc. |
| | PROTOCOL | Protocol |
| | RADIAN | Radian Corporation |
| | RESTEK | Restek |
| | SPEX | SPEX Industries |
| | SGAS | Scotty Specialty Gases |
| | SIGMA | Sigma Chemical Co. |
| | SOLPUS | Solutions Plus |
| | SPECTRA | Spectra |
| | SUPELCO | Supelco |
| | SOURCE | The Source |
| | USATHAMA | U.S. Army |
| | NIST | U.S.D.C., National Institute of Standards & Technology |
| | ULTRA | Ultra Scientific |
| | VHGLABS | VHG Labs, Inc. |
| CLCODE (55) | SBSA | Both Reagent and Matrix Sample Accuracy for Surrogates |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|---|
| | SBSP | Both Reagent and Matrix Sample Precision for Surrogates |
| | CLPCC | CLP Continuing Calibration Acceptance Criteria |
| | CLPIC | CLP Initial Calibration Acceptance Criteria |
| | CLPA | Contract Laboratory Program Accuracy Limits for Spiked Samples |
| | SCLA | Contract Laboratory Program Limits for Surrogate Accuracy |
| | SCLP | Contract Laboratory Program Limits for Surrogate Precision |
| | CLPP | Contract Laboratory Program Precision Limits for Spiked Samples |
| | CLPLR | Contract Laboratory Program Precision for Lab Replicates |
| | DU | Data Unavailable |
| | LCC | Laboratory Continuing Calibration Accuracy |
| | LLR | Laboratory Established Precision for Lab Replicates |
| | LIC | Laboratory Initial Calibration Accuracy |
| | LSA | Laboratory Sample Accuracy for Spiked Samples |
| | SLSA | Laboratory Sample Limits for Accuracy for Surrogates |
| | SLSP | Laboratory Sample Limits for Precision for Surrogates |
| | LSP | Laboratory Sample Precision for Spiked Samples |
| | MLR | Matrix Laboratory Replicate Precision |
| | MSA | Matrix Spike Accuracy for Spiked Samples |
| | MSP | Matrix Spike Precision for Spiked Samples |
| | MEA | Method Established Accuracy for Spiked Samples |
| | MECC | Method Established Continuing Calibration Acceptance Criteria |
| | MEIC | Method Established Initial Calibration Acceptance Criteria |
| | SMEA | Method Established Limits for Accuracy for Surrogates |

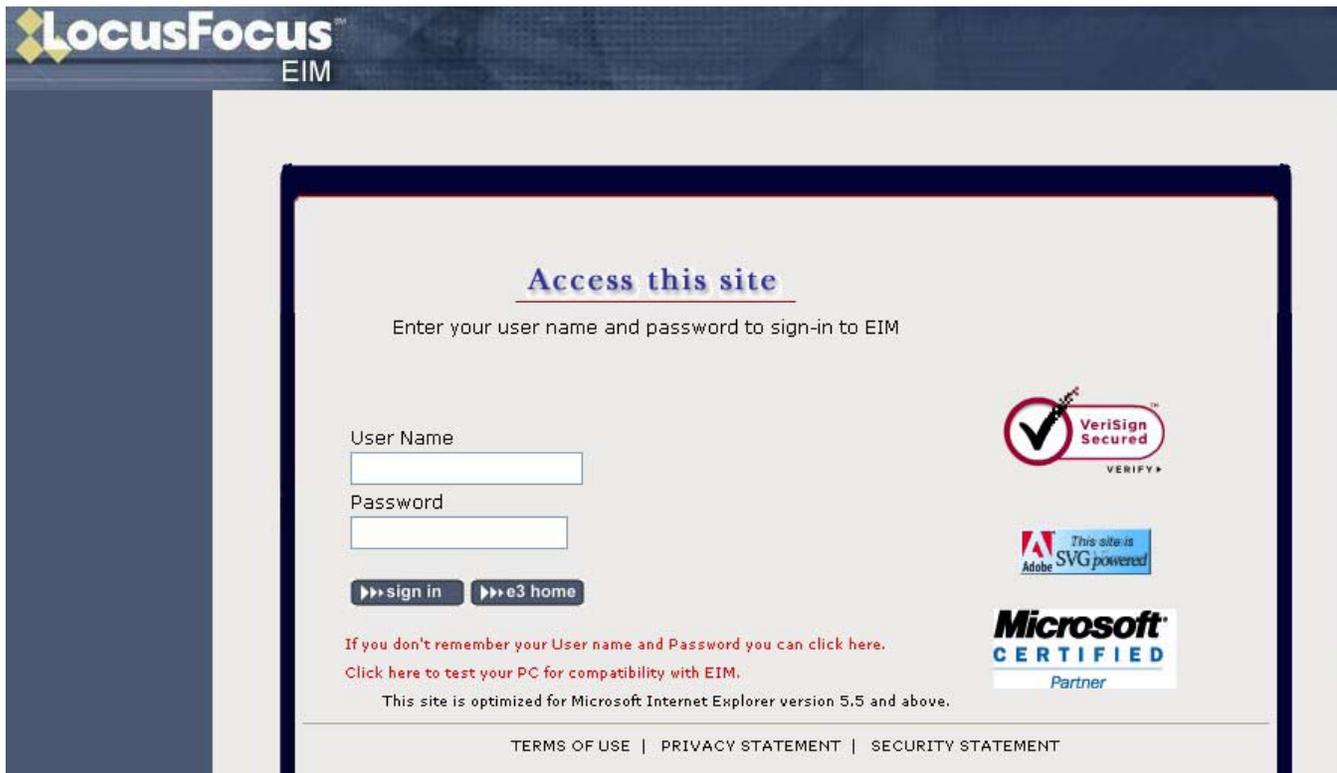
| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|--|
| | SMEP | Method Established Limits for Precision for Surrogates |
| | MELR | Method Established Precision for Laboratory Replicates |
| | MEP | Method Established Precision for Spiked Samples |
| | SMSA | Sample Matrix Limits for Accuracy for Surrogates |
| | SMSP | Sample Matrix Limits for Precision for Surrogates |
| | SRAD | Standard Reference Accuracy Defined by Agency/Manufacturer |
| | SRMA | Standard Reference Material Accuracy Limits Determined by Lab |
| | SRMP | Standard Reference Material Precision Limits Determined by Lab |
| | SRPD | Standard Reference Precision Defined by Agency/Manufacturer |
| PVCODE (59) | DU | Data Unavailable |
| | 1C | First Column Result - The Value Obtained from the First Column |
| | MS | GC/MS Result - Value Confirmed Using GC/MS |
| | NR | Not Reported - Data Not Reported |
| | NU | Not Usable - Data Not Usable |
| | PR | Primary Result - The Primary Result for a Parameter |
| | 2C | Second Column Result - The Value Obtained from the Second Column |
| | SR | Semi-Quantitative Result |
| QCCODE (60) ⁷ | BS1 | Blank Spike (#1). If EIM Field #37 = BS; then QCCODE = BS1. |
| | BD1 | Blank Spike Duplicate (#1). If Field #37 = BSD; then QCCODE = BD1. |
| | CS1 | Client Sample. If Field #37 = REG; then QCCODE = CS1. |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|--|
| | LB1 | Laboratory Blank. If Field #37 = MB; then QCCODE = LB1. |
| | LR1 | Lab Replicate. If Field #37 = LR; then QCCODE = LR1. |
| | MS1 | Matrix Spike. If Field #37 = MS; then QCCDOE = MS1. |
| | NC | Non-Client Sample. If the results of the Matrix Spike are reported from a sample which is not a Honeywell sample (batch QC), the unspiked result of the other client's sample must be reported with the spiked sample (which is part of the Honeywell batch by virtue of its being used as a QC sample). The unspiked result carries the "NC" flag. If only Honeywell samples are used in a batch and the spike is performed on a Honeywell sample, this flag is not used. Labs reporting this flag incorrectly create significant errors. . |
| | SD1 | Lab Matrix Spike Duplicate. If Field #37 = MSD; then QCCODE = SD1. |
| REPDVQ (61) | CDL | Contract Required Detection Limit |
| | DU | Data Unavailable |
| | EQL | Estimated Quantitation Limit |
| | IDL | Instrument Detection Limit |
| | LOQ | Limit of Quantitation |
| | LLD | Lowest Level of Detection |
| | DDL | Method Defined Detection Limit |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit (lowest standard adjusted for prep.) |
| | NA | Not Applicable |
| | PRL | Parameter Range Limit |
| | PQL | Practical Quantitation Limit |
| | TDL | Target Method Detection Limit |
| BASIS (53) | W | Wet weight basis (soil samples) |
| | D | Dry weight basis (soil samples) |

| Field (# out of EIM in parentheses) | Valid Values | Values Description |
|-------------------------------------|--------------|---|
| | F | Field filtered (liquids) |
| | L | Lab filtered (liquids); exclusive of ordinary procedural requirements such as filtration of metal digestates) |
| | N | Not filtered (liquids) |
| | G | Centrifuge supernatant (liquids) |
| | U | Data unavailable |
| | A | Air |

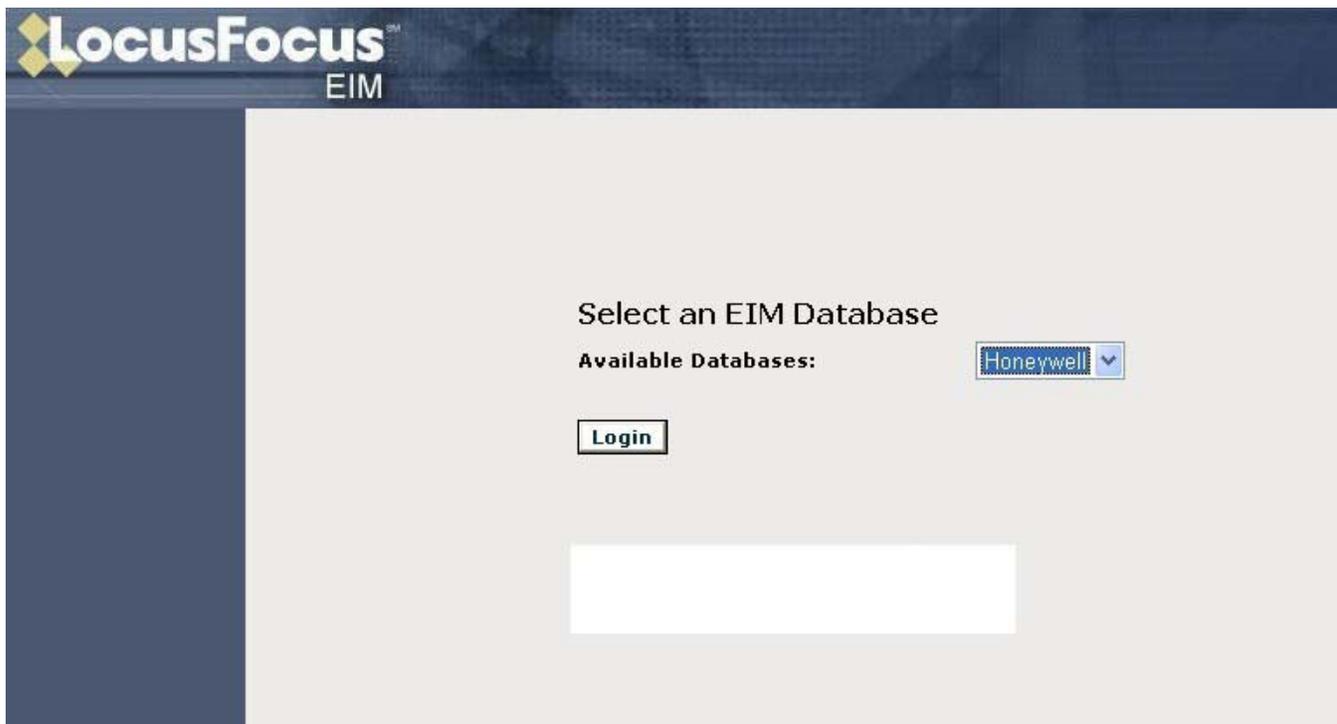
1. The actual valid values used must match those listed.
2. For any spiked compound, the lab must report the percent values for the SPIKE_RECOVERY, UPPER_LIMIT, and LOWER_LIMIT fields.
3. For Matrix Spike/Matrix Spike Duplicates or Lab Replicates, the lab should include, as applicable, the ID of the original field sample in the FIELD_SAMPLE_ID column with MS, MSD or LR appended.
4. A given LAB_SAMPLE_ID must have a unique purpose. As such, reporting the same ID for the original sample, and the Matrix Spike, Matrix Spike Duplicate, and/or Lab Replicate of this sample is not acceptable. If necessary, append the sample purpose code to these IDs (original sample excluded) to make them unique.
5. The sample date of a lab-originated sample is the date it came into existence in the lab, not the date the sample was collected in the field. Many labs use the prep date for this field. A given lab sample should not have multiple sample dates.
6. Valid Values must conform to the list of Honeywell Valid Values. Valid Values are maintained by the Honeywell Laboratory Program Manager and available on the Locus EIM Web Site.
7. Geotracker EDF provides for a substantial number of entries in these categories (i.e., BS1, BS2, BS3 ...BSW.. for the Blank Spike). Geotracker format allows for submission of EDD results by Laboratory Work Order. There can be numerous batches (20 samples + MS + MSD + MB + LCS in a laboratory Work Order Number. If the laboratory Work Order consists of only one SDG, then the QCCODE need only use BS1. EIM provides the SDG and the laboratory Work Order Number
8. Shaded items are those indicated by the labs as being used most frequently.

Appendix A3. Locus EIM Screens Encountered During Laboratory Upload and Autnotification



The screenshot shows the LocusFocus EIM login page. At the top left is the LocusFocus EIM logo. The main heading is "Access this site" with a sub-heading "Enter your user name and password to sign-in to EIM". There are two input fields for "User Name" and "Password". Below these are two buttons: "sign in" and "e3 home". To the right of the input fields are three security logos: VeriSign Secured, Adobe SVG powered, and Microsoft Certified Partner. Below the buttons, there are two links: "If you don't remember your User name and Password you can click here." and "Click here to test your PC for compatibility with EIM." At the bottom, there is a note: "This site is optimized for Microsoft Internet Explorer version 5.5 and above." and a footer with links for "TERMS OF USE", "PRIVACY STATEMENT", and "SECURITY STATEMENT".

Figure 1. EIM login.



The screenshot shows the LocusFocus EIM database selection page. At the top left is the LocusFocus EIM logo. The main heading is "Select an EIM Database". Below this is the text "Available Databases:" followed by a dropdown menu showing "Honeywell". Below the dropdown menu is a "Login" button. At the bottom of the page is a large empty white rectangular box.

Figure 2. Login and database selection.

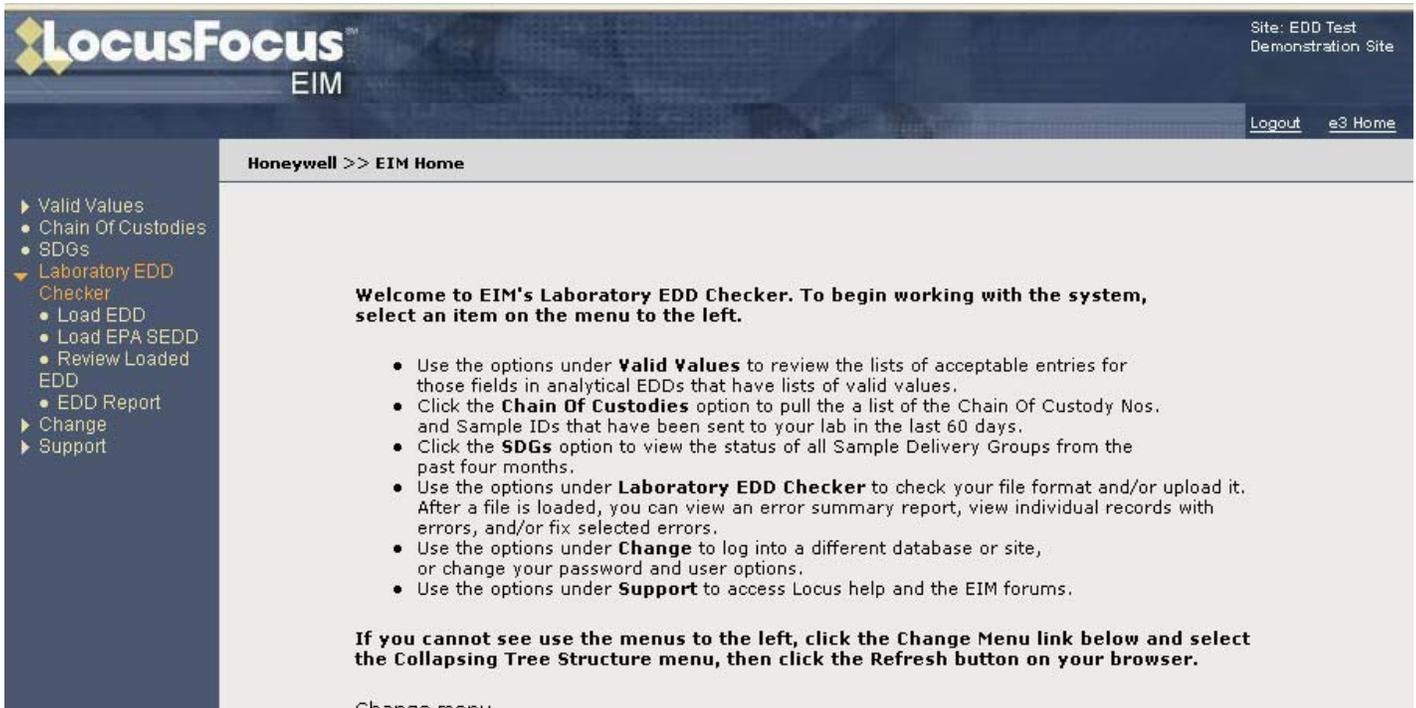


Figure 3. Laboratory upload window.

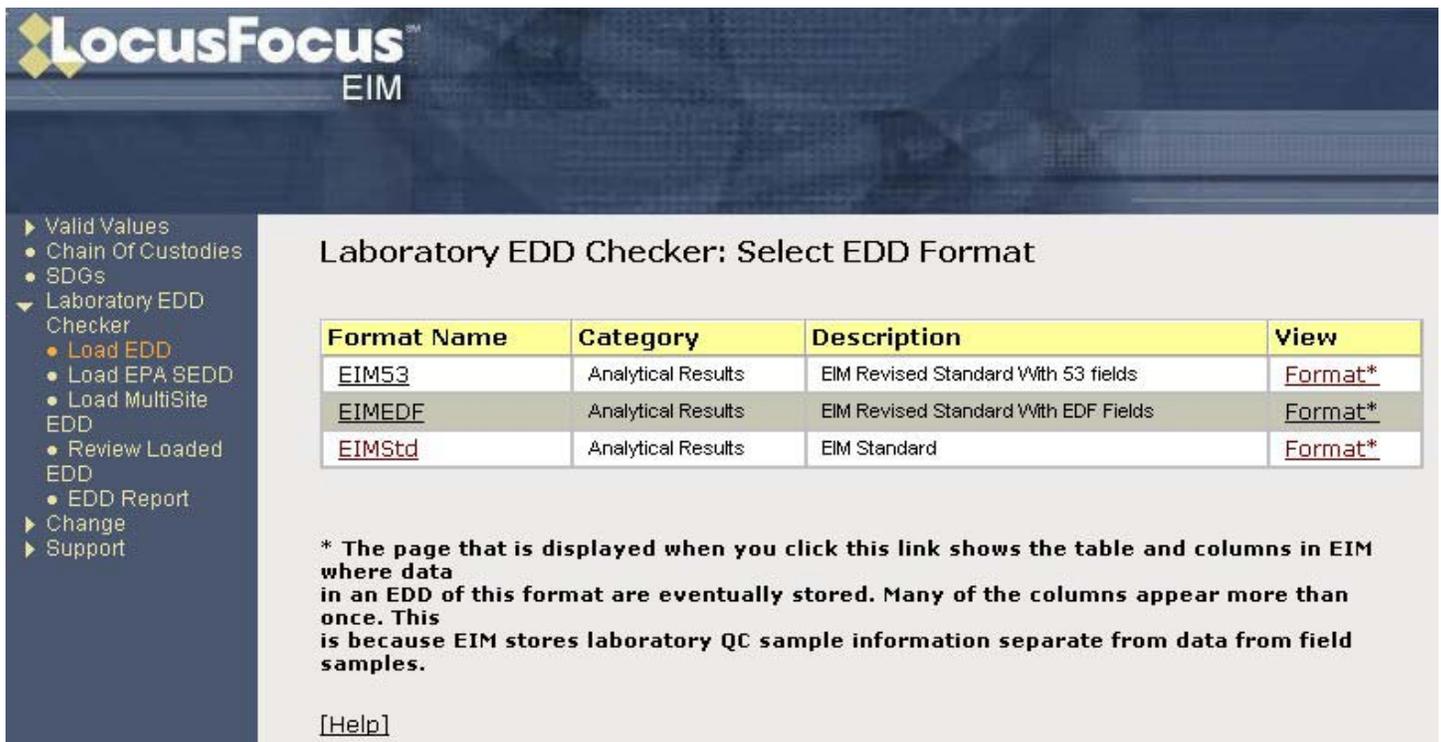


Figure 4. EIM Formats (EIMStd will be phased out and replaced by EIM53). EIMEDF is the single EDD that satisfies your Honeywell EDD and CA EDF EDD requirement with one EDD.

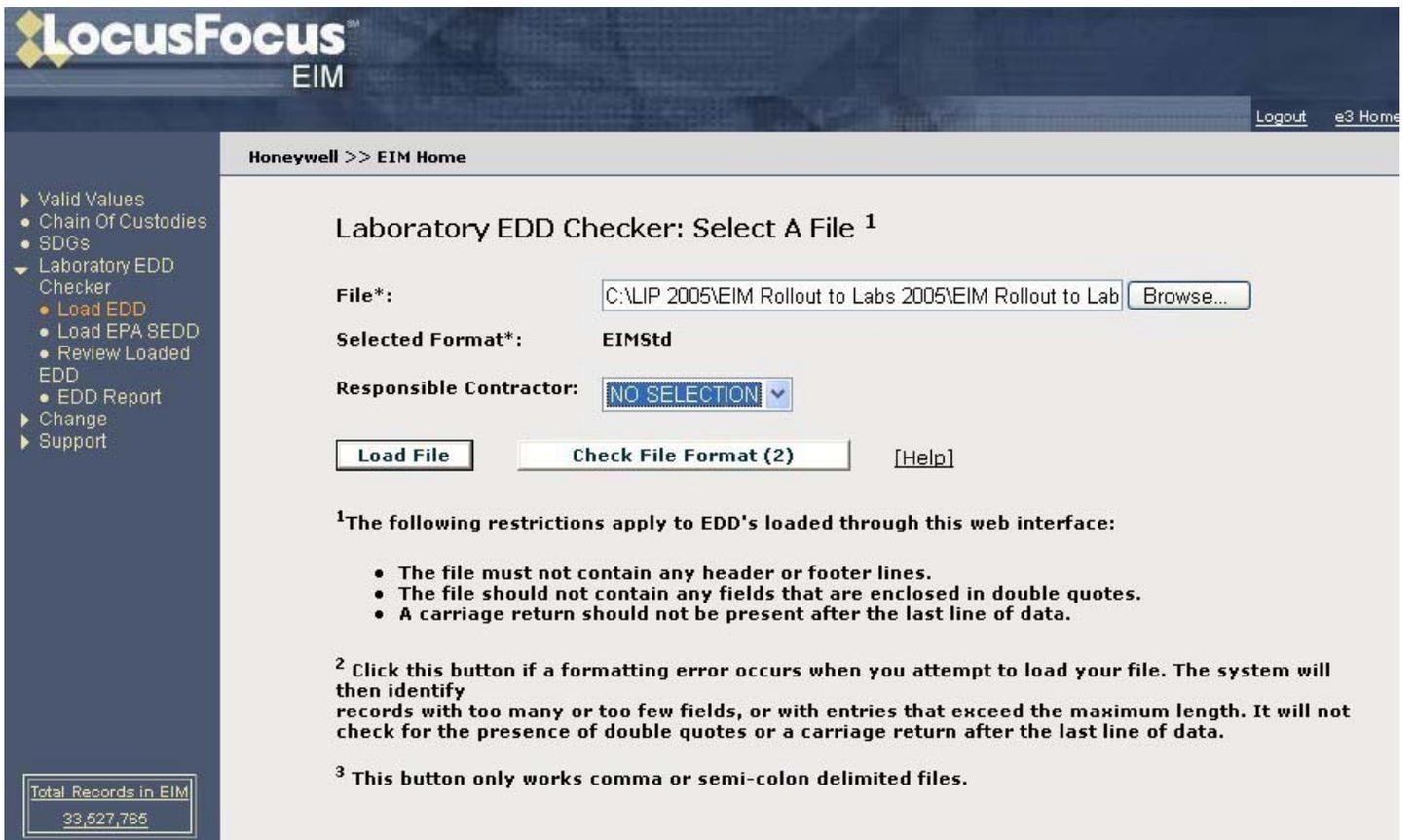


Figure 5. File Selection for laboratory upload to EIM.

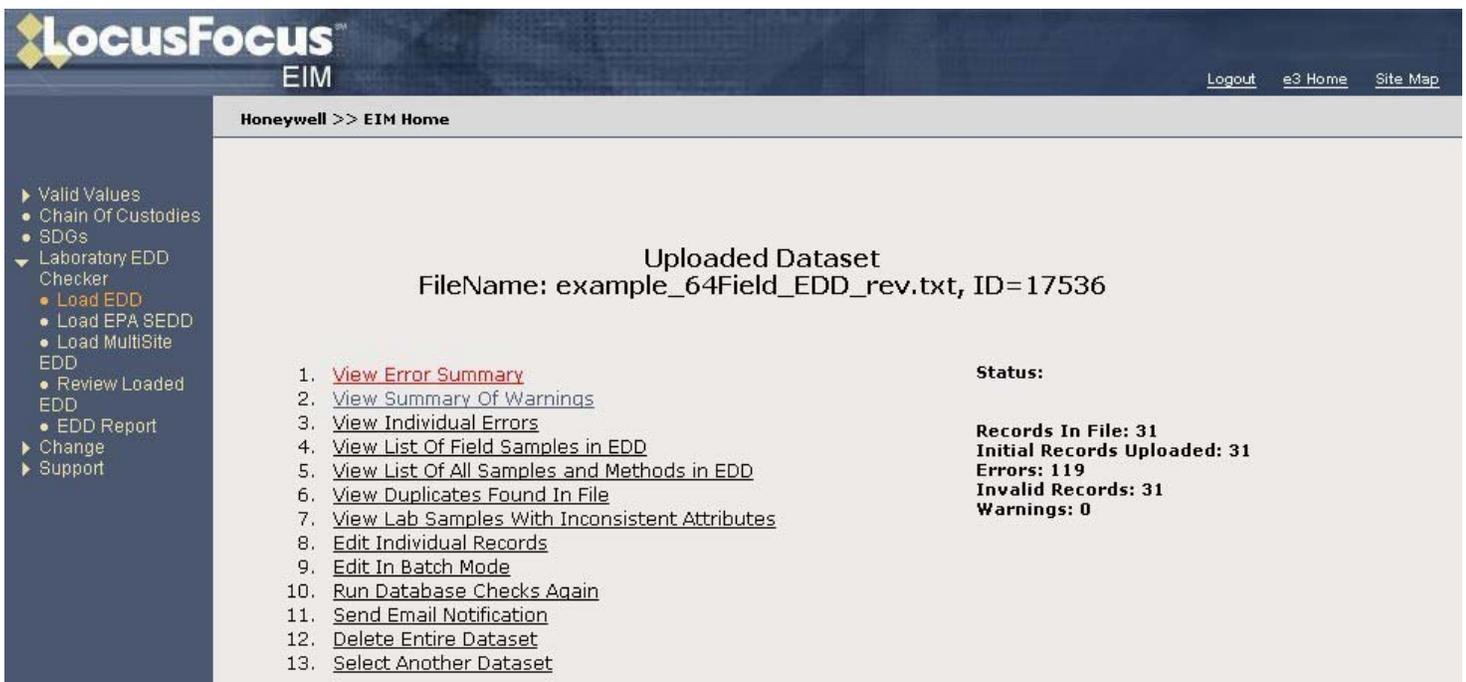


Figure 6. Selection that appears immediately after laboratory upload of dataset by laboratory to site specific database. Note “View Error Summary” and “Send Email Notification”.

Figure 7. EIM Error Report. This is the report that the lab should view during its uploads prior to sending the autonotification that the EDD delivery is complete. The lab should resolve all error messages prior to submitting an autonotification; which may involve calling the consultant to clarify the basis of the errors listed. This sheet will be the one reviewed by AESI and the consultant. The autonotification date will be the time stamp for the purposed of computing on-time delivery and the errors reported here will form the basis of corrective action. This scenario shows where errors may listed, but be no fault of the laboratory. Appropriate corrective action will be taken against consultants who have not appropriately uploaded their portion of the EDD.

| Destination Column | Entry In Column | Type Of Error | Error No. | Number Of Records | Responsible Party |
|--------------------|-----------------|--|-----------|-------------------|-------------------|
| | | Method/Parameter Combination Not Requested | 6 | 12 | Lab/Consultant |
| ANALYTICAL_METHOD | SW8260 | Entry has not been assigned to given site or site group. | 16 | 31 | Consultant |
| FIELD_SAMPLE_ID | MW1-0805 | Entry Not In List Of Valid Values | 2 | 7 | Lab/Consultant |
| FIELD_SAMPLE_ID | MW2-0805 | Entry Not In List Of Valid Values | 2 | 7 | Lab/Consultant |
| FIELD_SAMPLE_ID | TB1-08/20/05 | Entry Not In List Of Valid Values | 2 | 7 | Lab/Consultant |
| LAB_ID | ACTD | Entry has not been assigned to given site or site group. | 16 | 31 | Consultant |

Figure 8. This is an example of an error diagnostic in the event the lab (or the consultant) would like more information regarding an error (Figure 7).

Review Error Summary (Dataset: 17536)

Page 1 of 1 Rows 8

| View Records | Destination Column | Entry In Column | Type Of Error | Error No. | Number Of Records |
|----------------------|--------------------|-----------------|--|-----------|-------------------|
| View | | | Method/Parameter Combination Not Requested | 6 | 12 |
| View | ANALYTICAL_METHOD | SW8260 | Entry has not been assigned to given site or site group. | 16 | 31 |
| View | FIELD_SAMPLE_ID | MW1-0805 | Entry Not In List Of Valid Values | 2 | 7 |
| View | FIELD_SAMPLE_ID | MW2-0805 | Entry Not In List Of Valid Values | 2 | 7 |
| View | FIELD_SAMPLE_ID | TB1-08/20/05 | Entry Not In List Of Valid Values | 2 | 7 |
| View | LAB_ID | ACTD | Entry has not been assigned to given site or site group. | 16 | 31 |

Figure 9. The error report can be output to an Excel version. The lab is advised to retain such an output in the event a discrepancy should arise in the nature of the errors.

| | A | B | C | D | E | F | G | H | I |
|----|----------------------|---------------------------|------------------------|---|------------------|--------------------------|--------------------------|----------------------|---|
| 1 | View Records | Destination Column | Entry In Column | Type Of Error | Error No. | Number Of Records | Responsible Party | Error Details | |
| 2 | View | | | Method/Parameter Combination Not Requested | 6 | 12 | Lab/Consultant | 17536 | |
| 3 | View | ANALYTICAL_METHOD | SW8260 | Entry has not been assigned to given site or site group. | 16 | 31 | Consultant | 17536 | |
| 4 | View | FIELD_SAMPLE_ID | MW1-0805 | Entry Not In List Of Valid Values | 2 | 7 | Lab/Consultant | 17536 | |
| 5 | View | FIELD_SAMPLE_ID | MW2-0805 | Entry Not In List Of Valid Values | 2 | 7 | Lab/Consultant | 17536 | |
| 6 | View | FIELD_SAMPLE_ID | TB1-08/20/05 | Entry Not In List Of Valid Values | 2 | 7 | Lab/Consultant | 17536 | |
| 7 | View | LAB_ID | ACTD | Entry has not been assigned to given site or site group. | 16 | 31 | Consultant | 17536 | |
| 8 | View | REPORT_RESULT | | Required Value Calculated Or Derived From Database Is Missing | 14 | 12 | Consultant | 17536 | |
| 9 | View | REPORT_UNITS | | Required Value Calculated Or Derived From Database Is Missing | 14 | 12 | Consultant | 17536 | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |

Figure 10. Excel versions of error report.

The screenshot shows the LocusFocus EIM web interface. At the top left is the LocusFocus logo. The top right has links for Logout, Home, and Site. Below the header, the breadcrumb trail reads "Honeywell >> EIM Home".

The main content area is titled "Send EDD Upload Notification". It contains several input fields:

- From*:** Lab Project or Data Manager
- From Email Address:** LabPM@lab.com
- To Email Addresses:** Honeywell Contractor
- Send CC copy to Email Address:** ReneSurgji@aol.com
- Subject:** EDD example_64Field_EDD.txt now loaded into EIM site BBIBelmo
- Message*:** The EDD example_64Field_EDD.txt has been loaded to EIM site BBIBelmont as Dataset No. 17757. The EDD is ready for your review. The EDD contains 119 errors in 31 records.

At the bottom left, a box displays "Total Records in EIM: 33,966,800". At the bottom right, there are "Send" and "Cancel" buttons.

Figure 11. Autnotification memo that will contain the site ID, dataset#, #records and # errors. This e-mails should be sent to the consultant and AESI (renesurgji@aol.com). The lab should also email a copy to itself to retain a time/date stamp.

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)