Sampling and Analysis Plan

Post UST Decommissioning Environmental Monitoring
Cornelius Estby II Property, 1021 E Baseline Street, Cornelius, Oregon 97113
UST Facility 5112, LUST 34-06-1375

Prepared for

Metro
600 NE Grand Avenue
Portland, Oregon 97232

Prepared by

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January 5, 2026

Project Number O010.014.001

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terraphase engineering

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Acronyms and Abbreviations

AMSL	above mean sea level
Apex	Apex Analytical Laboratory
bgs	below ground surface
City	City of Cornelius
CSM	conceptual site model
ESA	Environmental Site Assessment
HASP	Health and Safety Plan
LUST	Leaking Underground Storage Tank
MFA	Maul Foster & Alongi
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ODEQ	Oregon Department of Environmental Quality
Programmatic QAPP	*Programmatic Quality Assurance Project Plan*
QA	quality assurance
QC	quality control
RBC	risk-based concentration
SAP	*Sampling and Analysis Plan*
Site	1021 E Baseline Street, Cornelius, Oregon 97113
SOP	Standard Operating Procedure
SSA Work Plan	*Site-Specific Assessment Work Plan*
TOC	top of casing
Terraphase	Terraphase Engineering, Inc.
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

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Signatures

This Sampling and Analysis Plan (SAP) for Phase II Environmental Site Assessment activities has been prepared for Metro by Terraphase Engineering Inc.

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January 5, 2026
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1 Introduction

Terraphase Engineering Inc. (Terraphase), on behalf of Metro, has prepared this *Sampling and Analysis Plan* (SAP) to conduct environmental monitoring activities following underground storage tank (UST) decommissioning at 1021 E Baseline Street, Cornelius, Oregon (the "Site"; Figure 1). Metro has agreed to assist the City of Cornelius (the City) with environmental monitoring activities as the successful applicant for Metro's Brownfield United States Environmental Protection Agency (USEPA) funding. The Site is a former gasoline service station on the southeast corner of the East Baseline Street and South 10th Avenue intersection.

The work described in this SAP is a portion of the 2025 *Site-Specific Assessment Work Plan* (SSA Work Plan) prepared by GSI. The SSA Work Plan scope is a subset of the Scope of Work included in the Prospective Purchaser Agreement between the City and the Oregon Department of Environmental Quality (ODEQ [2025]). The City acquired the Site in January 2025, and Metro is assisting ODEQ with the environmental monitoring portion of the SSA Work Plan scope described in this SAP.

This SAP has been prepared in accordance with the *Programmatic Quality Assurance Project Plan* (Programmatic QAPP) created by Maul Foster Alongi (MFA), on behalf of Metro, dated January 8, 2025.

1.1 Project Overview

Remedial action is required at the Site due to reported releases from USTs resulting in petroleum hydrocarbon impacts to soil, groundwater, and soil vapor. The Prospective Purchaser Agreement required the decommissioning of existing USTs and subsequent groundwater and soil-vapor monitoring (ODEQ 2025). In November 2025, GSI began remedial activities including the decommissioning by removal and in place closure of USTs. GSI will document the UST removal activities in accordance with the SSA Work Plan and develop a conceptual site model (CSM) for the Site. Terraphase will conduct the post-decommissioning groundwater and soil-vapor monitoring and reporting described in this SAP.

1.2 Objective

The objective of the scope of work described in this SAP is to determine soil vapor and groundwater conditions following UST decommissioning. The data will be used to evaluate potential human health and ecological risk associated with residual contamination and to update the CSM for the Site.

1.3 Project Organization

The following are brief descriptions of key project roles and designated personnel for this project:

- **Project Manager (Metro):** Brian Harper, Planning and Development Manager, will provide communication, project management, and logistics, including arranging access to the Site with the City.
- **Project Officer (USEPA)**: Margaret Olson, USEPA Brownfields Project Manager, is responsible for reviewing and approving site-specific work plans and providing assistance to Metro and its consultants to achieve project objectives.

- **Quality Assurance Manager (USEPA)**: Cindy Fields, USEPA Regional Quality Assurance Manager, is responsible for providing quality assurance oversight.
- **Project Manager (ODEQ)**: Jeff Schatz, Project Manager, Hydrogeologist, ODEQ, is responsible for providing guidance to Metro in its implementation of this brownfields assessment program, including conducting reviews of the forthcoming site-specific work plans for brownfield sites addressed by this grant that are enrolled in ODEQ's Voluntary Cleanup Program.
- **Project Manager (Terraphase):** James Farrow, RG, LHG, Principal Hydrogeologist, will manage the development and implementation of the SAP and ensure that all aspects of the field and office work, including reports, are prepared (1) in accordance with the specifications of the work plan; (2) in a professional, safe, and prudent manner; (3) in compliance with applicable laws; (4) using properly trained, licensed, and otherwise qualified personnel; (5) in accordance with the standards of care, skill, and diligence currently recognized in the profession or industry associated with the work scope; and (6) in proper coordination and communication with Metro.
- **Task Manager and Site Health and Safety Officer (Terraphase):** Don Malkemus, RG, LHG, Associate Hydrogeologist, will manage the pre-field activities and implementation of field procedures required to implement the project scope. The Site Health and Safety Officer will also be responsible for the development of and adherence to the Health and Safety Plan (HASP) required to identify hazards and prevent accidents or injuries during implementation of the project scope. The Task Manager and Health and Safety Officer will report to the Terraphase Project Manager.
- **Project Quality Assurance/Quality Control (QA/QC) Manager (Terraphase):** John Hildebrand, Principal Environmental Scientist, will assist in the design of the project scope, monitor the project, and evaluate the project's QA/QC program. The Project QA/QC Manager will communicate QA/QC issues with the Terraphase Project Manager.
- **Soil and Groundwater Laboratory Manager (Apex Laboratory [Apex]):** Cameron O'Brien, Project Manager.
- **Soil Vapor Laboratory Manager (Eurofins Environment Testing Air Toxics, LLC):** Monica Tran, Senior Project Manager.

1.4 Special Training and Certification

Terraphase employees and subcontractors retained for this project will have documented 40-hour Hazardous Waste Operations and Emergency Response training certification, and annual 8-hour Hazardous Waste Operations and Emergency Response Refresher training (as applicable), per Occupational Safety and Health Administration regulations in addition to other requirements of 29 CFR § 1910.120(e).[1]

[1] "Hazardous waste operations and emergency response," 29 CFR § 1910.120, https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910/subpart-H/section-1910.120

1.5 Health and Safety

The site-specific HASP will be prepared in accordance with 29 CFR § 1910.120 prior to the field activities described in this SAP. The HASP will address hazards associated with the planned field activities.

Before the start of each day of field work, and on days when new personnel report to the Site, the Site Health and Safety Officer will conduct a site safety briefing that will include all personnel involved in field operations. All field personnel are to attend the briefing and sign the briefing form. Field personnel will also participate in medical surveillance programs that meet the requirements of 29 CFR § 1910.120(f).

1.6 Permitting and Notifications

No permits are required for this work. Notification of Site visits will be provided to Metro, ODEQ, and the City. If monitoring wells or permanent soil vapor wells are installed, the drilling contractor will submit required construction notices (start cards) and completion to the Oregon Water Resources Department.

2 Background

This section describes the Site, current and historical uses, physical setting, and previous investigations conducted at the Site.

2.1 Site Description and Use

The Site consists of three contiguous land parcels—identified by Washington County's Department of Assessment as tax lots 1S304AB00100, 1S304AB00200, and 1S304AB00201— at 1021 E Baseline Street in Cornelius, Oregon. The approximately 0.53-acre Site is currently vacant, predominantly asphalt-covered, and developed with three out-of-use fueling islands and a kiosk underneath a fueling canopy on the central portion (tax lot 1S304AB00100) and a bathroom/office building on the southwestern portion (tax lot 1S304AB00200; Figure 2). The northwest portion of the Site (tax lot 1S304AB00201) is public right-of-way (sidewalk and roadway).

The Site was first developed with a railroad spur associated with the Southern Pacific Railroad by at least 1912 and was used commercially as a fueling station between 1953 and 2007. Prior to 1994, the fueling station consisted of a building in the center of tax lot 1S304AB00200 with fueling dispensers on the northern portion. In 1994, the station was reconfigured to its current layout, with three fueling islands under a canopy on the west side of tax lot 1S304AB00100. The Site has been unused since the fueling station ceased operation in 2007 (GSI 2025).

ODEQ lists the Site as UST Facility 5112. The following USTs in the western portion of the Site have been decommissioned by GSI in 2025:

- Two 3,000-gallon diesel USTs - removed from the Site (previously decommissioned-in-place by others).

- One 3,000-gallon diesel UST installed in 1985 - removed from the Site.
- One 4,000-gallon gasoline UST installed in 1985 - filled with controlled-density fill and decommissioned-in-place.
- One 5,000-gallon gasoline UST installed in 1981 - removed from the Site.
- One 8,000-gallon gasoline UST installed in 1983 - filled with controlled-density fill and closed in place.
- One 10,000-gallon gasoline UST installed in 1985 - filled with controlled-density fill and decommissioned-in-place.

2.2 Site Geology and Hydrogeology

The Site is approximately 182 feet above mean sea level and slopes slightly to the southwest (GSI 2025). The nearest surface water bodies are Council Creek and the Tualatin River approximately 0.5 miles north and 0.6 miles southeast of the Site, respectively.

Boring logs for borings previously advanced at the Site record poorly graded sand/silt with gravel from the surface to about 2 feet below ground surface (bgs), with very poorly graded silty clays to approximately 15 feet bgs, the maximum depth explored (GSI 2025). This is consistent with Quaternary young alluvium mapped in the vicinity of the Site (Schlicker 1967). Based on geologic mapping, the alluvium is underlain by the Pliocene Troutdale Formation, comprised of older alluvial silt, clay, and sand with occasional gravel and cobble interbeds. Basalt lava flows of the Columbia River Basalt underlie the Troutdale Formation up to 900 feet bgs in the vicinity of the Site (Schlicker 1967).

Depths to first encountered groundwater have been measured in groundwater monitoring wells between 3 and 11 feet below the top of casing. The primary groundwater flow direction has generally been reported towards the south and southeast, though the most recent investigation in 2025 reported groundwater flow to the north (Eastern Research Group, Inc. [ERG] 2025).

2.3 Previous Investigations

In 1994, gasoline contamination was reported to ODEQ presumably during the decommissioning of the two 3,000-gallon diesel USTS. Approximately 24 tons of impacted soil were disposed of at the Hillsboro Landfill and a No Further Action letter was issued in 1996 under Leaking Underground Storage Tank (LUST) case no. 34-94-0100 (GSI 2025).

In 2006, a second release was reported in the vicinity of the 5,000-gallon UST. ODEQ assigned the Site as LUST case no. 34-06-1375. Site investigations were conducted between 2006 to 2019 to assess soil and groundwater quality in the western portion of the Site. These investigations included soil boring advancements, monitoring well installations, groundwater monitoring, and soil vapor sampling. The investigations identified exceedances of ODEQ risk-based concentrations (RBCs) for petroleum compounds (GSI 2025).

In 2019, a focused site investigation was conducted by Evren Northwest, which included the completion of six soil vapor borings and seven soil borings (GSI 2025). The highest concentrations of contaminants in

soil were detected in the vicinity of the decommissioned USTs. The highest concentrations of contaminants were detected at well MW-2 adjacent to the previously decontaminated USTs.

On behalf of the City, the USEPA Targeted Brownfields Assessment Program retained ERG to complete a Phase I Environmental Site Assessment (ESA) in November 2024 and a Phase II ESA in January 2025. The Phase II ESA included 18 soil borings where soil samples were collected, the installation of two monitoring wells, groundwater sampling of existing and new wells, the installation and sampling of five permanent soil-vapor wells, and a hazardous building materials survey. The soil vapor sampling results indicated the potential for vapor intrusion of total petroleum hydrocarbons (TPH) to potential future building inhabitants, with the highest concentrations (650,000 micrograms per cubic meter) recorded at soil-vapor well VP-5.

In July 2025, GSI subcontracted with Ground Penetrating Radar Systems to conduct a ground penetrating radar survey and locate private utilities in the vicinity of the USTs, dispenser islands, and product pipelines. The ground penetrating radar survey confirmed that the location and orientation of the USTs and product pipelines were generally consistent with representations in prior reports and Site documentation (GSI 2025).

3 Scope of Work

The scope of work consists of soil vapor and groundwater sampling at monitoring wells previously installed at the Site to meet the project objectives (Section 1.2; Figure 2). Additional soil vapor and groundwater monitoring wells may be installed if existing monitoring wells are destroyed during decommissioning and excavation activities, or if results of the initial sampling indicate additional monitoring locations are warranted to further delineate petroleum hydrocarbon impacts. This section describes each of these activities.

3.1 Soil-Vapor Sampling

Soil-vapor samples will be collected from the five existing soil-vapor wells (VP-01 through VP-05; Figure 2) in accordance with Terraphase Standard Operating Procedure (SOP) 401-24-00, “Soil-Vapor and Sub-Slab Soil-Vapor Sampling” (Appendix A) and ODEQ and USEPA guidance.

The SOP describes sampling using a Summa™ canister for USEPA Method TO-15 and D-1946 analysis, which will be concluded when a vacuum of approximately 5 inches of mercury is left in the Summa™ canister. Following sample collection, the pump will be removed from the purge line, and the purge line will be fitted with a laboratory-supplied desorption tube and a sampling syringe (or a digital air pump with a known flow rate) for collection of a USEPA Method TO-17 sample. The sampling syringe or pump will be used to collect sample volume in the desorption tube at the laboratory-specified volume. Once the appropriate sample volume has been collected, the tube will be removed, capped at both ends, and placed back into the laboratory-supplied container (if provided) and a Ziploc bag. Each sample will be labeled in accordance with Section 3.5. Samples will be placed in an ice-filled cooler immediately after collection, packaged and shipped to Eurofins Environment Testing Air Toxics, Inc. in Folsom, California,

under chain-of-custody procedures in accordance with Section 4.5 of the Programmatic QAPP (MFA 2025), and submitted for the following analyses under a normal 10-day turn-around time:

- Samples collected in Summa™ canisters will be analyzed for low-fraction TPH[2] and volatile organic compounds (VOCs) using USEPA Method TO-15.
- Samples collected in desorption tubes will be analyzed for TPH in the diesel range using USEPA Method TO-17.
- All samples will be analyzed for helium, oxygen, and carbon dioxide using ASTM Method D-1946.

Analyte-specific container, volume, preservative, and hold time requirements are detailed in Table 2.

3.2 Soil-Vapor Well Installation

If soil-vapor well VP-05 is damaged or removed during decommissioning activities, a replacement soil-vapor well (VP-05R) will be installed subject to ODEQ approval, consistent with its original design, using a direct-push drilling rig in general accordance with Terraphase SOP 400-24-00, "Soil-Vapor Probe Installation" (Appendix A). If an additional soil-vapor well is to be installed based on the analytical results of the sample collected from VP-05, the well (VP-06) will be installed using the same methods. The soil vapor wells will be installed in the boreholes and constructed with a 6-inch stainless-steel screen, 0.25-inch Teflon tubing, and a valve at the termination. A flush-mounted well monument will be used to secure the tubing.

Soil-vapor samples will be collected from the newly installed soil-gas wells following a minimum 48-hour equilibration period after each well installation, in accordance with procedures outlined in Section 3.1.

3.3 Groundwater Monitoring and Sampling

Groundwater samples will be collected from the five existing groundwater monitoring wells (MW-2R[3] and MW-3 through MW-6; Figure 2) using low-flow sampling methods in accordance with the Programmatic QAPP (MFA 2025). The depth to the water table, free product (if present), and field water quality parameters will be measured in each accessible monitoring and remediation well during each sampling event in accordance with the Programmatic QAPP. An oil/water interface probe will be used for water level measurement to assess the potential presence of free-phase TPH. The samples will be labeled in accordance with Section 3.5 and placed in an ice-filled cooler immediately after collection. The samples will be transported to Apex under chain-of-custody procedures in accordance with the Programmatic QAPP for the following analyses under a normal 10-day turn-around time:

- TPH in the gasoline range using NWTPH-Gx;
- TPH in the diesel and motor oil range using NWTPH-Dx;
- TPH-related VOCs (12 total analytes) using USEPA Method 8260D;
- Polycyclic aromatic hydrocarbons using USEPA Method 8270E; and

[2] Laboratory accreditations for TPH analysis using USEPA Methods TO-15 and TO-17 are not included in Appendix A of the Programmatic QAPP and are instead attached as Appendix B of this SAP.

[3] To be installed as described in Section 3.4.

- Dissolved and total lead using USEPA Method 6020B (a 0.45 micron filter will be used to remove entrained particulates prior to dissolved lead analysis)

Analyte-specific container, volume, preservative, and hold time requirements are detailed in Table 2.

3.4 Groundwater Well Installation and Development

MW-2 was destroyed during remedial excavation activities. A replacement groundwater monitoring well, MW-2R, will be installed in the general location of MW-2 in accordance with the Programmatic QAPP (MFA 2025). The monitoring well will be constructed in a 6-inch-diameter boring advanced using a direct-push drilling rig. The monitoring well casing will consist of 2-inch-diameter, pre-packed PVC. The final boring depth and screen interval will be consistent with its original design with well screen across the water table. The screen will extend at least 1 foot above the expected shallowest annual water table, if possible. The screen will consist of pre-perforated 0.010-inch slots with a sand pack of #0/30 silica sand or equivalent to minimize the intrusion of silt. The sand pack will extend from the bottom of the borehole to 1 foot above the top of the screen interval. Hydrated bentonite chips will be placed from the top of the sand pack to 2 feet above the sand pack. Neat cement grout will be placed above the bentonite seal to approximately 1-foot bgs. Concrete will be added in the upper 1-foot bgs and a protective well monument will be placed securely in the concrete. The monitoring well will be fitted with a water-tight, locking well cap.

The monitoring well will be developed a minimum of 48 hours after installation in accordance with the Programmatic QAPP. This replacement groundwater monitoring well, in addition to all others, will be surveyed for top of casing (TOC) data elevation above mean sea level (AMSL).

3.5 Sample Nomenclature

Samples will be labeled in general accordance with the Programmatic QAPP (MFA 2025). Groundwater sample labels are made of a waterproof material backed with a water-resistant adhesive that are applied to the sample container. TO-15 soil-vapor sample labels are tags attached to the Summa™ canister, while TO-17 soil-vapor sample labels are adhered to the sample container. Each sample will be labeled with its unique sample identification code, the time and date of collection, the name and company of the sampler, the project number, the sampling location, and the preservative, if applicable. In addition, soil-vapor sample labels will include the canister identification number, manifold identification number, initial canister vacuum, and final canister vacuum.

A sample designation system will be used to identify samples for laboratory analysis. A list of identifiers used for each sample will be documented in the project logbook by the Field Team Leaders. Each collected sample will be designated a unique sample ID (Table 1). The following information will be utilized to identify samples:

1. **Sample ID standard format:** [Site Name Code]-[Sample Type]-[##]-[Date]
    a. The four-digit site name code will be COEP (Cornelius Estby II Property).
    b. Examples of sample type abbreviations: MW (monitoring well) and (VP) soil-vapor point.
    c. ## represents the Specific Location ID per sample type. The location code will match the location IDs shown in Figure 2.

d. Date will be in Month/Day/Year format and will reflect the date the sample was collected (listed on the chain-of-custody form).

2. **Abbreviations for types of QC samples**: Field duplicate (DUP), trip blank (TB), and field (equipment) blank (EB). Duplicates will be labeled the same as the primary sample with -DUP following the primary sample ID. No blind duplicates will be collected.

3.6 Screening Criteria Selection

Soil vapor and groundwater analytical result will be compared to ODEQ RBCs (ODEQ 2023, 2025) and EPA Regional Screening Levels (USEPA 2024) where an RBC has not been established for an assessment of risk to human health based on the likelihood of exposure. The property is currently undeveloped, and future development has not been determined; therefore, the RBCs for the occupational worker and residential receptor scenarios (the most stringent scenario) for vapor intrusion exposure pathway will be used to compare results. Due to the availability of municipal water to the site and surrounding area, the leaching to groundwater and tap water exposure pathways are considered incomplete. The necessity for including ecological screening criteria will be evaluated after reviewing the CSM (to be developed by GSI).

3.7 Field QA /QC

Field QA/QC procedures will be conducted in accordance with the Programmatic QAPP (MFA 2025). The following field QA/QC samples will be submitted for each event:

- One duplicate soil-vapor sample will be collected from soil-vapor well VP-05 using a clean sample tee connected to the sample train after the flow controller to maintain the same rate of flow.
- One field blank will be collected for TO-17 by uncapping and recapping a desorption tube in the field.
- One duplicate groundwater sample will be collected from groundwater monitoring well MW-2.
- One aqueous filter blank will be collected and submitted with groundwater samples.
- One laboratory-supplied trip blank will be submitted with groundwater samples for each event.
- One Matrix Spike and Matrix Spike Duplicate (MS and MSD, respectively) groundwater sample will be collected for each sampling event. An MS/MSD is not applicable for soil vapor sampling. The MS/MSD samples will be designated on the chain-of-custody form.

The QA/QC samples will be submitted for the same analyses as the respective primary sample, with the exception of the trip blank, which will be submitted for analysis of VOCs using USEPA Method 8260D. No groundwater or soil-vapor sampling equipment blanks will be collected as all the equipment associated with these matrices are single use. A temperature blank will be provided in each cooler submitted to Apex.

3.8 Investigation-Derived Waste

One 55-gallon drum of investigation-derived waste consisting of purge water will be stored at a location suitable to the City. The drum will be labeled with its contents, the date of generation, and Terraphase's

contact information. The drums will be removed from the Site pending analytical characterization by a licensed waste disposal company. Disposal manifests and analytical results of investigation-derived waste will be included as appendices to the reports.

4 Reporting

Two reports will be prepared following the completion of the activities described above – one following the initial groundwater monitoring event and a second following the soil gas sampling and second groundwater monitoring event. The reports will contain the analytical results and include sampling and monitoring forms, analytical laboratory reports, and data validation results. The initial report will also include a boring log and well development form for MW-2R. If additional soil-vapor wells are installed, the second report will document their installation. Figures will be prepared to illustrate the distribution of contaminants of concern, as appropriate. The reports will include an update to the CSM for the Site and an evaluation of the potential risk of identified contamination to human and environmental receptors.

5 Project Schedule

Terraphase proposes to complete this work based on the following schedule:

Scope Element Task	Completion Date
: Submit Draft SAP and HASP for USEPA review	November/December 2025
Reinstall monitoring well MW-2 and perform initial groundwater monitoring	January 2026
Submit Reinstallation and Groundwater Sampling Report	February 2026
Soil vapor sampling and second groundwater monitoring event	August–October 2026
Submit Soil Vapor and Groundwater Sampling Report	November 2026

6 Limitations

This document was prepared for the sole use of Metro and their successors and assignees for specific application to the Site. No other party should rely on the information contained herein without the prior written consent of Terraphase, Metro, USEPA, and the City of Cornelius.

Terraphase will perform the work in accordance with the scope of this SAP. Recommendations or conclusions made by Terraphase are based on our research, inspections, field work, and on-site information provided to us by Metro. It is important to recognize that even the most comprehensive

scope of services may fail to detect environmental liabilities on a particular site. Therefore, Terraphase cannot "certify" that a site is free of environmental contamination. No expressed or implied representation or warranty is included or intended in our reports, except that our services were performed as described by our scope of services in accordance with the standard of care of our profession. Additionally, subsurface conditions will vary between exploration locations, perhaps significantly. The impacts of future events may require further investigation of the subject property and subsequent data analysis along with revision of recommendations or conclusions.

7 References

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Table

Table 1
Sample Matrix
Sampling and Analysis Plan - Post-UST Decommissioning Environmental Monitoring
Cornelius Estby II Property, 1021 E Baseline Street, Cornelius, Oregon 97113

Sample Name	Sample Description	Analysis							
		TPH-g	TPH-d & TPH-o	VOCs	PAHs	Lead (Dissolved and Total)	TPH & VOCs	TPH-d	Helium, Oxygen, and Carbon Dioxide
		NWTPH-Gx	NWTPH-Dx	8260D	8270E	6020B	TO-15	TO-17	ASTM D-1946
First Monitoring Event									
COEP-MW-02-[DATE][1]	Groundwater sample collected from groundwater monitoring well MW-02	X	X	X	X	X			
COEP-MW-02-DUP-[DATE][1]	Duplicate groundwater sample collected from groundwater monitoring well MW-02	X	X	X	X	X			
COEP-MW-03-[DATE]	Groundwater sample collected from groundwater monitoring well MW-03	X	X	X	X	X			
COEP-MW-04-[DATE]	Groundwater sample collected from groundwater monitoring well MW-04	X	X	X	X	X			
COEP-MW-05-[DATE]	Groundwater sample collected from groundwater monitoring well MW-05	X	X	X	X	X			
COEP-MW-06-[DATE]	Groundwater sample collected from groundwater monitoring well MW-06	X	X	X	X	X			
COEP-AQ-FB-[DATE]	Aqueous filter blank collected for field-filter					X			
COEP-TB-[DATE]	Trip blank provided by the laboratory			X					
COEP-MS-[DATE]	Matrix spike/matrix spike duplicate groundwater sample	X	X	X	X	X			
Second Monitoring Event									
COEP-MW-02-[DATE][1]	Groundwater sample collected from groundwater monitoring well MW-02	X	X	X	X	X			
COEP-MW-02-DUP-[DATE][1]	Duplicate groundwater sample collected from groundwater monitoring well MW-02	X	X	X	X	X			
COEP-MW-03-[DATE]	Groundwater sample collected from groundwater monitoring well MW-03	X	X	X	X	X			
COEP-MW-04-[DATE]	Groundwater sample collected from groundwater monitoring well MW-04	X	X	X	X	X			
COEP-MW-05-[DATE]	Groundwater sample collected from groundwater monitoring well MW-05	X	X	X	X	X			
COEP-MW-06-[DATE]	Groundwater sample collected from groundwater monitoring well MW-06	X	X	X	X	X			
COEP-AQ-FB-[DATE]	Aqueous filter blank collected for field-filter					X			
COEP-TB-[DATE]	Trip blank provided by the laboratory			X					
COEP-MS-[DATE]	Matrix spike/matrix spike duplicate groundwater sample	X	X	X	X	X			

Table 1
Sample Matrix
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Sample Name	Sample Description	Analysis							
		TPH-g	TPH-d & TPH-o	VOCs	PAHs	Lead (Dissolved and Total)	TPH & VOCs	TPH-d	Helium, Oxygen, and Carbon Dioxide
		NWTPH-Gx	NWTPH-Dx	8260D	8270E	6020B	TO-15	TO-17	ASTM D-1946
Second Monitoring Event (continued)									
COEP-VP-01-[DATE]	Soil-vapor sample collected from soil-vapor monitoring well VP-01						X	X	X
COEP-VP-02-[DATE]	Soil-vapor sample collected from soil-vapor monitoring well VP-02						X	X	X
COEP-VP-03-[DATE]	Soil-vapor sample collected from soil-vapor monitoring well VP-03						X	X	X
COEP-VP-04-[DATE]	Soil-vapor sample collected from soil-vapor monitoring well VP-04						X	X	X
COEP-VP-05-[DATE][1]	Soil-vapor sample collected from soil-vapor monitoring well VP-05						X	X	X
COEP-VP-05-DUP-[DATE][1]	Duplicate soil-vapor sample collected from soil-vapor monitoring well VP-05						X	X	X
COEP-VP-FB-[DATE]	Field blank collected for TO-17 (soil-vapor)							X	

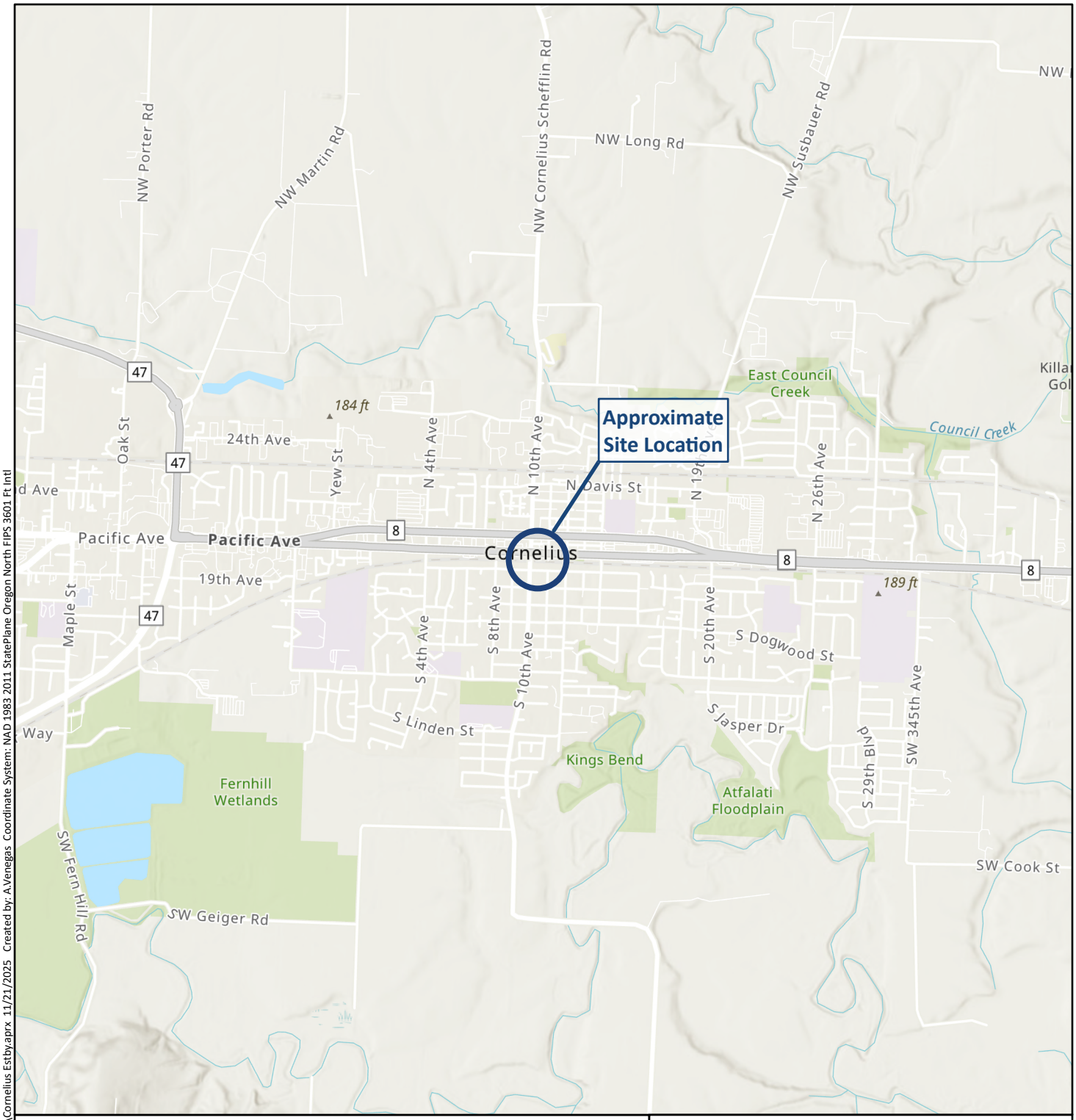
Note:
[1] = location ID contingent on well installation/replacement. If well is to be replaced, sample name will be revised to be consistent with new location ID (e.g., "MW-02R-[DATE]")
[DATE] = Year/Month/Day that the sample was collected (e.g., 20250621)
PAHs = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons
TPH-d = deisel-range TPH
TPH-g = gasoline-range TPH
TPH-o = oil-range TPH
VOCs = volatile organic compounds (the 12 petroleum-related, not full-list)
X = submit sample for specified analysis

Table 2
Sample Requirements
Sampling and Analysis Plan - Post-UST Decommissioning Environmental Monitoring
Cornelius Estby II Property, 1021 E Baseline Street, Cornelius, Oregon 97113

Analyte	Method	Container	Preservative	Hold Time
Groundwater				
TPH-g	NWTPH-GX	40 milliliter VOA (3)	HCL, cool to 4 degrees C	14 days
TPH-d and TPH-o	NWTPH-Dx	1 Liter Amber Glass (1)	HCL, cool to 4 degrees C	14 days
VOCs	EPA 8260D	40 milliliter VOA (3)	HCL, cool to 4 degrees C	14 Days
PAHs	EPA 8270E	1 Liter Amber Glass (1)	Cool to 4 degrees C	7 days
Total and Dissolved Lead	EPA 6020B	250 milliliter Polyethylene (1)	HNO3, cool to 4 degrees C	6 months
Soil Gas				
TPH-g and VOCS	EPA TO-15	1 liter Summa Canister (1)	NA	30 days
TPH-d	EPA TO-17	Sorbent Tube (1)	Cool to 4 degrees C	30 days
Helium, oxygen, and carbon dioxide	ASTM D-1946	1 liter Summa Canister (1)	NA	3 0 days

Note:
PAHs = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons
TPH-d = diesel-range TPH
TPH-g = gasoline-range TPH
TPH-o = oil-range TPH
VOCs = volatile organic compounds (the 12 petroleum-related, not full-list)

Figures



0 1,250 2,500 5,000 Feet

1 inch = 2,500 feet

N

Legend

Approximate Site Location

Service Layer Credits: World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
World Hillshade: Esri, NASA, NGA, USGS, FEMA

SAFETY FIRST

terraphase engineering

CLIENT: Metro

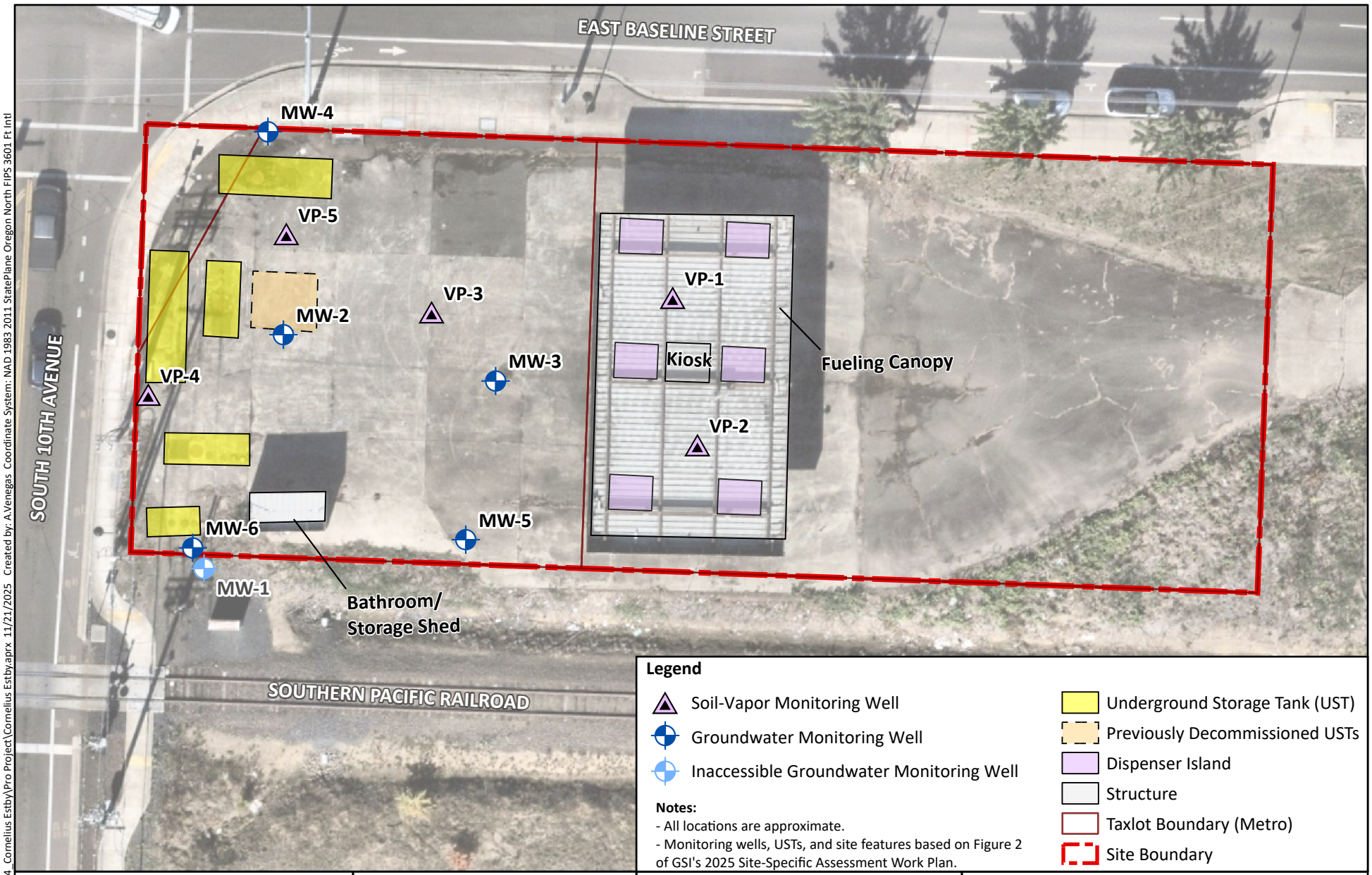
PROJECT: Cornelius Estby II
Environmental Monitoring SAP
1021 E Baseline Street, Cornelius, OR

PROJECT NUMBER: O010.014.001

Site Location

FIGURE 1

File: N:\GIS\Prj\0010 Metro\014_Cornelius Estby\Pro Project\Cornelius Estby.aprx 11/21/2025 Created by: AVenegas Coordinate System: NAD 1983 2011 StatePlane Oregon North FIPS 3601 Ft Intl



Legend

- Soil-Vapor Monitoring Well
- Groundwater Monitoring Well
- Inaccessible Groundwater Monitoring Well
- Underground Storage Tank (UST)
- Previously Decommissioned USTs
- Dispenser Island
- Structure
- Taxlot Boundary (Metro)
- Site Boundary

Notes:
- All locations are approximate.
- Monitoring wells, USTs, and site features based on Figure 2 of GSI's 2025 Site-Specific Assessment Work Plan.

0 7.5 15 30 Feet

1 inch = 30 feet

N

Imagery Source: Nearmap (September 15, 2025)

SAFETY FIRST

terraphase engineering

CLIENT:	Metro
PROJECT:	Cornelius Estby II Environmental Monitoring SAP 1021 E Baseline Street, Cornelius, OR
PROJECT NUMBER:	O010.014.001

Site Map and Proposed Sample Locations

FIGURE 2

File: N:\GIS\Prj\O010 Metro\014_Cornelius Estby\Pro Project\Cornelius Estby.aprx 11/21/2025 Created by: A.Venegas Coordinate System: NAD 1983 2011 StatePlane Oregon North FIPS 3601 Ft Intl

Appendix A

Terraphase SOPs

terraphase engineering

Standard Operating Procedure 400-24-00

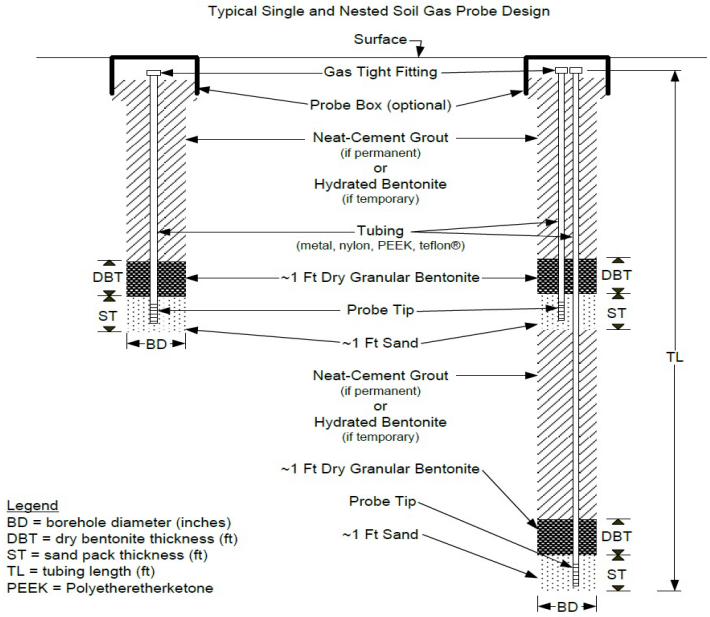
Soil-Vapor Probe Installation

This Standard Operating Procedure (SOP) defines and standardizes procedures to install soil-vapor probes for soil-vapor sample collection. These procedures are recommended for use at all soil-vapor probe locations to provide for consistent and accurate soil-vapor probe installation. Strict adherence to these procedures shall help ensure the proper collection and integrity of the soil-vapor sample.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Drilling equipment
- Teflon or Nylaflow tubing – ¼-inch outer diameter
- Airstone filter or stainless-steel screen
- Probe tubing cap or polycarbonate Luer-Lok™ valve
- Kiln dried sand
- Distilled water (enough for hydrating bentonite **and** mixing grout)
- Dry granular bentonite crumbles
- Bentonite chips or neat cement and bentonite powder
- Well box (optional)



Source: California Environmental Protection Agency Department of Toxic Substances Control, Los Angeles Regional Water Quality Control Board, San Francisco Regional Water Quality Control Board, *Advisory – Active Soil Gas Investigations,* July 2015.

2. Procedures

The following procedures shall be adhered to during the installation of all soil-vapor sampling probes. The boring for the probe installation may be drilled using several methods such as direct-push technology, hollow-stem auger, or hand auger; however, mud rotary drilling should never be used for soil-vapor probe borings.

2.1 Shallow/Single-Depth Probes

The screen implant and tubing will be placed down the boring to the appropriate depth using a temporary rod or pipe to ensure accurate depth of placement. For probes deeper than 15 feet, the probe implant and tubing should be affixed to a downhole rod (e.g., small-diameter PVC pipe) that remains in the boring to ensure accurate placement of the probe. For probes with multiple implants at various depths in a single boring, mark the depth of each probe at the top of the tubing that extends aboveground.

The screen implant should be centered in an approximate 1-foot-thick interval of clean sand. Approximately 6 to 12 inches of dry granular bentonite crumbles should be placed on top of the filter sand as a transition seal and hydrated in 3-inch lifts with **distilled water**. The remainder of the boring, above the transition seal, should be filled either with bentonite chips or pellets in 1-foot **distilled water** hydrated lifts (for temporary probes) or with a neat cement grout containing up to 5 percent bentonite powder (for permanent probes). The water used to mix the cement grout should be distilled water, not potable water.

The surface of the installation should be sealed with hydrated bentonite (for temporary probes) or grout (for permanent probes) and covered for protection. For temporary probes, a 2-inch-diameter PVC cover may be inserted into the surface seal and flagged to ensure that the monitoring point is visible. Temporary probes may also be buried by wrapping the probe tubing in plastic, covering with clean sand, and applying cold patch asphalt at the surface. Permanent probes should be protected by installing a well box set in concrete.

After installation, ensure the top of the probe tubing is sealed with a cap of polycarbonate valve to ensure no moisture enters the tubing and soil vapor from the probe is not released. The location of the probes will be measured and accurately marked on a field map or the location will be read using a GPS unit and the coordinates will be recorded in the field notes.

2.2 Deep/Multi-Depth Probes

For borings with more than one probe installed at various depths follow the procedures above. However, after placing the first (deepest) probe, sand pack, and granular bentonite transition seal, place the annular seal of hydrated bentonite or neat cement/bentonite grout to approximately 6 inches below the next shallowest probe depth.

Once the bentonite or grout have set enough to support the next 1-foot-thick filter sand interval, begin constructing the next shallower vapor probes using the same methodology as above. Repeat this approach on additional shallower probes, as necessary.

For borings deeper than 15 feet below ground surface, the granular bentonite transition seal and neat cement grout (if used) should be placed using a tremie pipe.

2.3 Documentation

Field documentation will be maintained in the project field notes and the probe construction details will be recorded on the Terraphase Monitoring Well Completion Record form. Field notes and the Monitoring Well Completion Record will contain, at a minimum, the site and subsurface lithology

conditions observed at the time of the soil-vapor probe installation, construction details (depth and diameter of boring, type and size of implant, length of tubing, height of sand pack, height of dry bentonite, specific types of sand/bentonite/grout used; e.g., bentonite crumbles or granular bentonite), and any deviations from the above protocol.

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Standard Operating Procedure 401-24-00

Soil-Vapor and Sub-Slab Soil-Vapor Sampling

This Standard Operating Procedure (SOP) defines and standardizes soil-vapor and sub-slab vapor sample collection procedures to provide consistency in collection techniques and ensure collection of high quality, representative samples. Strict adherence to these procedures will help ensure that the sampling results in meaningful and accurate data. The sampling activities should be performed in accordance with applicable regulatory guidance.

1. Regulatory Guidance

Regulatory guidance documents vary by state or region—verify the appropriate guidance for the project location. A partial list of regulatory guidance documents is provided in the references section of this SOP. Because guidance documents are often updated, check the source to ensure the current guidance is used. If unsure which guidance applies, consult with the project manager or one of the Vapor Intrusion Discipline Group leaders. Variances from this SOP due to local requirements should be documented.

2. Equipment and Materials

The following is a list of equipment necessary to carry out the procedures contained in this SOP:

- Sample container; maximum volume of 1 liter (Summa canister, Tedlar® bag, Bottle-Vac™, or similar).
- Sampling manifold with flow controller pre-set to proper flow rate (100–200 milliliters [mL] per minute [mL/min]) from the laboratory.
- Standalone digital vacuum gauge from the laboratory.
- Sample inlet tubing (1/4-inch outer diameter [OD] Nylaflow, Teflon, or Teflon-lined tubing) with compatible fittings for connections to the probe and the sampling manifold (e.g., Swagelok or single-use polycarbonate tubing fittings). Avoid low-density polyethylene and vinyl fittings. Typically, laboratory equipment and soil-vapor wells use 1/4-inch OD diameter tubing and fittings.
- Purging device (60-mL syringe with Luer-Lok™ tip/three-way valve, air sampling pump [such as Sensidyne GilAir Plus pump], or extra Summa canister).
- Sampling shroud (see Figure 1) either constructed by Terraphase or supplied by the laboratory.

Figure 1: Soil-Vapor Sampling Shroud

- Leak detection/tracer gas, typically consisting of a helium gas tank with compatible flow regulator. Other gas or liquid tracers may be substituted on a project-specific basis. This SOP focuses on helium as it is the most commonly used tracer.
- Helium gas field detector(s); Dielectric MGD-2002 helium detector (± 0.1 percent accuracy) or similar (preferably two separate units).
- Multi-gas detection meter if methane is a concern.
- Purge volume calculator/spreadsheet.
- Soil-vapor sampling field logs (digital or paper).
- Recommended tools:
  - Flathead screwdriver
  - Open end combination wrenches (9/16- and 1/2-inch)
  - Crescent adjustable wrench (2x)
  - Scissors/snips to cut tubing
  - Ball point pen
  - Clipboard
  - Nitrile gloves
  - Fittings for connecting the soil-vapor probe to the manifold/sampling apparatus. Common fittings include:
    - Stainless-steel compression fittings/valves (e.g., 1/4-inch OD Swagelok)
    - Three-way polycarbonate stop valves (Luer-Lok™)
    - Luer-Lok™ to barb adaptors (1/4-inch OD)
    - Silicone or Tygon tubing (2-inch sections of 1/4-inch-inner-diameter tubing)
    - Zip ties (4-inch).
  - Stopwatch or other time-keeping device.
  - Health and safety plan.

3. Sampling Methods

This section presents an overview of field sampling methods and considerations.

3.1 Equilibration Times and Weather Considerations

Subsurface conditions are disturbed during drilling and soil-vapor probe placement. To allow the subsurface to equilibrate back to representative conditions, the following equilibration times should be observed before proceeding with sampling:

- Soil-vapor probes installed using direct-push technology – at least 2 hours.
- Soil-vapor probes installed by auger methods (including hand auger) – at least 48 hours.
- Sub-slab vapor probes – at least 2 hours.

See applicable guidance for recommended equilibration times based on other probe placement methods.

Soil-vapor sampling should not occur during or within 5 days after a significant rain event (0.5 inches or greater during a 24-hour period). However, soil-vapor sampling after rainfall can proceed where infiltration has not occurred, such as under buildings or beneath high-integrity pavement. The project manager should be consulted for a final decision on sampling timing based on significant rainfall events.

3.2 Shut-In Test

Prior to initiating soil-vapor purging and sampling, an initial shut-in test will be conducted to assess the integrity of the sample apparatus fittings. The sample train should first be fully assembled, including connection from the probe or well to the manifold, then to the purge line and sampling container. With the valves at the Summa canister (or other sample container) and the soil-vapor probe both in the closed position, the purging device will be used to apply a vacuum to the sampling manifold of approximately 100 inches of water (equivalent to approximately 7.4 inches of mercury [Hg]). The purge line valve will then be closed to isolate the manifold under vacuum. The shut-in test will be conducted for a minimum of 1 minute to observe whether the vacuum is maintained in the sampling manifold. Shut-in tests typically do not continue longer than 2–3 minutes. If a noticeable drop in vacuum is observed, recheck and retighten all the fittings/connections and repeat the test until there is no noticeable drop in vacuum.

3.3 Purging and Leak-Check Procedures

Purging removes stagnant air from the sampling system and the soil-vapor probe prior to sample collection. Leak checks are performed during purging to evaluate if ambient air is entering the probe or sample train during purging (and therefore could be introduced into the sample during the collection process). Leak-check methods are described in the subsections below. For quantitative leak-check methods, purging must be conducted with the entire sample train under a shroud with an atmosphere enriched by the selected tracer gas. For either qualitative or quantitative leak-check methods, the leak check setup shall be put in place at the probe or well location prior to initiating purging procedures described below.

Three purge volumes should be calculated and extracted prior to sampling. When possible, purge volumes should be calculated prior to field mobilization. One purge volume typically consists of the vapor probe filter sand (30 percent sand porosity) and dry bentonite void space (50 percent dry bentonite porosity), the tubing and probe tip volume, and any aboveground manifold volume. To aid in the calculation of the purge volumes, a purge calculator available on the Terraphase server may be used (J:\Project Management Policies and Forms\Field Forms\Soil Gas, Indoor, Outdoor Air).

Stagnant soil vapor in the probe will be purged using the selected purging device (e.g., gas-tight syringe, purge canister, or pump) with a flow rate of not greater than 200 mL/min. A higher flowrate may be applied in the case of excessive purge times; however, flowrate should return to no greater than 200 mL/min for sampling.

Vacuum on the aboveground tubing/manifold during purging and sampling will be monitored to ensure the imparted vacuum is no greater than 100 inches of water (7.4 inches of Hg). If vacuum above 100 inches of water is observed, indicating high back-pressure conditions, contact the project manager for instructions. If this occurs, the probe is either sampled using a slower purge rate with a vacuum of less than 100 inches of water or sampled using an alternative approach as allowed by the appropriate regulatory guidance or sampling of that probe is aborted.

3.3.1 Quantitative (Gaseous) Leak Check

A quantitative leak check can be performed if the selected tracer gas (helium as a default) can be measured in real time in the field using a gas detector. Prior to purging, a sample shroud will be placed over the top of the soil-vapor probe, the sample container, the manifold, and the shroud helium gas detector (if used). A good seal between the shroud and the ground surface will be ensured. The helium gas will then be introduced into the shroud via tubing. The purge line (i.e., purging device, in-line gas detector, and tubing) and the sample container will be connected to the soil-vapor probe by a three-way valve. The purging device and in-line gas detector remain outside the shroud, while the sample container, the shroud helium gas detector (if used), and the three-way valve and other tubing remain within the shroud. The figure below shows a typical shroud setup.

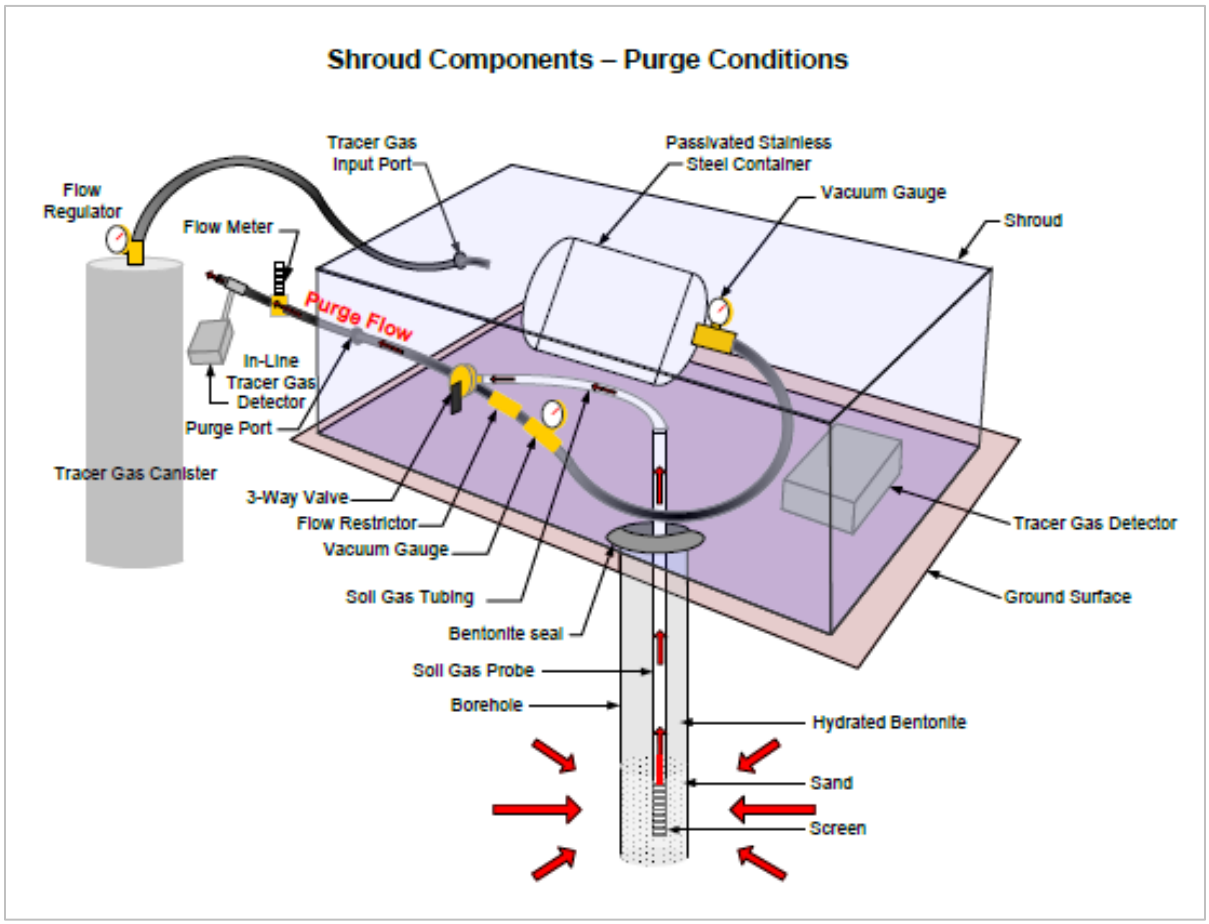

Figure 2: Shroud Components – Purge Conditions
Source: Advisory

Throughout the purging process, the helium tracer gas concentration inside the shroud should be maintained between 15 and 20 percent by observing the shroud helium detector and introducing more helium whenever the level drops below 15 percent. During purging, the helium concentration in the purged air should be measured periodically to ensure that a leak is not occurring. This will be performed by monitoring air exiting the soil-vapor purge line using the (external) helium detector to determine if helium is entering the probe or sample train during purging activities. Helium levels in the shroud and purge line will be recorded on the soil-vapor sampling field logs throughout sampling.

Helium concentrations detected in the purged air which are greater than 5 percent of the average shroud concentration during purging activities indicates that the probe should be resealed and retested. A helium tracer gas concentration in the purged air less than 5 percent of the average shroud concentration indicates the probe is sealed sufficiently and collection of the vapor sample can proceed.

After sample collection, ensure that laboratory analysis for helium is included on the laboratory chain of custody.

3.3.2 Qualitative (Liquid) Leak Check

If a quantitative (gaseous) leak-check process is not being used, a qualitative (liquid) leak check should be used to demonstrate sample integrity. Liquid tracer compounds include, but are not limited to, 1,1-diflouroethane, n-propanol, hexane, and pentane. The selected liquid leak-check compound should not be a suspected site-specific contaminant. Liquid leak checks are more commonly used when analyzing samples using an on-site mobile laboratory because the laboratory results can be provided the same day and if leaks (elevated tracer gas concentrations) are discovered, there may be an opportunity to correct the leak and resample.

Liquid tracer compounds should only be handled while using single-use disposable gloves and should be applied to a towel or clean rag by pouring or spraying away from the sampling location. Before applying the liquid tracer compound to towels or clean rags, the sampling connections between the vapor probe to the sample manifold and sample container should already be completed and ready for purging to minimize the chance the liquid tracer contaminating the sample apparatus or equipment prior to sample collection. The rags with liquid tracer compound should be stored in a zipper-sealed bag until they are ready to be used. The liquid tracer container should also be stored in a separate, closed, air-tight container away from the sampling location.

The liquid leak-check compound should be applied immediately prior to purging and sampling the probe. The gloves used to handle the liquid tracer should be carefully removed and disposed in a sealed container (e.g., zipper-sealed bag) before touching the sampling equipment. Hands should be washed between handing the liquid tracer and start of purging and sampling. If a probe is located indoors, the liquid leak check should be applied to the towel or rag outdoors, while all the doors and windows to the sample collection area are closed, and then brought to the sample location once ready for purging and sampling. If sampling is conducted outside, the liquid leak-check compound should be applied to the towel or rag in a downwind location, away from the sample equipment and probe location. If two samplers are present, following clean/dirty hands protocols is recommended, with clean hands handling the sample collection and dirty hands handling the liquid leak compound.

The bag with the liquid tracer-saturated towel or rag should then be placed near the connections from the probe, the sampling train, and sample container, and then opened just prior to purging and sampling. If necessary, especially on windy days or if the sampling train requires a large area, the saturated towel(s) can be removed from the plastic bag and placed immediately adjacent to the sample collection equipment, especially at the probe surface and connections in the sample train. Do not apply, spray, or pour the liquid tracer directly onto a fitting or any part of the sample apparatus.

The towel or rag used for the leak detection can be reused between sample locations. If reused, additional liquid compound should be applied to re-saturate the towel or rag prior to purging and sampling each location. If the purging and sampling collection takes longer than approximately 5 minutes, it is recommended that the liquid tracer be reapplied to the cloth.

After sample collection, ensure that laboratory analysis for the liquid tracer compound is included on the laboratory chain of custody.

3.4 Sample Collection

After the shut-in test has been successfully performed, the soil-vapor probe purged, and the leak-check procedure completed, sample collection shall begin. This section is specific to use of helium as a tracer. For sampling using a liquid leak-check compound, the procedures are similar but without use of the shroud, helium, and field gas detectors.

Prior to sample collection, the helium concentration inside the shroud will be measured and adjusted to the target concentration of 15 to 20 percent. The purge line will then be closed. At this point, the sample train configuration will be open from the soil-vapor probe, through the manifold/flow controller, and to the sample container. Pre-sampling data will be recorded on field forms, including shroud helium concentration and initial Summa canister vacuum.

Sampling will begin by opening the Summa canister valve or another acceptable sampling container. Sample start time shall be recorded. The concentration of helium inside the shroud and remaining Summa canister vacuum will be recorded every minute after sampling has begun. The sample container or the connected sampling manifold will be fitted by the laboratory with a vacuum gauge and critical orifice flow regulation device designed to allow sample collection at a flow rate of approximately 100 to 200 mL/min. The flow rate will be verified from the rate of change in the canister vacuum during sample collection. If sampling with a Tedlar® bag, either use a lung box with a sample pump set to a flow rate of approximately 100 to 200 mL/min or fill the Tedlar® bag using a 60-mL syringe and three-way valve at a rate of approximately one syringe volume every 20 to 30 seconds.

To stop sample collection, the Summa canister valve will be closed tightly. Sample collection shall be terminated when there is still residual vacuum left in the canister (typically 5 inches of Hg) rather than allowing the canister to fill completely to zero vacuum. The residual vacuum reading and sample stop time will be recorded on the field form. A 1-liter Summa canister will typically fill within 5 to 8 minutes at an approximate flowrate of 200 mL/min. If sample collection is slower than typical, the vacuum gauge rate of change will continue to be monitored while sampling. Sample duration should not exceed 30 minutes. If the Summa cannot be filled to a residual vacuum of 5 inches of Hg within 30 minutes, the project manager will be notified to determine if the sample should not be analyzed due to insufficient sample volume.

The samples will be submitted to the analytical laboratory under chain-of-custody protocols for analysis of the project-specific analyte list and the appropriate leak-check compound.

4. Documentation

Field purging and sampling information will be documented using a Terraphase soil gas sampling log. All entries on the forms will be completed (i.e., leaving no blank cells). A line will be placed across cells that are unused or not applicable in accordance with proper field note-taking protocols. Any deviations from the above protocols will be recorded on the sampling log. As noted, it is recommended that the canister pressure and the percentage of helium in the shroud and the purge line be recorded throughout purging and sampling. For a standard soil-vapor sampling event that typically has a sample duration of less than 10 minutes, canister pressure and shroud helium percentage readings should be measured immediately once sampling has started, at a minimum of every 1 minute thereafter, and the final readings should be recorded when the sample collection has ended.

5. Additional Recommendations

After receiving the Summa canisters from the laboratory, and prior to field mobilization, the pressure in each canister should be measured with a vacuum gauge and recorded to ensure that the appropriate negative pressure exists within the sample canister (-26 to -30+ inches of Hg). If any canister shows insufficient initial vacuum during this pre-field check, a replacement canister should be obtained from the laboratory, if possible, prior to mobilization.

Duplicate samples shall be collected from a single soil-vapor probe using a “Y” connection (also referred to as a “T-splitter”) that has one line of tubing connected to the well, branching to two lines of tubing connected to separate Summa canisters or other sampling containers. The primary and duplicate samples will be collected concurrently.

Each vacuum gauge should be inspected prior to use as they can sometimes be damaged during transport. Gauges that are reading well outside of their indicated range, have broken protective housings, or stuck needles, shall not be used.

An additional 10 percent (minimum) of extra sets of sampling equipment will be requested when ordering laboratory equipment (i.e., Summa canister and manifold) in case of damaged equipment, leaking fittings, field errors, or insufficient canister vacuum.

Delivery of sampling equipment from the laboratory will be requested at least 3 days prior to the scheduled field sampling event to allow time to inventory equipment and check canister vacuums. Do not order equipment for delivery more than 1 week in advance of sampling because canister vacuums can dissipate if allowed to sit unused for long periods.

Unused laboratory equipment after the sampling event will not be retained (i.e., all equipment will be returned to the laboratory after each event).

6. References

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Washington State Department of Ecology, Toxic Cleanup Program. 2022. *Guidance for Evaluating Vapor Intrusion in Washington State: Investigation and Remedial Action.* Publication No. 09-09-047. March. https://apps.ecology.wa.gov/publications/documents/0909047.pdf.

Appendix B

Laboratory Quality Assurance Manuals

ANALYTICAL METHODS

Section 9.0

Method: EPA Method TO-14A/TO-15 Volatile Organic Compounds (Standard/QUAD)			
Laboratory SOP #: 6	Revision #: 50	Effective Date: May 28, 2024	Methods Manual Summary

Description: This method involves full scan gas chromatograph/mass spectrometer (GC/MS) analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds (VOCs) using EPA Method TO-14A/TO-15 protocols. An aliquot of up to 0.5 liters of air is withdrawn from the canister utilizing a volumetric loop or mass flow controller. This volume is loaded onto a hydrophobic multibed sorbent trap to remove water and carbon dioxide and to concentrate the vapor sample. The focused sample is then flash-heated to sweep adsorbed VOCs onto a secondary trap for further concentration and/or directly onto a GC/MS for separation and detection.

Eurofins Environment Testing Northern California, LLC maintains a suite of TO-14A/TO-15 methods, each optimized to efficiently meet the data objectives for a wide range of targeted concentration ranges. The methods, their reporting limits, and typical applications are summarized in the table below. This method summary describes TO-14A/TO-15 full scan (Standard or QUAD).

Eurofins Environment Testing Northern California, LLC Method	**Base Reporting Limits**	**Typical Application**
TO-14A/TO-15 Full Scan (5&20)	5 – 20 ppbv	Soil gas and ppmv range vapor matrices
TO-14A/TO-15 Full Scan (Standard or QUAD)	0.5 – 5.0 ppbv	Ambient air, soil gas, and ppbv level vapor matrices
TO-14A/TO-15 Full Scan (Low-level)	0.1 – 1.0 ppbv	Indoor and outdoor air
TO-14A/TO-15 SIM	0.01 – 0.5 ppbv	Indoor and outdoor air

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

Eurofins Environment Testing Northern California, LLC takes no modifications of technical significance to Method TO-15 for the "QUAD" configurations. Since Eurofins Environment Testing Northern California, LLC applies TO-15 methodology to all Summa canisters regardless of whether TO-14A or TO-15 is specified by the project, the laboratory has

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established modifications to method TO-14A as detailed in Table 1. Please note that Methods TO-14A and TO-15 were validated for specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of the method and not recommended for ambient or indoor air samples. It is the responsibility of the data user to determine the usability of TO-14A and TO-15 results generated from Tedlar bags.

Table 1. Summary of TO-14A Method Modifications

Requirement	TO-14A	Laboratory Modifications
Sample Drying System	Nafion Drier	Multibed hydrophobic sorbent.
Blank acceptance criteria	≤ 0.2 ppbv	≤ RL
BFB ion abundance criteria	Ion abundance criteria listed in Table 4 of TO-14A	Follow abundance criteria listed in TO-15.
BFB absolute abundance criteria	Within 10% when comparing to the previous daily BFB	CCV internal standard area counts are compared to ICAL; corrective action when recovery is less than 60%.
Initial Calibration	≤ 30% RSD for listed 39 VOCs	Follow TO-15 requirements of ≤ 30% RSD with 2 of Laboratory's 62 standard compounds allowed out to ≤ 40% RSD

The standard target analyte list, reporting limit (RL) also referred to as Limit of Quantitation, QC criteria, and QC summary can be found in Tables 2 through 6.

Table 2 is the standard list of accredited compounds (except where noted), reporting limits and QC acceptance criteria. Each project may be customized as needed. Additional compounds and different reporting limits may be obtainable and/or achieved upon request.

Table 2. Method TO-14A/TO-15 Analyte List (QUAD)

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
1,1,2,2-Tetrachloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1,2-Trichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trichlorobenzene	2.0	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trimethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dibromoethane (EDB)	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25

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Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
1,2-Dichloropropane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3,5-Trimethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Benzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Bromomethane	1.0	≤ 30%	70 – 130	70 – 130	± 25
Carbon Tetrachloride	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chloroethane	2.0	≤ 30%	70 – 130	70 – 130	± 25
Chloroform	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chloromethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Chlorotoluene (Benzyl Chloride)	0.5	≤ 30%	70 – 130	70 – 130	± 25
cis-1,2-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
cis-1,3-Dichloropropene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Dichloromethane (Methylene Chloride)	1.0	≤ 30%	70 – 130	70 – 130	± 25
Ethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 11 (Trichlorofluoromethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 113 (Trichlorotrifluoroethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 114	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 12 (Dichlorodifluoromethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Hexachlorobutadiene	2.0	≤ 30%	70 – 130	70 – 130	± 25
m,p-Xylene	1.0	≤ 30%	70 – 130	70 – 130	± 25
Methyl Chloroform (1,1,1-Trichloroethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
o-Xylene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Styrene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Tetrachloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Toluene	1.0	≤ 30%	70 – 130	70 – 130	± 25
trans-1,3-Dichloropropene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Trichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Vinyl Chloride	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3-Butadiene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dioxane	1.0	≤ 30%	70 – 130	70 – 130	± 25

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Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
2-Butanone (Methyl Ethyl Ketone)	2.0	≤ 30%	70 – 130	70 – 130	± 25
2-Hexanone	2.0	≤ 30%	70 – 130	70 – 130	± 25
4-Ethyltoluene	0.5	≤ 30%	70 – 130	70 – 130	± 25
4-Methyl-2-Pentanone (MIBK)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Acetone	5.0	≤ 30%	70 – 130	70 – 130	± 25
Bromodichloromethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Bromoform	0.5	≤ 30%	70 – 130	70 – 130	± 25
Carbon Disulfide	2.0	≤ 30%	70 – 130	70 – 130	± 25
Cyclohexane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Dibromochloromethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Ethanol	5.0	≤ 30%	70 – 130	70 – 130	± 25
Heptane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Hexane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Isopropanol	2.0	≤ 30%	70 – 130	70 – 130	± 25
Methyl t-Butyl Ether (MTBE)	2.0	≤ 30%	70 – 130	70 – 130	± 25
Tetrahydrofuran	0.5	≤ 30%	70 – 130	70 – 130	± 25
trans-1,2-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
2,2,4-Trimethylpentane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Cumene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Propylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
3-Chloropropene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Naphthalene*	1.0	≤40%	60 – 140	60 – 140	± 25
TPH (Gasoline) **	50	1-Point Calibration	N/A	ICV only; 60 – 140	± 25
NMOC (Hexane/Heptane)**	10	1-Point Calibration	N/A	NA	± 25

*Due to its low vapor pressure, Naphthalene may exceed TO-15 performance requirements. The wider QC limits reflect typical performance. Although Naphthalene is not on Eurofins Environment Testing Northern California, LLC's "standard" TO-15 list, it is commonly requested and included in Table 2.

**TPH and NMOC are not on Eurofins Environment Testing Northern California, LLC's "standard" TO-15 list, but are included in Table 2 due to common requests. These are semi-quantitative non-accredited parameters.

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Table 3 is the list of non-standard NELAP accredited Method TO-15 compounds that may be requested.

Table 3. Method TO-15 Additional Analyte List (QUAD)

Analyte	RL/LOQ (ppbv)	QA Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
1,1,1,2-Tetrachloroethane	0.5	≤30%	70 – 130	70 – 130	± 25
1,2,3-Trichloropropane	0.5	≤30%	70 – 130	70 – 130	± 25
1,2-Dibromo-3-chloropropane	2.0	≤30%	70 – 130	70 – 130	± 25
1,3-Dichloropropane	0.5	≤30%	70 – 130	70 – 130	± 25
2-Chlorotoluene	2.0	≤30%	70 – 130	70 – 130	± 25
Acrylonitrile	0.5	≤30%	70 – 130	70 – 130	± 25
alpha-methyl-styrene	2.0	≤30%	70 – 130	70 – 130	± 25
4-Isopropyltoluene (p-Cymene)	2.0	≤30%	70 – 130	70 – 130	± 25
Bromobenzene	2.0	≤30%	70 – 130	70 – 130	± 25
Butane	2.0	≤30%	70 – 130	70 – 130	± 25
Butyl Benzene	0.5	≤30%	70 – 130	70 – 130	± 25
Dibromomethane	0.5	≤30%	70 – 130	70 – 130	± 25
Ethyl Acetate	2.0	≤30%	70 – 130	70 – 130	± 25
Freon 21 (Dichlorofluoromethane)	2.0	≤30%	70 – 130	70 – 130	± 25
Freon 22 (Chlorodifluoromethane)	2.0	≤30%	70 – 130	70 – 130	± 25
Isobutane	2.0	≤30%	70 – 130	70 – 130	± 25
Isopentane	2.0	≤30%	70 – 130	70 – 130	± 25
Methyl Methacrylate	2.0	≤30%	70 – 130	70 – 130	± 25
Methylcyclohexane	2.0	≤30%	70 – 130	70 – 130	± 25
Nonane	2.0	≤30%	70 – 130	70 – 130	± 25
n-Pentane	2.0	≤30%	70 – 130	70 – 130	± 25
Propylene	2.0	≤30%	70 – 130	70 – 130	± 25
Octane	2.0	≤30%	70 – 130	70 – 130	± 25
sec-Butylbenzene	0.5	≤30%	70 – 130	70 – 130	± 25
tert-Butyl Alcohol	2.0	≤30%	70 – 130	70 – 130	± 25
tert-Butyl Benzene	2.0	≤30%	70 – 130	70 – 130	± 25
Vinyl Acetate	2.0	≤30%	70 – 130	70 – 130	± 25
Vinyl Bromide	0.5	≤30%	70 – 130	70 – 130	± 25

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Table 4. Internal Standards

Analyte	Accuracy (% R)
Bromochloromethane	60 – 140
1,4-Difluorobenzene	60 – 140
Chlorobenzene-d_5	60 – 140

Table 5. Surrogates

Analyte	Accuracy (% R)
1,2-Dichloroethane-d_4	70 – 130
Toluene-d_8	70 – 130
4-Bromofluorobenzene	70 – 130

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Table 6. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours	TO-15 ion abundance criteria	Correct problem then repeat tune.
Minimum 5-Point Initial Calibration (ICAL)	Prior to sample analysis	% RSD ≤ 30 with 2 compounds allowed out to ≤ 40% RSD	Correct problem then repeat Initial Calibration curve.
Initial Calibration Verification and Laboratory Control Sample (ICV and LCS)	After each Initial Calibration curve, and daily prior to sample analysis	Recoveries for 85% of "Standard" compounds must be 70–130%. No recovery may be < 50%. ICV evaluated on a full list basis at the time of calibration. If specified by the project, in-house generated control limits may be used.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Continuing Calibration Verification (CCV) for Standard compounds	At the start of each analytical clock after the tune check	70–130%	Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than two compounds from the standard list recover outside of 70–130% or > 10% of VOCs if short list is used (20 compounds or less), corrective action will be taken. If any compound exceeds 60–140%, samples are not analyzed unless data meets project needs. Check the system and reanalyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory reporting limit	Inspect the system and re-analyze the blank. "B"-flag data for common contaminants.

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

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ANALYTICAL METHODS

Section 13.0

Method: EPA TO-17 VOCs and SVOCs – Analysis of Tenax TA and Multi-bed VI Sorbent Tubes by Thermal Desorption GC/MS (Full Scan)			
Laboratory SOP #: 109	Revision #: 29	Effective Date: October 29, 2025	Methods Manual Summary

Description: This sorbent tube method is an alternative to the canister-based sampling and analysis methods that are presented in EPA Compendium Methods TO-14A and TO-15 as well as an alternative to PUF/XAD sampling for semivolatile compounds as described by EPA Compendium TO-13A. The Tenax TA tube is well-suited for compounds in the C6 to greater than C22 range, and the multi-bed VI tube provides sufficient retention of light VOCs such as Vinyl Chloride while providing an efficient desorption of semi-volatile compounds up to 2-Methylnaphthalene.

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

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

Table 1. EPA TO-17 Method Modifications

Requirement	TO-17	Laboratory Modifications
Audit Accuracy	70-130%	Second source recovery limits for Fluoranthene and Pyrene = 60-140%.
Verification of Safe Sampling Volume	Collection of distributed volume pairs at uncharacterized sites and/or utilize field test method to evaluate breakthrough by sampling tubes in series at different air volumes.	Field surrogates are spiked onto each tube prior to deployment in the field. Recovery is used to monitor method performance from sample collection through analysis for each sample tube.
Analytical Precision	≤20%RPD	≤30% RPD for 3- and 4-ringed PAHs, TPH

The standard target analyte list, reporting limit (RL), QC criteria, and QC summary can be found in Tables 2 through 7.

Table 2. Method TO-17 VOCs /SVOCs (Tenax TA) Reporting Limits and QC Limits

Analytes	Reporting Limit (ng)	QC Acceptance Criteria		
		ICAL (%RSD)	ICV/LCS (% R)	CCV (%D)
Benzene	10	30	70 – 130	30
Toluene	5.0	30	70 – 130	30
Ethylbenzene	5.0	30	70 – 130	30
Naphthalene	1.0	30	70 – 130	30
m,p-Xylene	10	30	70 – 130	30
o-Xylene	5.0	30	70 – 130	30
2-Methylnaphthalene	1.0	30	70 – 130	30
1-Methylnaphthalene	1.0	30	70 – 130	30
Biphenyl	5.0	30	70 – 130	30
Acenaphthylene	5.0	30	70 – 130	30
Acenaphthene	5.0	30	70 – 130	30
Fluorene	5.0	30	70 – 130	30
Phenanthrene	5.0	30	70 – 130	30
Anthracene	5.0	30	70 – 130	30
Fluoranthene	10	30	60 – 140	40
Pyrene	10	30	60 – 140	40
2-Propanol*	50	NA	NA	NA

**2-Propanol is poorly retained on Tenax; Safe sampling volume of 0.2 L has been verified by the lab. Semi-quantitative results are generated byutilizing a single point calibration analyzed in each analytical sequence.zing a single level concentration.*

Table 3. Method TO-17 VOCs (VI) Reporting Limits and QC Limits

Volatile Organic Compounds	Reporting Limit(ng)	Acceptance Criteria			
		ICAL (%RSD)	ICV (% R)	CCV (%D)	LCS (%R)
Chloroform	5.0	30	70 – 130	30	70 – 130
Benzene	10	30	70 – 130	30	70 – 130
Trichloroethene	5.0	30	70 – 130	30	70 – 130
Toluene	5.0	30	70 – 130	30	70 – 130
Tetrachloroethene	5.0	30	70 – 130	30	70 – 130
Ethylbenzene	5.0	30	70 – 130	30	70 – 130
m,p-Xylene	10	30	70 – 130	30	70 – 130
o-Xylene	5.0	30	70 – 130	30	70 – 130
Volatile Organic Compounds	**Reporting Limit(ng)**	**Acceptance Criteria**			
		ICAL (%RSD)	**ICV (% R)**	**CCV (%D)**	**LCS (%R)**
Isopropyl alcohol†*	50	30	70 – 130	30	70 – 130
Polyaromatic Hydrocarbons	**Reporting Limit(ng)**	**Acceptance Criteria**			
		ICAL (%RSD)	**ICV (% R)**	**CCV (%D)**	**LCS (%R)**
Naphthalene	1.0	30	70 – 130	30	70 – 130
2-Methylnaphthalene	1.0	30	70 – 130	30	70 – 130
1-Methylnaphthalene	1.0	30	70 – 130	30	70 – 130
Supplement Volatile Organic Compounds	**Reporting Limit(ng)**	**Acceptance Criteria**			
		ICAL (%RSD)	**ICV (% R)**	**CCV (%D)**	**LCS (%R)**
1,1-Dichloroethene†	5.0	30	70 – 130	30	70 – 130
1,4-Dioxane†	10	30	70 – 130	30	70 – 130
cis-1,2-Dichloroethene†	5.0	30	70 – 130	30	70 – 130
trans-1,2-Dichloroethene†	5.0	30	70 – 130	30	70 – 130
Vinyl Chloride†	5.0	30	70 – 130	30	70 – 130

†Non-routine compounds by special request only.

Table 4. Commonly requested TPH parameters (Tenax TA and VI)

TPH	Reporting Limit (ng)	ICAL (%RSD)	ICV (% R)	CCV (%D)	LCS (%R)
GRO (Gasoline Range)*	1000	30	60 – 140	40	60 – 140
DRO (C10-C22 Diesel Range)	1000	30	60 – 140	40	60 – 140

*Non-accredited parameters.

Table 5. Internal Standard (Tenax TA and VI)

Analyte	CCV IS % Recovery	Sample IS % Recovery
Bromochloromethane	>60	60 – 140
1,4-Difluorobenzene	>60	60 – 140
Chlorobenzene-d5	>60	60 – 140
Bromofluorobenzene	>60	60 – 140

Note: A subset of the listed internal standards may be monitored based on their applicability to the requested target list.

Table 6. Field Surrogate Recoveries (Tenax TA and VI)

Analyte	% Recovery
1,2-Dichloroethane-d4	50 – 150
Benzene-d6	50 – 150
Toluene-d8	50 – 150
Naphthalene-d8	50 – 150

Note: A subset of the available field surrogates may be reported based on their applicability to the requested target list. Field surrogates are not reported for projects requesting TPH only.

Table 7. Summary of Calibration and QC Procedures for TO-17 General Application

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
BFB Tune Check	Before initial and daily calibration. Check is valid for 24 hours.	TO-15 tune criteria	Correct problem then repeat tune.
5-Point Calibration	Prior to sample analysis	%RSD $\leq$ 30% with 2 compounds exceeding up to 40%RSD	Correct problem then repeat Initial Calibration Curve.
Initial Calibration Verification (ICV)	After each initial Calibration Curve	See tables 2 through 4; 20% of the compounds are allowed to exceed criterion.	Determine if the exceedance is due to an inaccurate calibration standard or inaccurate ICV standard. Recalibrate with an accurate standard or re-prepare the ICV as necessary. If any VOC exceeds 50-150% recovery, system is checked and the ICV is reanalyzed. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case-by-case basis.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification (CCV)	At the start of each 24-hour clock after the Tune Check	70 – 130 %; 60-140% for Fluoranthene, Pyrene and TPH	If project-specified risk drivers exceed these criteria, more than 5% of the compounds exceed these criteria, or any VOC exceeds 50–150% recovery, maintenance is performed and the CCV test repeated. If the system still fails the CCV, perform a new 5-point Calibration Curve.
Laboratory Blank	After the CCV, before samples and at the end of the sequence	Results less than the laboratory RL. (If MDL reporting is required, lab blank results less than the MDL	Inspect the system and re-analyze the Blank. Flag associated data as appropriate.
Laboratory Control Sample (LCS)	Each analytical batch	Recovery 70 – 130%; 60-140% Fluoranthene and Pyrene; TPH Or as noted in table 3; 20% of the compounds may exceed criteria before corrective action is required.	Verify accuracy of standard. Re-prepare LCS if necessary. If calibration curve and/or system is found to be out of control, perform maintenance and re-calibrate. If any VOC exceeds 50-150% recovery, maintenance is performed and the LCS test is repeated. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case by case basis.
Laboratory Control Sample Duplicate (LCSD)	Once per analytical batch – (reanalysis of LCS)	≤20%RPD for all compounds with exception of Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, TPH which must be ≤30%RPD	Verify accuracy of standard. Re-prepare LCSD if necessary. If calibration curve and/or system is found to be out of control, perform maintenance and re-calibrate. If any VOC exceeds 50-150% recovery, maintenance is performed and the LCSD test is repeated. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case by case basis.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Internal Standard (IS)	As each QC sample and sample are being loaded	**CCVs:** area counts >60% recovery, RT w/in 20 sec of mid-point in ICAL **Blanks and samples**: Retention time (RT) must be within ±0.33 minutes of the RT in the CCV. The IS area must be within ±40% of the CCV's IS area for the Blanks and samples.	**CCV:** Inspect and correct system prior to sample analysis. **Blanks:** Inspect the system and re-analyze the Blank. **Samples:** Investigate the problem by verifying the instrument is in control by running a Lab Blank. Re-analyze recollected samples to verify recovery. Report the run with acceptable IS recovery. If both runs are unacceptable, narrate and flag associated data. If sample matrix is causing a systematic change in internal standard response with each successive run, an End Check spiked at the CCV concentration can help to assess the impact on target compound accuracy.
Field Surrogates	Added to each tube prior to shipment to field. Added to QC samples prior to analysis	50 – 150%	**Blanks:** Inspect the system and re-analyze the Blank. **Samples:** Review data to determine whether sample collection parameters or matrix interference resulted in the exceedances. If so, narrate and flag recovery. If no cause is evident, verify the instrument is in control by running a Lab Blank. Re-analyze recollected sample to verify recovery.
Field Blank	Project dependent	Artifact levels should be less than the reporting limit or less than 10% of the mass measured on the sampled tubes, whichever is less	Flag associated results and evaluate tube conditioning and storage procedures.
Distributed Pairs	Project dependent	%RPD $\leq$ 25%	Narrate discrepancy