
APPENDIX F

Sample Analysis Plan

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) consists of a Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) for the removal actions scheduled at the Cooper Drum Site in Southgate, California. The purpose of this SAP is to ensure collection of representative samples through quality and consistency in sample collection, handling, and analysis procedures.

The FSP describes the field activities that may be conducted during the implementation of the removal action (RA) including: sample collection procedures, documentation procedures, field-screening procedures, sample handling/management practices, equipment decontamination procedures, and laboratory analyses. The QAPP presents the organization, functions, procedures, and specific quality assurance (QA) and quality control (QC) activities designed to achieve the removal action data quality objectives. The QAPP is organized according to the QAPP elements listed in the *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, February 1998. Some of the sections in the QAPP refers to Basis of Design Report (BDR) and the FSP, where applicable, to minimize repetition. However, all required QAPP elements are addressed or referenced in the QAPP.

1.1 PROJECT DESCRIPTION

The site description and history, as well as, the site's investigative history are included in the introduction section (Section 1.0) of the BDR. Project objectives are detailed in Subsection 3.0 of the BDR.

1.2 PROJECT ORGANIZATION AND RESPONSIBILITY

The organizational structure and responsibility is designed to assure adequate project control and proper quality assurance for site removal actions. The following is a suggested list of personnel and general roles, it is intended only as a guideline.

- **Project Manager.** The project manager has the primary responsibility for the completion of all activities on the project. He is responsible to the EPA for the day-to-day control of planning, scheduling, cost control, and implementation of the project, and for the development of the technical reports and other project documents. The project manager monitors all project personnel in planning, coordinating, and controlling all technical aspects of the tasks.
- **Project Health and Safety Officer.** The project health and safety officer (HSO) will work directly with the project manager and other project personnel. The HSO monitors and verifies that work is performed in accordance with the Site Health and Safety Plan. The HSO will advise the project manager regarding health and safety issues, but will function independently of the project manager.
- **Field Team Coordinator.** The field team coordinator is responsible for managing the day-to-day activities of implementing the RA at the site. The field team coordinator will provide status updates in the form of daily teleconferences and weekly field reports.
- **Chemistry/Data Management.** Chemistry and Data Management will be responsible for coordinating sampling activities with the laboratories and the field team sampler(s). Chemistry will provide the sampler with pre-printed chain-of-custody and sample labels. Chemistry and data management will ensure the validity of the data received from the laboratories and the storage of retrieval of the data.

- **Others.** The removal action contractor will identify other necessary personnel.

2.0 FIELD SAMPLING PLAN

All field and laboratory work to be performed will follow the procedures and guidance provided in the QAPP (Section 3.0). This section presents the rationale, methods, and frequencies for sampling activities related to the various phases of dual phase extraction (DPE) site evaluation, startup, operation, optimization, and eventual closeout and excavation as part of the soils removal action. The FSP for soils sampling as part of the soils removal action, is presented in Subsection 2.1. The FSP for operating DPE systems, consisting of DPE wells, monitoring wells, and the treatment system, is presented in Subsection 2.2. Data quality objectives (DQOs) and criteria for measurement data are presented in Subsection 3.2.1; the DPE system implementation, continued operation, and closeout procedures and criteria are described in Subsection 3.3. The following procedures may be modified in the field as required as conditions in the field change. Changes will require approval by EPA. The project manager, with the EPA's approval, will modify the FSP to address these changes.

2.1 SOIL SAMPLING

Soil samples will be collected to confirm that soils contamination above the cleanup goals have been removed during the RA activities and that the areas immediately outside the excavation are below the cleanup goals. Locations for sampling are established by standards of confirmation requirements. These requirements are described as follows: (1) For narrow excavation areas (less than four feet in width), such as pipeline excavations, soil samples will be collected at 20-foot intervals below the invert of former underground piping; and (2) For larger excavations, soil samples will be collected on 20-foot centers, and side wall samples will be collected below the zone of contamination at 40-foot intervals. Soil samples will also be collected on the perimeter of the excavation to confirm that the surface contamination surrounding the excavation is below the established cleanup levels.

Sample Collection

Soil samples may be collected by one of the following methods: (1) a spade and scoop method or, when the excavation does not allow for safe sampling by this method, and (2) driving a stainless steel liner into soil of a backhoe bucket.

If the spade and scoop method is used, samples will be collected with a precleaned or decontaminated stainless steel spade. The soil will be transferred into the appropriate sample container, secured and properly labeled. If a stainless steel liner is used, the liner will be prepared for chemical analysis by covering the ends of the tube with Teflon sheeting and plastic end caps, and sealed with tape. The liner will be properly labeled and placed in a new resealable plastic bag. Samples collected by either method will be placed in an ice chest and kept cool (approximately 4 degrees centigrade [°C]) until they can be transported under chain-of-custody procedures to an analytical laboratory.

Sample Analysis

All confirmation soil samples during the removal action will be screened using a field portable x-ray fluorescence (XRF) for lead and an immunoassay field test kit for polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). Twenty percent of the samples analyzed by a field method will be split and submitted to a standard laboratory for confirmatory analysis.

Table 1-1 details the specific analyses for the site. Figures 4-1 and 4-2 of the BDR depicts the expected areas of excavation at the site. Sample analyses are based on previous data collected at the site.

TABLE 1-1
Site-Specific Confirmation Sample Matrix

Contaminants of Concern	Analytical Method	
	Soil	Water
Lead	Field XRF, SW 7421	SW7421
PCBs	Immunoassay test kit, SW 8082	SW8082
PAHs	Immunoassay test kit, SW 8310	SW8310

2.1.1 Surface Water sampling

Surface water is not expected to be present at the Cooper Drum site under normal conditions. The need for sampling surface water will only become necessary if, during excavation, water is observed within the excavation. Potential sources of water within the excavation include, but are not limited to broken sewer or water lines, or rainwater. Groundwater is not expected to enter the excavations because the excavation depths are not anticipated to extend below the depth to the top of groundwater surface in the on site monitoring wells.

Water samples will be analyzed for the above contaminants of concern. Samples will be collected using a clean container and transferred into the appropriate pre-preserved sample container. An adequate supply of pre-preserved sample containers should be at the site during excavation activities in the event they are required. Samples will then be labeled and cooled in an ice chest to approximately 4°C until they can be transported to an analytical laboratory.

2.1.2 Decontamination

All sampling equipment should be thoroughly decontaminated prior to use. Sampling equipment will be scrubbed with clean water and non-phosphate detergent, rinsed with clean water, re-rinsed using deionized water, and allowed to air dry in a clean, dust free location. Clean, dry equipment will be stored in a clean environment until use.

2.1.3 Investigation Derived Wastes (IDW)

There are no IDW anticipated with this removal action. Any wastes generated will be transported with the contaminated soils to the off-site treatment, storage, disposal facility.

2.1.4 Sample Documentation and Custody

Field Logbook

Documentation of field sampling and associated activities in the field logbook provides a permanent record that proper protocols were followed during implementation of the field sampling activities. All entries will be made in blue or black ink and no erasures will be allowed. If an incorrect entry is made, the

information will be crossed out with a single strike mark and the change initialed and dated by the team member initiating the change. The information in the field book will include the following at a minimum:

- Project name and project number
- Location of sample and sample number
- Sampler's name and signature
- Date and time of sample collection
- Sample identification numbers and sample depth (if applicable)
- Description of samples (matrix sampled), composite or grab sample
- Analysis to be performed
- Description of QA/QC samples (if collected)
- Sample methods
- Field observations (weather/temperature problems encountered)
- Personnel present (including visitors to the site)

Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the field staff's memory. The project manager or designee will be responsible for documenting appropriate field activities. The person making the entry will sign below it. One logbook may be used by multiple people to document the work at the site. Each sampler will individually be listed and sign each day that they made entries into the book.

Photographs

Photographs will be taken during field activities to support written descriptions of sampling activities, soil removal, etc. The photographs will be recorded in the field logbook. When the photograph is taken, date, time, weather conditions (if applicable), subject, purpose of photograph, and photographer name will be recorded in the field notes. Information recorded in the field book will be recorded with the photograph, which will be maintained with the project file.

Sample Number System

A sample numbering system should be established and used to identify each sample collected and submitted for analysis. The purpose of the numbering system is to assist in the tracking of samples and to facilitate retrieval of analytical results. The sample identification numbers for each sampling effort should be used on sample labels, sample tracking matrix forms, chain-of-custody forms, field logbooks, and all other applicable documentation. A listing of all sample identification numbers should be recorded in the field logbook. The sampling numbering system may vary depending upon the number and type of samples that will be collected. Each sample collected must be assigned a unique sample number. Sample numbers should change when the media or location changes. Sample numbers should not change because different analyses are requested.

Sample Labels

All sample labels will be filled out with indelible ink and uniquely numbered. Labels maybe partially completed prior to sample collection. The date, time, sampler's initials, and the sample identification number should not be completed until the time of sample collection. At a minimum, each label shall contain the following information:

- Project name
- Sampler's company affiliation
- Date and time of sample collection
- Sample depth
- Sampler's initials
- Sample identification number
- Analyses required
- Preservatives used

Chain-of-Custody Procedures

This section briefly describes the procedures for sample documentation using the chain-of-custody protocol. Chain-of-custody procedures provide documentation of the handling of each sample from the time it is collected until it is destroyed. Chain-of-custody procedures are implemented so that a record of sample collection, transfer of samples between personnel, sample shipping, and receipt of the sample by the laboratory is maintained. The project manager or their designee will be responsible for monitoring compliance with the chain-of-custody procedure. The sampler will be responsible for initiating and filling out the chain-of-custody form. The sampler will sign the chain-of-custody when relinquishing the sample to anyone else. It is not necessary for the courier to sign the chain-of-custody; however, the airbill number will be noted on the chain-of-custody and retained by the sample handler for tracking purposes. A chain-of-custody form contain the following information:

- Sampler's signature
- Project number
- Date and time of collection
- Sample location
- Sample identification number
- Sample type/matrix
- Preservative used, if any
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times

- Method of shipment and airbill number, when shipped
- Signature of persons accepting custody, dates, and times (laboratory)

The field team members are responsible for the care and custody of the samples until they are transferred to another party, dispatched to the laboratory, or disposed. A sample is considered to be under custody if one or more of the following criteria are met:

The sample is in the sampler's possession.

- The sample is in the sampler's view after being in possession.
- The sample was in the sampler's possession and then locked up to prevent tampering.
- The sample is in a designated secure area.

Transfer of Custody and Shipment

When transferring the possession of samples, the individual relinquishing and receiving will sign, date, and note the time in the appropriate space on the custody paperwork. When shipping samples by overnight courier, the individual in possession of the samples relinquishes the samples by signing, dating, and noting the time and completing the Received By box with the courier name and air bill number.

All shipments will be accompanied by the appropriate custody and analyses specification document(s) identifying the shipment container's contents and analyses needed for each sample. The original documents will be sealed in a plastic bag and placed securely in the ice chest.

The following information will be conveyed to the scheduled laboratory when samples are shipped:

- Date shipped
- Number of samples and samples matrix
- Carrier and air bill number

The laboratory will be notified at least 24 hours in advance of Saturdays sample deliveries, if necessary.

Upon receipt at the laboratory, the designated laboratory sample custodian shall sign the chain-of-custody form indicating receipt of the incoming field samples. The samples shall be checked against the chain-of-custody upon arrival at the laboratory. The receiving personnel will properly document the receipt of all arriving samples and note any problems or discrepancies of the sample container, chain-of-custody forms and sample cooler contents, and record the temperature of the temperature blank and seal conditions on sample receipt form. Any problem or discrepancy will be reported immediately to the laboratory project manager, who will notify the project chemist. In conjunction with the laboratory reports, a copy of the chain-of-custody and the sample receipt form shall be returned to the project manager for inclusion into the central project file.

2.1.5 Project Schedule

The contractor selected to perform the removal action will determine the project schedule. This section should include an outline of the schedule based on client and regulator requirements. Listed items should

include: project plan review periods, easement/permit periods, fieldwork, sample analysis, data management and validation, and investigation report writing.

2.2 DUAL-PHASE EXTRACTION SAMPLING

FSPs for operating DPE systems consist of sampling plans for the DPE wells and soil vapor monitoring (SVM) wells and the treatment system during the pre-operation, initial operation, optimization, and long-term operation. These sampling plans are general guidelines that adhere to the DQOs presented in Section 3.3. The sampling locations, sample collection procedures and analytical methods, field QC samples, and sampling frequencies are described in the following subsections.

2.2.1 Sampling Locations

For operating DPE systems, the sampling locations may consist of the following:

- SVM wells
- DPE wells
- Catalytic oxidizer influent (COI)
- Caustic scrubber effluent (CSE)
- HiPOX influent (HPI)
- HiPOX effluent (HPE)
- Primary liquid carbon effluent (PLCE)
- Secondary liquid carbon effluent (SLCE)

In general, all DPE and SVM wells are sampled once during pre-operation and again periodically during normal operation. A subset of the wells may be chosen for sampling during the optimization and continued operation phases of each project to minimize sampling and analytical costs while providing data to follow the strategy outlined in Section 5.0 of the BDR. The subset may include SVM wells believed to be within the radius of influence (ROI) of the operating DPE wells, SVM wells, and non-operating SVE wells that are relatively high in soil vapor contaminant concentrations compared to other locations at the site, and SVM wells that are located near the edge of the contaminant plume. All operating DPE wells are routinely sampled at the frequency stated in Subsection 5.6.

Residual aqueous samples are also collected from the air-water separator (AWS) and the caustic scrubber as required by the Removal Action Work Plan.

2.2.2 Sample Collection Procedures and Analytical Methods

The following sections summarize the sample collection and analytical methods for vapor, scrubber blowdown (SFB), AWS liquid, residual sediment, and ambient air samples (AAS). Details on the analytical methods to be used are presented in Section 3.0.

Vapor Samples

SUMMA Canisters

Gas samples may be collected in canisters for analysis by modified EPA Method TO-15 for VOCs. Evacuated SUMMA canisters may be used to collect soil gas samples from the SVM and DPE wells, as well as to collect process gas samples from the COI and CSE.

Continuous Monitors

Gas samples are analyzed for criteria pollutants using continuous monitors. The monitors are instruments with detectors that respond immediately to the constituent being analyzed. Three monitoring events of at least an hour each are performed on the same day. Emission control samples from the CSE/FSE will be collected following the procedures outlined in California Air Resources Board (CARB) Methods 5 and 100. Individual monitoring of criteria pollutants at the CSE/FSE location will be performed using the following sampling methods:

- Sulfur dioxide (SO₂) will be analyzed using a pulsed fluorescence or infrared absorption detector;
- Oxides of nitrogen (NO_x) will be analyzed using a chemiluminescent detector; and
- Carbon monoxide (CO) will be analyzed using a non-dispersive infrared detector.

Impingers

Gas samples for hydrochloric acid (HCl)/hydrofluoric acid (HF) analyses are collected with impinger sampling trains, following the procedures outlined in CARB Method 421. Impingers are Pyrex brand glass containers designed for collecting airborne chemicals and particulates by passing them through liquid reagents. The bubbling action in the impinger brings the sample into intimate contact with the collecting liquid. Gas samples are collected through a probe into a series of chilled impingers containing an acidic solution of potassium permanganate. The solution is then analyzed by cold vapor atomic absorption spectroscopy. Other site-specific inorganic vapors, such as mercury, may also require collection and analysis on a site-specific basis.

Groundwater

Treatment Plant Sampling Points

The following steps will be used to collect water samples from treatment plant sampling locations:

- Don the appropriate PPE.
- Check the label on the sampling port and the labels on the sampling bottles to ensure the correct sample bottles are used.
- Open the valve on the sampling port and adjust the valve so that flow of approximately 300 milliliters per minute is attained using a timer and a graduated cylinder.
- If applicable, perform a field instrument calibration check before analyzing samples. The results should be within $\pm 5\%$ of the expected value. If the results are greater than 5%, recalibrate the instrument.

- If applicable, collect the sample for turbidity directly into the cuvette. Collect the sample for pH, conductivity, temperature, and dissolved oxygen in a disposable sample container. Perform the analyses immediately after collection in the following order: turbidity, dissolved oxygen, temperature, pH, and conductivity. Document the results in the sample logbook.
- Collect the samples for VOC analyses. Fill the sample vial leaving a positive meniscus, but do not overfill the vial. Put the cap on and check for air bubbles by turning the vial upside down and tapping. If any air bubbles are present, recollect the sample.
- Place all samples in a cooler containing ice and a trip blank immediately after collection.
- After the VOC samples have been collected, the flow can be increased to 500 milliliters per minute to collect the remaining samples. The flow should not create turbulence or bubbling in the sample containers.
- Collect the one-liter amber for 1,4-dioxane analysis, followed by the 500-milliliter and 1,000-milliliter poly bottles. The bottles should be filled to the neck of the container, leaving a quarter-inch of headspace. Bottles will be tightly capped to prevent leakage.
- Document the sample collection times in the sample log book and the chain-of-custody records.

DPE Wells

Samples will be collected in a way that ensures representative characteristics are preserved from collection through laboratory examination. These general procedures for sampling will be followed:

- Wear appropriate PPE.
- Calibrate the pH, conductivity, dissolved oxygen and turbidity instruments
- Decontaminate any reusable sampling equipment
- Change gloves before and after the collection of each sample.
- Purge sampling port a minimum of 15 seconds (not applicable for surface water sampling).
- Collect samples, duplicates, and additional volume for laboratory spikes.
- Follow sample documentation, handling, and shipment procedures outlined in the QAPP.

Combined Media

Effluent samples for analysis of dioxins/furans and particulate matter are collected in a sampling train consisting of both solid and liquid components. Samples are collected at the CSE/FSE sampling port using the following sampling methods:

- Dioxins/Furans. Effluent samples are collected following the procedures outlined in EPA Method 23. A sample is collected through a glass-lined, stainless steel, sample probe onto a heated, glass-fiber filter through a water-cooled condenser and a water-cooled sorbent trap followed by a series of impingers.

- **Particulate Matter.** Samples from the CSE/FSE are collected following the procedures outlined in CARB Method 5. Particulate matter samples are collected through a sampling probe onto a glass-fiber filter, and into impingers containing water.

Scrubber Blowdown and AWS Samples (Residuals Management)

Samples are collected to characterize the aqueous residuals produced by the SVE system and caustic scrubber. The following sampling methods will be used.

AWS. AWS liquid samples will be collected and analyzed by Method E1613B for dioxins/furans and Method SW8260B for VOCs. AWS liquid samples are collected using a disposable coliwasa or similar sampling apparatus, which allows collection of a representative, cross-sectional sample from the top to the bottom of the drum. Any stratified AWS liquids are homogenized during sample collection using this apparatus while minimizing VOC loss. These samples are collected quarterly provided there is sufficient quantity to sample. Following receipt of AWS sampling analytical results, McClellan AFB is contacted to dispose of the liquid. These data are also used to calculate the SVE system mass balance. Since samples are collected directly from drum contents using dedicated sampling equipment, equipment blanks are not needed.

SFB. Samples are collected from the SFB sample port directly into a certified clean sample bottle.

Residual Sediment Samples (Residuals Management)

Sediment samples are collected from two locations to characterize the residual sediments produced by the caustic scrubber. In addition, spent carbon from the carbon units is analyzed to determine the feasibility of carbon regeneration or to characterize the spent carbon for disposal. The following sampling methods are used:

Scrubber Sump Sludge (SSS). Sludge accumulated in the scrubber sump is sampled by removing the manhole cover from the scrubber sump and collecting a grab sample of the SSS into a certified clean sample container.

Spent Granular Carbon (SGC). The spent carbon is sampled soon after it is transferred from the vessels into drums. The drum containing carbon that was near the influent soil vapor stream is noted at the time of transfer. It is expected that the carbon from this drum should represent the most contaminated area of the vessel and thus provide a worst case scenario for characterization. A grab sample is then collected from this drum. The sample will be sent to the carbon vendor to analyze for appropriate disposal.

Ambient Air Health and Safety Monitoring

A photoionization detector (PID) and Draeger tubes are used to confirm that concentrations of VOCs, HCl, HF, and chlorine are below a level that could pose a hazard or irritation to on-site personnel or nearby residents. The health and safety monitoring is performed twice during the first day of startup, once per week during the first month, and only as necessary afterwards, based upon stack sampling results. Health and safety monitoring is also performed if there is an indication of toxic odors, or as requested by the EPA following the first month. If results are greater than the exposure threshold, Draeger tubes will continue to be used on a daily basis until the problem is mitigated.

Noise Level Measurement

Noise levels are measured using a noise meter equipped with a decibel A-scale (dBA) range of 30 to 135 dBA. The noise meter is calibrated according to the manufacturer's specifications. To determine overall system noise levels, measurements are collected approximately 100 feet from the system in each of the four compass directions. If the nearest residential area can be determined, a measurement of system noise is recorded approximately 100 feet from the system in the direction of the residential area. To determine noise levels generated by individual pieces of equipment, noise measurements are collected approximately 4 feet from the selected piece of equipment. For both overall system and individual equipment noise measurements, the noise meter receptor is pointed in the direction of the system or equipment and the noise level recorded from the meter. Noise measurements are recorded onto the Ambient Noise Monitoring Data Sheet.

Induced Vacuum Measurement

Induced vacuum is measured annually in selected SVM wells at varying distances from DPE well(s). The SVM wells selected for vacuum measurements may or may not be used for routine sampling. If the SVM well is scheduled for routine sampling, it is fitted with a threaded valve. With the valve off, a vacuum gauge is attached to the valve using flexible tubing and threaded compression fittings. Once the valve is opened, the vacuum as indicated by the vacuum gauge is recorded. If the selected SVM well is not scheduled for routine sampling, it may be fitted with a temporary valve and sampled as just stated, or the well will be fitted with a hose barb and short piece of flexible tubing. The end of the tubing is capped, providing an airtight fit. To obtain a vacuum reading, the tubing is pinched, the cap removed, and the tubing fitted onto the vacuum gauge. Once the pinch is released, the vacuum indicated by the vacuum gauge is recorded.

2.2.3 Field Quality Control Samples

Results for QC samples collected and submitted blind to the laboratory are used to evaluate data quality. Descriptions and frequencies of the field QC samples are presented below. Field QC sample collection procedures are described in the SOP (Attachment). For sample types that are collected infrequently, the collection frequency of QC samples may be greater than specified. The following types of QC samples will be collected.

Field Duplicates. Field duplicates are collected sequentially from the designated locations to evaluate overall measurement precision. For vapor samples, field duplicates are collected at a frequency of 1 per 10 samples. Since SFB, and SSS samples will be collected infrequently, field duplicates of these samples may be collected at a higher frequency.

Trip Blanks. Trip blanks are used to identify VOC contamination from sample media or transport and storage procedures. Trip blanks are subject to the same handling protocols as environmental samples. For VOC scrubber blowdown samples and AWS samples, prepreserved VOC vials containing organic-free water are prepared. Each trip blank is then labeled, and one is placed in every batch of aqueous VOC samples shipped to the laboratory.

Train Blanks. For the analyses of vapor phase dioxins/furans and HCl/HF, train blanks are collected during each sampling event to monitor contaminants that may be introduced from reagents and during sampling train assembly and recovery. The train blanks are collected and archived for analysis, if needed, based on primary sample results.

Equipment Blanks. Equipment blanks are collected and analyzed to determine whether contaminants detected in samples are actually present or are due to inadequate decontamination of sampling equipment. Equipment blanks are collected at a frequency of 1 per 10 sampling locations without dedicated sampling equipment (i.e., SVM wells) by passing ambient air through the sampling train. If analytes are detected above the reporting limit and have the potential to affect field sample results, the frequency of equipment blank collection will be increased and the possible source of contamination will be investigated.

Ambient Blanks. Field or ambient blanks are not collected because all gas sample collection trains are closed systems that prevent exposure to ambient air.

2.2.4 Sampling Frequencies

The sample analytical frequency and the analytical methods to be used in support of the DPE system operation and monitoring strategy are described in Section 5.0 and Table 5-5 of the BDR. The sample frequencies listed are intended solely as guideline and are refined as needed to meet site requirements. The sampling frequency may be altered to more closely monitor the performance standards when process parameters are changed (i.e., vacuum, temperature, etc.), or when a DPE well is no longer yielding enough mass to justify extraction. The sampling frequency may also be altered either at the request of, or concurrence with, the EPA. The following assumptions were used to determine the sampling frequencies listed in Tables 5-5 of the BDR:

- All SVM and DPE wells will be sampled and analyzed once for VOCs during pre-operation. Following pre-operation, operating SVE wells and selected SVM and non-operating SVE wells will likely be sampled weekly during a four-week initial operation/optimization period. More frequent well sampling may be required if a migrating soil gas plume is present or suspected. During long-term operation, operating DPE wells will be sampled monthly and non-operating DPE wells, and SVM wells will be sampled as needed (e.g., monthly, quarterly, or less frequently, as discussed in Subsection 5.6 of the BDR) to enable graphical representation/mapping of the lateral and vertical extent of contamination.
- Method TO-15 for soil gas and SW 8260B for liquids will be used to analyze all VOCs.
- Residuals sampling is not anticipated during the pre-operation phase.
- Waste extraction test (WET) analyses are conducted only if required for disposal.
- Residuals will be analyzed for hexavalent chromium only when a chromium catalyst is used.

3.0 QUALITY ASSURANCE PROJECT PLAN

3.1 PROJECT MANAGEMENT

These project management elements address the procedural aspects of project development.

Title and Approval Sheet

The Title and Approval Sheets are to be located at the beginning of the Removal Action Work Plan.

Table of Contents

The table of contents precedes the SAP text.

Distribution List

The distribution list is located at the beginning of the BDR document.

Project Organization

Project organization and manager responsibilities for the implementation of the Cooper Drum removal action task are identified in Section 1.2, FSP, of the SAP.

Problem Definition/Background

The problem definition and background are presented in Section 1.0 of the BDR.

Project/Task Description and Schedule

The task description and schedule are presented in Section 2.5, FSP, of the SAP.

3.2 SOILS QAPP

3.2.1 Data Quality Objectives and Criteria for Measurement Data

The data quality objective process was developed for the sampling and analysis of soil from the Cooper Drum site.

- 1. State the Problem.** Four non-VOC areas are present above acceptable risk levels in the surface to near surface soils at the site.
- 2. Identify the Decision.** The decision is whether the risk to human health due to non-VOC contamination has been removed following the removal of the soil at the site.
- 3. Identify Inputs to the Decision.** The inputs to the decision are the analytical data for the four areas and any validation reports.
- 4. Define the Study Boundaries.** The soil data will only define the contamination at the localized sample location, although the data are considered to represent the excavation area.

The data will be limited to those non-VOCs identified in the remedial investigation as contaminants of concern (based upon the human health risk assessment).

5. **Develop a Decision Rule.** If the soil concentrations are less than or equal to the cleanup goals identified in the BDR, the site will be considered to be cleaned up to acceptable levels. If the soil concentrations exceed the cleanup goals, further excavation will be required and additional samples will be collected.
6. **Specify Limits on Decision Errors**
 - a) The null hypothesis is that the Non-VOC soil data are below the cleanup goals.
 - b) A false positive is defined as considering the soil as contaminated, when it is not. This may result in further excavation and sampling, which would most likely correct the erroneous conclusion.
 - c) A false negative is defined as considering the site cleaned up, when there is still a risk to human health.

Actual Concentration	Correct Decision	Type of Error	Tolerable Probability of Incorrect Decision
Less than or equal to cleanup goal	Site is cleaned up	False positive	20%
Cleanup goal +10% cleanup goal	Site is not cleaned up	False negative	10%
Greater than cleanup goal + 10% cleanup goal	Site is not cleaned up	False negative	5%

7. **Optimize the Design for Obtaining Data.** The sampling grid is based upon reasonable sample number for the size of the planned excavation area, not statistical sampling approaches. The analytical methods for analysis of the soil samples are based upon the need for real-time screening data during the excavation and historical EPA-approved definitive analytical methods, which satisfy the decision criteria (step 5 above) and the decision error limits (step 6 above). The design will be used to focus all sampling and analysis activities on the decision (step 2 above) in an efficient and cost-effective manner.

3.2.2 Special Training Requirements/Certification

Field sampling personnel will be certified to work on hazardous waste sites as required by the federal and California Occupational Safety and Health Administration. The laboratory shall be certified by the state of U.S. EPA.

3.2.3 Documentation and Records

All data relating to field sampling and analysis will be maintained, to allow re-creation of the sampling and analytical activities. The data packages will include a narrative describing any special situations or non-conformances, and analytical report forms for all samples and associated QC samples. The analytical data packages, the FSP, the chains-of-custody, field sampling forms, and the final report will be stored for 7 years in an off-site storage facility following the completion of this task.

The precision and accuracy criteria (data quality indicators) for measurement data are listed in Tables 3-1 and 3-2.

3.2.4 Measurement/Data Acquisition

Sampling Process Design

The sampling design is described in Subsection 2.2. All measurements are considered critical—the field XRF data will determine the need for further excavation during the course of the removal and the fixed laboratory non-VOC data will confirm adequate removal of contaminated soil.

Sampling Method Requirements

The sampling procedures are described in Section 2.0, FSP.

Sample Handling and Custody Requirements

The sample handling and custody requirements are described in Subsection 2.2.4. Table 3-3 lists the analytical methods, preservation, containers, and analytical holding times.

Analytical Methods Requirements

The analytical methods are listed below.

- On-site XRF for lead. Samples are prepared by a combination of techniques including sieving, drying, and pulverizing prior to analysis. Approximately twenty grams of sample is pulverized to <100 mesh (rock flour consistency) by mortar and pestle or ball mill techniques. The sample is analyzed under preset energy conditions for the contaminants of concern. The software is programmed to calculate final concentrations by “Fundamental Parameters” or by a least squares fit to “site-specific” calibration data. The software algorithms correct for matrix effects, and calculate final concentrations by an iterative process.
- EPA SW-846 Methods 3050B (soil) or 3010A (water) and SW7421 for preparation and analysis of lead.
- EPA SW-846 Methods SW8082 and SW8310 extraction and analysis of the PCBs and PAHs.

The QC and reporting limit requirements for the fixed laboratory methods are presented in Tables D3-1 and D3-2. The reporting limit for lead using XRF is approximately 50 mg/kg.

Quality Control Requirements

The QC checks of both field screening and laboratory sample analyses will be used to assess and document data quality, and to identify discrepancies in the measurement process requiring correction. The collection and analysis of equipment decontamination rinsates and field duplicate samples will be used to assess the representativeness of the environmental samples, the thoroughness of the field equipment decontamination procedures, and the precision of sample collection, handling, and analytical procedures. Method blanks, laboratory control samples, and matrix spike/matrix spike duplicate pairs will be performed in the laboratory to assess the potential for false positive results due to laboratory contamination, accuracy of laboratory analysis, and the accuracy and precision due to laboratory procedures and matrix.

Equipment Decontamination Blanks

Equipment decontamination blanks will be used to assess the adequacy of procedures that are intended to prevent cross-contamination between sampling locations and samples. An equipment blank will be collected at a maximum of two locations during sample collection for fixed laboratory analyses. Equipment blanks will be collected following the final decontamination rinse of non-disposable sample equipment and then dispensed into the metals and pesticide sample containers. Equipment blanks will not be collected if disposable sampling equipment is used. The criteria are that the analytes are less than the quantitation limits specified in Tables D3-1 and D3-2.

Field Duplicates

Field duplicates will be collected at selected locations to evaluate the environmental variability throughout the excavation area. Sample containers will be filled to yield an appropriate sample volume for each type of analysis conducted by the laboratory and the field XRF. The field duplicates will be handled and analyzed in the same manner as the other environmental samples. Samples will be collected and analyzed at a minimum of one per ten environmental samples collected. The criterion for soil field duplicates is less than or equal to 50 relative percent difference (RPD) for results greater than 5 times the detection limit.

Method Blanks

Method blanks are required for all analyses performed in the fixed laboratories. The required frequency of analysis is once per preparation batch containing 20 samples or less. The criteria are that the analytes are less than the quantitation limits specified in Tables D3-1 and D3-2.

Laboratory Control Samples

Laboratory control samples (LCSs) containing all analytes are required for all analytical methods performed in the fixed laboratory. The required frequency of analysis is once per preparation batch containing 20 samples or less. The LCS criteria are listed in Tables D3-1 and D3-2.

Matrix Spike/Matrix Spike Duplicates

Matrix spikes and matrix spike duplicates (MS/MSD) samples will be specified for selected samples at a frequency of one per twenty samples analyzed. A known concentration of the spike solution containing all analytes will be added to each sample in the fixed laboratory and analyzed in the same manner as the environmental samples. The MS/MSD results will be used to assess the accuracy and precision of the dataset due to the project-specific sample matrix. The MS/MSD criteria are listed in Tables 3-1 and 3-2.

Performance Evaluation Samples

One set of performance evaluation (PE) samples will be submitted to the analytical laboratory for Non-VOC analysis. The PE samples will be submitted double blind to the laboratory with the first set of soil samples.

3.2.5 Assessment/Oversight

Assessments and Response Actions

A senior internal technical reviewer will review all documents to ensure that correct conclusions were made regarding the removal action. When a difference of opinion or an error is identified, it is documented, discussed with the author, and revised. If the issue cannot be resolved, the project manager makes the determination regarding the content of the report.

Reports to Management

The internal technical review form is submitted to the project manager upon completion. A technical memorandum will provide the summary of the PE sample results, including a statement regarding acceptability. A summary of data quality will be produced based upon the results of the data validation and the PE sample results for incorporation into the Summary Report.

3.2.6 Data Validation and Usability

Data Review, Validation, And Verification Requirements

Laboratory verification and reduction will be reviewed in the Laboratory Quality Assurance Plan. EPA Region 9 Tier 1A validation (data review) will be performed for all of the data generated. A more in-depth level of review will be performed if serious analytical problems are identified during the initial validation. The validation will follow the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, October 1999* and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, February 1994*, where applicable. These guidelines will be revised based upon the requirements set forth in the analytical method and this QAPP.

The Data Quality Summary will present the usability of the data to determine any remaining soil contamination at Cooper Drum Site. The completeness objective of 95% must be met. Completeness is defined as the Total Number of Results – Number of Rejected Results divided by the Total Number of Results.

Validation and Verification Methods

Data packages will be received by the contractor for validation. Any issues regarding the completeness of the data package, the content, or data quality will be documented and submitted to the laboratory for a formal response. This response will be incorporated into the validation findings.

Reconciliation with Data Quality Objectives

The objective of the project is to remove shallow soil metal, PAH, and PBC contamination from the Cooper Drum Site. The data produced under this QAPP will be validated and compared to cleanup goals to determine if the objective was met. If concentrations exceed the cleanup goals or anomalies in data quality are identified, further investigation, sampling, and/or excavation would be warranted to meet the project objectives.

3.3 DUAL PHASE EXTRACTION QAPP

3.3.1 Data Quality Objectives and Criteria for DPE OPS

These DQOs are specific to the operation of the DPE system.

1. **State the Problem.** VOCs areas are present in the vadose zone above acceptable risk levels at the site.
2. **Identify the Decision.** It must be decided if the DPE RA meets OPS criteria.
3. **Identify the Inputs to the Decision.**

Phase of Operation	Information Parameter	Information Source
Design/ Construction	List of contaminants, plume characterization, soil characteristics, physical parameters, pilot study (vacuum), design calculations such as pressure losses, power requirements, flow rates.	RI/FS, BDR
Startup/ Initial Operations	Flow rates, SVE well contaminant concentrations to calculate mass removal rate	To be acquired as part of this task
	System operation data: temperature, flow rates, costs (analytical costs, O&M cost, data reduction/reporting costs)	To be acquired as part of this task
	System contaminant data for DRE and emission mass estimate	To be acquired as part of this task
Long-Term Operations	Flow rates, DPE well contaminant concentrations to calculate mass removal rate	To be acquired as part of this task
	System operation data: temperature, flow rates, costs (analytical costs, O&M cost, data reduction/reporting costs)	To be acquired as part of this task
	System contaminant data for DRE and emission mass estimate	To be acquired as part of this task
	Source testing data for emission control	To be acquired as part of this task
	Residual data for disposal	To be acquired as part of this task
	Vadose zone contaminant data for trend analysis and optimization	To be acquired as part of this task
	Ambient air contaminant levels for health and safety monitoring	To be acquired as part of this task
Rebound Study	Vadose zone contaminant data	To be acquired as part of this task
OPS Determination	SVM and DPE well concentration data, indicating decreasing trends, one-year period of operation.	To be acquired as part of this task

4. **Define the Boundaries of the Study.** The vadose zone plume on the Cooper Drum Site and that extend south to the Tweedy School.
5. **Develop a Decision Rule.**

Decision Step	Input Parameter	Action Level	Decision
1	Total and individual VOC concentrations in vapor and groundwater from influent and effluent to DPE system	< Permit levels	Operating properly IF NOT, resample, troubleshoot, take corrective action, optimize system,
2	HCl and HF concentrations in vapor from scrubber influent and scrubber effluent	≥ 99 percent removal efficiency (RE)	Operating properly IF NOT, resample, troubleshoot, take corrective action, optimize system
3	NO _x , ROCs mass emissions from system effluent	< Permit levels	Operating properly IF NOT, troubleshoot, take corrective action, optimize system
4	Flow rate at each extraction well and total influent flow rate	According to design	Operating properly IF NOT, readjust flowrates for optimal mass removal
5	VOC concentrations from spent granulated carbon (SGC), Toxicity Characteristic Leaching Procedure (TCLP), and WET leachates of SGC, hexavalent chromium from scrubber sump sediment (SSS), TCLP, and WET leachates of SSS	TCLP concentration > federal TCLP regulatory criteria Total concentration > California Total Threshold Limit Concentration (TTLC) regulatory criteria Soluble Threshold Limit Concentration (STLC) concentration > California STLC regulatory criteria	Dispose of as hazardous waste
6	VOC, pH concentration from DPE system effluent	> County sewer discharge limits pH 5 to 12.5 Total toxic organics (TTO) 2.13 milligrams per liter (mg/L)	Notify county, accumulate residuals until corrective action has been taken IF NOT, continue discharge to sewer

Decision Step	Input Parameter	Action Level	Decision
7	SVM well and DPE well contaminant concentration values and trends over time.	Decreasing over time to an asymptotic level (overall).	Operating successfully IF NOT, continue operation
		SVE well exhibits decreasing concentrations over time	Operating successfully IF NOT, optimize system by adjusting flow rate(s) from SVE well(s) or install additional SVE well(s)
		SVM well exhibits decreasing concentrations over time	Operating successfully IF NOT, optimize system by adjusting flow rate(s) from SVE well(s) or install additional SVE well(s)
		Insufficient data to characterize location or determine cleanup progress at site.	Install new SVM well IF NOT, continue operation
8	VOC mass removal	Total VOC mass removal rate is as designed	Operating successfully IF NOT, optimize system by adjusting flow rate(s) from SVE well(s) or install additional SVE well(s)

6. Specify Tolerable Limits on Decision Errors

1. Input Parameter VOC concentrations from influent and effluent to DPE system.
- Action Level Permit levels.
- Decision Operating properly.
- Null Hypothesis Removal efficiency (RE) is greater than or equal to 95 percent.
- Gray Region 94 percent to 95 percent RE.
- False Positive Error Actual RE is greater than or equal to 95 percent, but data indicate that the RE is less than 95 percent (high bias for effluent or low bias for influent).

<u>Consequences of False Positive Error</u>	Resampling costs, operator cost to determine potential error.
<u>Tolerable False Positive Error Rate</u>	5 percent due to no health risks and relatively low cost to rectify.
<u>False Negative Error</u>	Actual RE is less than 95 percent DRE, but data indicate that RE is greater than 95 percent (low bias for effluent or high bias for influent).
<u>Consequences of False Negative Error</u>	More VOCs emitted, potential health consequences, and violation of regulatory requirements.
<u>Tolerable False Negative Error Rate(s)</u>	0.5 percent for RE 80 to 94 percent. 0.1 percent for RE less than 80 percent due to potential human and ecological health risks.
2. <u>Input Parameter</u>	HCl and HF concentrations in vapor from scrubber influent and scrubber effluent.
<u>Action Level</u>	99 percent RE.
<u>Decision</u>	Operating properly.
<u>Null Hypothesis</u>	The chloride and fluoride RE across the scrubber is greater than or equal to 99 percent.
<u>Gray Region</u>	95 percent to 99 percent RE.
<u>False Positive Error</u>	Actual RE is greater than or equal to 99 percent, but data indicate RE is less than 99 percent (high bias for effluent or low bias for influent).
<u>Consequences of False Positive Error</u>	Resampling costs, operator cost to determine potential error.
<u>Tolerable False Positive Error Rate(s)</u>	5 percent due to no health risks and relatively low cost to rectify error.
<u>False Negative Error</u>	RE is actually less than 99 percent, but data indicate RE is greater than or equal to 99 percent RE (low bias for effluent or high bias for influent).

<u>Consequences of False Negative Error</u>	More HCl, HF emitted, potential health consequences, and violation of regulatory requirements.
<u>Tolerable False Negative Error Rate(s)</u>	0.5 percent for RE of 80 to 98.5 percent, 0.1 percent for RE < 80 percent.
3. <u>Input Parameter</u>	NO _x , reactive organic compound (ROC) mass emitted at system effluent.
<u>Action Level</u>	Permit levels.
<u>Decision</u>	Operating properly.
<u>Null Hypothesis</u>	The NO _x and ROC mass emitted are less than or equal to the maximum allowances.
<u>Gray Region</u>	Action level plus 30% of action level (1.3 times action level) based upon ±30% acceptable accuracy limits.
<u>False Positive Error</u>	Actual mass emitted multiplied by 1.3 is less than allowance, but data indicate that mass emitted multiplied by 1.3 exceeds the allowances (high bias).
<u>Consequences of False Positive Error</u>	Resampling costs, operator cost to determine potential error.
<u>Tolerable False Positive Error Rate(s)</u>	1 percent.
<u>False Negative Error</u>	Actual mass emitted multiplied by 1.3 is greater than allowance, but data indicate that mass emitted multiplied by 1.3 is less than the allowances (low bias).
<u>Consequences of False Negative Error</u>	More VOCs emitted, potential health consequences, and violation of regulatory requirements.
<u>Tolerable False Negative Error Rate(s)</u>	0.1 percent for concentrations greater than the gray region due to potential health effects.

4. Input Parameter Flow rates at each extraction well, total influent flow rate, cleanup zone extent.
- Action Level Flow rates produce adequate cleanup zone at all depth intervals within the plume.
- Decision Operating properly.
- Null Hypothesis Flow rates produce adequate cleanup zone at all depth intervals within the plume
- Gray Region Cleanup zone is unknown.
- False Positive Error Flow rates produce adequate cleanup zone at all depth intervals within the plume but data indicate otherwise.
- Consequences of False Positive Error Flow rates may be changed or additional DPE wells drilled.
- Tolerable False Positive Error Rate 10% due to minimal impact of error.
- False Negative Error Flow rates produce inadequate cleanup zone at one or more depth intervals within the plume but data indicate otherwise.
- Consequences of False Negative Error Delayed corrective actions until data are reanalyzed; possible extension of system operation.
- Tolerable False Negative Error Rate(s) 10% due to minimal impact of error.
5. Input Parameter Solid residuals exceed state or federal standards making them hazardous waste.
- Action Level Regulatory levels provided in California Assessment Code Title 26 STLC, TTLC, and RCRA TCLP.
- Decision Characterization of solid residuals as non-hazardous or as hazardous.
- Null Hypothesis TCLP, TTLC, or STLC regulatory criteria are exceeded.
- Gray Region 5 percent less than action level to action level.

<u>False Positive Error</u>	TCLP, TTLC, or STLC regulatory criteria are exceeded, but data indicate that regulatory criteria are not exceeded (low bias).
<u>Consequences of False Positive Error</u>	Waste classified as non-hazardous when it is actually hazardous. Turned over to the base for disposal.
<u>Tolerable False Positive Error Rate</u>	0.1 percent.
<u>False Negative Error</u>	TCLP, TTLC, or STLC regulatory criteria are not exceeded, but data indicate that regulatory criteria are exceeded (high bias).
<u>Consequences of False Negative Error</u>	Waste classified as hazardous when it is actually non-hazardous. Higher cost paid for disposal as hazardous waste.
<u>Tolerable False Negative Error Rate(s)</u>	5 percent.
6. <u>Input Parameter</u>	VOC concentration, pH of DPE effluent, if untreated and discharged to sewer system.
<u>Action Level</u>	Los Angeles County wastewater discharge permit criteria.
<u>Decision</u>	Notify county, take corrective action to collect and treat liquids.
<u>Null Hypothesis</u>	VOC concentration, pH of DPE effluent exceeds Sacramento County wastewater discharge permit criteria.
<u>Gray Region</u>	5 percent below permit criteria to permit criteria.
<u>False Positive Error</u>	VOC concentration, pH of DPE effluent exceed Los Angeles County wastewater discharge permit criteria, but data indicate the levels are not exceeded (low bias).
<u>Consequences of False Positive Error</u>	Out-of-specification liquids may be discharged to sewer without treatment.
<u>Tolerable False Positive Error Rate</u>	0.1%.
<u>False Negative</u>	VOC concentration, pH of DPE effluent do not exceed Los Angeles County wastewater discharge permit criteria, but data indicate the levels are

	<u>Error</u>	exceeded (high bias).
	<u>Consequences of False Negative Error</u>	Conservative treatment of liquids, extra cost of treating liquids prior to discharge.
	<u>Tolerable False Negative Error Rate(s)</u>	5 percent.
7.	<u>Input Parameter</u>	SVM and DPE well contaminant concentrations over time.
	<u>Action Level</u>	Decreasing to asymptote.
	<u>Decision</u>	Operating successfully if decreasing to asymptote.
	<u>Null Hypothesis</u>	Concentrations decreasing to asymptote.
	<u>Gray Region</u>	SVM or DPE well contaminant concentrations not decreasing to asymptote.
	<u>False Positive Error</u>	Actual contaminant concentrations decreasing to asymptote but data are misinterpreted or indicate otherwise.
	<u>Consequences of False Positive Error</u>	Extended DPE operating time, continued analysis of data.
	<u>Tolerable False Positive Error Rate</u>	5 percent.
	<u>False Negative Error</u>	Actual contaminant concentrations not decreasing to asymptote but data are misinterpreted or indicate otherwise.
	<u>Consequences of False Negative Error</u>	Determination of system as operating successfully prior to system actually meeting criteria. This error is unlikely because of the extended time period and many analytical results required to arrive at the decision point.
	<u>Tolerable False Negative Error Rate(s)</u>	10 percent for any single set of data. Many sets of data will be taken over the time period required to reach the decision point, so that any single set out of ten in error would be acceptable.
8.	<u>Input Parameter</u>	VOC mass removal.
	<u>Action Level</u>	DPE well total VOC mass removal rate is as much as or more than designed.

<u>Decision</u>	Operating successfully if DPE well total VOC mass removal rate is as much as or more than designed.
<u>Null Hypothesis</u>	DPE well total VOC mass removal rate is as much as or more than designed.
<u>Gray Region</u>	DPE well total VOC mass removal rate is within 70% of design rate.
<u>False Positive Error</u>	Actual DPE well total VOC mass removal rate is as much as or more than designed but data indicate otherwise.
<u>Consequences of False Positive Error</u>	Extended DPE operating time, continued data analysis.
<u>Tolerable False Positive Error Rate</u>	5 percent.
<u>False Negative Error</u>	Actual DPE well total VOC mass removal rate is less than 70% of design rate but data indicate mass removal rate is within 70% or greater of design rate.
<u>Consequences of False Negative Error</u>	Determination that system is operating successfully prior to system actually meeting criteria. This error is unlikely because of the extended time period and many analytical results required to arrive at the decision point.
<u>Tolerable False Negative Error Rate(s)</u>	10 percent for any single set of data. Many sets of data will be taken over the time period required to reach the decision point, so that any single set out of ten in error would be acceptable.

Step 1. Optimize the Design to Obtain Data

	Input Parameter	Frequency and Justification	QL	Precision and Accuracy	Completeness	Assumptions
1	Total and individual VOC concentrations in influent and effluent to DPE system	Monthly Permit Required	0.05 ppmv individual VOC	± 30 percent accuracy, ≤ 25 RPD for replicate samples	100% or resample	Individual VOC QL based on 95 percent DRE with 10 ppmv total influent VOC concentration and maximum of 10 compounds comprising total effluent VOC concentration of 0.5 ppmv – effluent concentration must be 0.5 ppmv, method accuracy and precision.
2	HCl and HF concentrations in vapor from scrubber influent and scrubber effluent	Annually SCAQMD direction	0.2 ppmv for each	±10 percent accuracy, ≤ 10 RPD for replicates	100% or resample	QL, method precision and accuracy.
3	NO _x , ROCs mass emissions from system effluent	Annually SCAQMD direction	0.1 ppmv NO _x 0.05 ppmv individual VOC	±30 percent accuracy, ≤25% RSD	100% or resample	QL same as needed for DRE calculation, method accuracy and precision
4	Flow rate at each extraction well and total influent flow rate	Monthly/Quarterly Sufficient trend to determine OPS	Varies with design	Not applicable	Not applicable	None
5	VOC concentrations from SGC, TCLP, and WET leachates of SGC, hexavalent chromium from SSS and WET leachates of SSS	As needed to profile for transport and treatment.	5 to 20 µg/kg total VOCs, 0.100 mg/L leachates 250 mg/kg total hexavalent chromium, 2.5 mg/L leachate	Varies with compound	100% or resample	No action levels for VOCs, leachate QLs one half of lowest leachate limit Total and leachate QL one half of lowest regulatory limit

Step 1. Optimize the Design to Obtain Data

	Input Parameter	Frequency and Justification	QL	Precision and Accuracy	Completeness	Assumptions
6	VOC and metals concentration from AWS and scrubber blowdown	Annually Characterization of liquid waste stream for disposal to sewer.	10 µg/L VOCs 0.1 mg/L individual heavy metals	± 30 percent accuracy, ≤ 25 RPD for sample replicates	100% or resample	VOC QL is minimum quantifiable value specified in the wastewater discharge permit. VOCs are approximately equivalent to TTO for SVE residuals. Heavy metals QLs are approximately one half of the monthly average value specified in the wastewater permit.
7	SVM well and DPE well contaminant concentration values and trends over time.	Quarterly – soil vapor concentration greater than cleanup goals; Semi-annual – soil vapor concentrations less than cleanup goals during the previous sample event; Annual – soil vapor concentrations less than cleanup goal for two consecutive sample events; Stop sampling a well, until confirmation sampling, if soil vapor concentrations less than cleanup goal for three consecutive sample events.	0.5 ppmv	± 30 percent accuracy, ≤ 25 RPD for sample replicates	95%	QL is one half the action level for individual VOCs, QL is one half the action level for individual VOCs
8	VOC Mass removal	Monthly TVH taken monthly for DRE calculation, flow rate taken monthly	0.5 ppmv TVH	± 30 percent accuracy, ≤ 25 RPD for sample replicates	100%	QLs are equivalent to those for calculating DRE, method accuracy and precision

AWS	=	air-water separator	SGC	=	spent granulated carbon
DRE	=	destruction removal efficiency	SCAQMD	=	South Coast Air Quality Management District
GWTP	=	groundwater treatment plant	SVM	=	soil vapor monitoring
HCl	=	hydrochloric acid	SSS	=	scrubber sump sediment
HF	=	hydrofluoric acid	SVE	=	soil vapor extraction
mg/kg	=	milligram per kilogram	TCLP	=	toxicity characteristics leaching procedure
mg/L	=	milligram per liter	TTO	=	total toxic organics
NO _x	=	nitrous oxide	TVH	=	total volatile hydrocarbons
OPS	=	operating properly and successfully	VOC	=	volatile organic compound
ppmv	=	parts per million by volume	WET	=	waste extraction test
QAPP	=	quality Assurance Project Plan	±	=	plus or minus
QL	=	quantitation limit	≤	=	less than or equal to
ROC	=	reactive organic compound	μg/kg	=	Microgram per kilogram
RPD	=	relative percent difference	μg/L	=	micrograms per liter
RSD	=	relative standard deviation			

3.3.2 DPE STOP

1. **State the Problem.** A DPE system has been successfully operating at a site, VOCs have been removed, and adequate justification for closeout must be developed.
2. **Identify the Decision.** The DPE RA will either be closed out or require further vadose zone remediation. Can the DPE RA be terminated and proceed to closeout?
3. **Identify Inputs to the Decision.**

Information/Parameter

Information Source

Post-rebound SVM and SVE well data	Periodic Monitoring Report
Site mass removal rate	Periodic Monitoring Report
Action levels	ROD
Confirmation boring soil gas concentrations	To be acquired as part of this task

Modeling Inputs

Air permeability, total porosity, dry bulk density, residual moisture content before and after remediation, water filled porosity, fraction organic carbon in soil	Remedial Investigation/Feasibility Study (RI/FS)
Henry's Law constant, gas viscosity, aqueous diffusion coefficient, organic carbon partitioning coefficient, gaseous diffusion coefficient	EPA physical characteristics database, RI/FS, or other reputable physical characteristics database
Maximum time-period modeled	To be determined
Minimum and maximum post-rebound SVM well data	To be acquired as part of this task
Lithologic descriptions	RI/FS
Fraction organic carbon in saturated zone, hydraulic conductivity near the water table, effective porosity	Recent site measurement, from nearby site or from RI/FS
Hydraulic gradient	Periodic Monitoring Report

Other information for STOP evaluation

DPE cleanup cost predictions	To be developed as part of this task
Groundwater cleanup cost predictions	To be developed as part of this task

4. Define the Study Boundaries.

- Spatial Boundaries** The site is established by the RI/FS data. The geological boundary is the vadose zone, defined as extending from the surface to the deeper of 50 feet or the deepest vapor well.
- Temporal Boundaries (time-frame)** The time period of the measured VOC concentrations is from the time before and after the rebound study, when SVM and SVE wells are sampled. The data will represent the anticipated time period for which it is modeled (find out what that is).
- Practical Constraints (site access, seasonal conditions, and resource availability)** Borings will be drilled in accessible locations that may be limited to relatively open areas (paved or unpaved). Also, boring locations and boring schedules may have to be adjusted because of unpaved areas that become saturated during the winter months. The numbers of borings are limited by cost.

5. Develop a Decision Rule.

The following decision rules are general guidelines for DPE RA closure. Other information may also be included to justify or negate terminating the DPE system. All applicable information will be included in the STOP evaluation included in the Closure Report.

Decision Step	Parameter	Action Level	Decision
1	Most current post-rebound SVM well individual VOC concentrations AND	\leq Cleanup Goals	DPE system will be considered for shutdown and SVM well concentrations will be modeled for potential contaminant transport to groundwater IF NOT, DPE RA continues
	Most current post-rebound DPE well VOC concentrations AND	\leq Cleanup Goals	
	Mass VOC removal rate	\leq 0.5 to 1 pound/day	
2	Modeled leachate concentrations from vadose zone individual VOC soil gas concentrations AND	$<$ Cleanup Goals	DPE system will be permanently shut down, confirmation borings drilled, and Closure Report will be prepared. IF NOT, for shallow soil gas, install new wells or other system optimization or investigate a remedial alternative or institutional controls. For leachate, an economic analysis will be performed. Proceed to Step 3.
	Soil gas concentrations from samples collected at 0 to 20 feet bgs	\leq Cleanup Goals	

Decision Step	Parameter	Action Level	Decision
3	Results of economic analysis – cost for DPE cleanup versus cost for additional groundwater cleanup only	Less than the cost for any additional groundwater remediation resulting from current vadose zone contamination to reach the groundwater cleanup standard without DPE.	DPE system will be permanently shut down, DPE closure document will be prepared, and confirmation borings will be drilled. IF NOT, DPE system will be optimized and continue operation.
4	Confirmation borings soil gas concentrations	soil gas concentrations ≤ Cleanup Goals	The DPE RA closure document will be amended with confirmation data. IF NOT, the boring will be converted to a DPE or SVM well, the system will be optimized, and the DPE system will continue operation.

6. Specify Limits on Decision Errors

- Null Hypothesis Post-rebound VOC concentrations are less than or equal to cleanup goals, and each individual DPE well VOC mass removal rate is less than or equal to 0.5 to 1 pound/day.

Gray Region VOCs from wells are within ±30% of cleanup standard, 0.5 to 1.33 pounds/day SVE well mass removal (based upon acceptable total sampling and analytical error of ±30%).

False Positive Error Data indicate that system operation should continue (high bias), but the correct decision is to consider closing out the DPE RA (true values meet null hypothesis).

Consequences of False Positive Error DPE operational costs will continue until the next sampling event. Data produced during next sampling event would most likely result in a correct decision. No risk to human or ecological health.

Tolerable False Positive Error Rate(s) 10% because only 3 additional months of operation would be added.

False Negative Error Data indicate that DPE RA closure to be considered (low bias), but the correct decision is to continue operating system (action levels have not been reached).

<u>Consequences of False Negative Error</u>	System will be shut down, post-rebound SVM well data will be modeled, DPE closure document will be prepared, and confirmation borings will be drilled. Confirmation borings would most likely invalidate incorrect post-rebound SVM well data. The amount of time to model, drill confirmation borings, and receive analytical results will be wasted before DPE system is started up again. No risk to human or ecological health because of additional soil vapor sampling in confirmation borings, which has low probability of confirming incorrect results leading to high risk decision.
<u>Tolerable False Negative Error Rate(s)</u>	5% due to the necessity of closing out the DPE RA
2. <u>Null Hypothesis</u>	The modeled leachate concentrations for each individual analyte from SVM wells are below groundwater cleanup goals. Soil gas concentrations from shallow well samples are below cleanup goals.
<u>Gray Region</u>	Action levels +20% of action level (or 1.2 x action level for each compound) based upon tighter accuracy requirements of $\pm 20\%$ recovery (random error).
<u>False Positive Error</u>	The analytical results indicate that the deep modeled VOC concentration of at least one contaminant is above the associated action level (high bias); however, it is actually below the action level.
<u>Consequences of False Positive Error</u>	An economic analysis is performed. The results may indicate that DPE system continues operating after optimization, which may include installation of new DPE and SVM wells. The potential cost and time delay impacts could be great; however, human or ecological health would not be affected. The economic analysis may also indicate that the DPE RA should be closed, confirmation borings would be drilled, analytical data would indicate acceptable levels of contamination (or none); this would result in the correct decision.
<u>Tolerable False Positive Error Rate(s)</u>	5% due to potential cost and time delay.
<u>False Negative Error</u>	The analytical results indicate that the deep modeled VOC concentrations and actual shallow soil gas concentration (for samples from 0 to 20 feet bgs) of all contaminants are below the associated action level (low bias); however, at least one is actually above the action level.
<u>Consequences of False Negative Error</u>	SVE system is shut down. Confirmation borings are drilled. Confirmation boring soil gas data may invalidate incorrect results, reversing the incorrect decision. However, cost of confirmation borings will be incurred and length of time to drill confirmation borings and receive analytical results would extend cleanup. The low probability of inaccurate confirmation boring concentrations would result in extended groundwater or dual-phase treatment system operation

and there may be potential inhalation risk to residents. Significant cost and time delay for site closure could occur.

- Tolerable False Negative Error Rate(s) 2% based upon potential risk to human and ecological health.
3. Null Hypothesis The predicted cost for continuing DPE for an agreed-upon time with groundwater remediation to the cleanup level is greater than the predicted cost for groundwater extraction alone to reach the cleanup level. This would lead to a decision to close out the DPE RA.
- Gray Region The predicted cost for continuing DPE for an agreed-upon period of time with groundwater remediation to the cleanup level is 10% of that predicted cost.
- False Positive Error Predicted DPE costs with groundwater extraction are calculated to be less than the groundwater extraction alone costs (low bias), but are actually higher.
- Consequences of False Positive Error SVE operation would continue following optimization, which may include borings for additional SVM and DPE wells. Costs will be higher, but no human or ecological health risks are expected (VOCs will be cleaned up either way).
- Tolerable False Positive Error Rate(s) 5%.
- False Negative Error Predicted DPE cost appears greater than groundwater remediation alone cost and time (high bias), yet are less.
- Consequences of False Negative Error Costs will be higher, but no human or ecological health risks are expected (VOCs will be cleaned up either way).
- Tolerable False Negative Error Rate(s) 5%.
4. Null Hypothesis Shallow (<20 feet bgs) soil gas concentrations are less than or equal to the cleanup goals and deep (20 to 50 feet bgs) soil gas concentrations are less than or equal to action levels (or leachate meets groundwater cleanup standards).
- Gray Region Action level +30% action level based upon $\pm 30\%$ acceptable accuracy criteria.
- False Positive Error Data indicate that concentrations are above action levels (high bias), resulting in installation of SVM or DPE wells and continuation of DPE RA. Concentrations are actually below action levels and DPE RA should be closed.

<u>Consequences of False Positive Error</u>	Additional time and costs associated with construction of wells and continuation of DPE RA. The following sampling results would most likely indicate previous error, and the decision would be reassessed. No human or ecological health risks would occur.
<u>Tolerable False Positive Error Rate(s)</u>	5%.
<u>False Negative Error</u>	Data indicate that concentrations are below action levels (low bias), resulting in site closure. Concentrations are actually above action levels and DPE RA should continue.
<u>Consequences of False Negative Error</u>	The DPE RA is closed, resulting in potential human health or ecological risk (shallow) or additional cost and extended groundwater cleanup (deep).
<u>Tolerable False Negative Error Rate(s)</u>	2% due to potential health risk.

7. Design Optimization for Obtaining Data

- | | |
|---|--|
| <u>Data to be Collected</u> | None. All data for this decision have been produced in previous tasks (DPE O&M) and reported in the Monitoring Reports. The data include post-rebound SVM and DPE well VOC concentrations and VOC mass removal rate. |
| <u>Frequency or Sample Quantity</u> | Not applicable. |
| <u>Justification for Frequency or Sample Quantity</u> | Not applicable. |
| <u>Quantitation Limit Requirements</u> | Developed for post-rebound sampling (OPS DQO) based upon these action levels (and action levels for proper operation). |
| <u>Precision and Accuracy Requirements</u> | Developed for post-rebound sampling (OPS DQO) based upon these acceptable error rates. |
| <u>Completeness Requirements</u> | 100%. |
| <u>Assumptions</u> | None. |

2. Data to be Collected The majority of information used for modeling is currently available in Site documents.
- Frequency or Sample Quantity Not applicable.
- Justification for Frequency or Sample Quantity Not applicable.
- Quantitation Limit Requirements Not applicable.
- Precision and Accuracy Requirements Not applicable.
- Completeness Requirements Not applicable.
- Assumptions All appropriate modeling inputs are available in RI/FS, or physical properties database. There are sufficient SVM data to adequately model the VOC concentrations. Sufficient shallow soil gas data are available.
3. Data to be Collected The inputs to predict cost and time period necessary for VOC cleanup will available in Monitoring Reports and modeling from previous task.
- Frequency or Sample Quantity Not applicable.
- Justification for Frequency or Sample Quantity Not applicable.
- Quantitation Limit Requirements Not applicable.

<u>Precision and Accuracy Requirements</u>	Not applicable.
<u>Completeness Requirements</u>	Not applicable.
<u>Assumptions</u>	None.
4. <u>Data to be Collected</u>	VOC soil gas concentrations from confirmation borings covering all depth intervals affected by DPE and shallow zone to provide sufficient data within site plume (together with previously sampled SVM wells). Method TO-15 used with analyte list containing all contaminants of concern.
<u>Frequency or Sample Quantity</u>	The quantity will depend upon the existing SVM wells and depths. The quantity of samples will also depend upon the size of the plume. Soil gas samples collected at a minimum of 10-foot intervals or at depth intervals where contamination was found in the RI.
<u>Justification for Frequency or Sample Quantity</u>	Justification is based upon professional judgment and the basis is presented in the RI/FS. Justification will be presented in the Closure Report.
<u>Quantitation Limit Requirements</u>	Individual VOC Cleanup Goals
<u>Precision and Accuracy Requirements</u>	Precision ≤ 20 , accuracy $\pm 30\%$
<u>Completeness Requirements</u>	95% overall, but 100% for contaminants of concern.
<u>Assumptions</u>	None.

3.3.3 Special Training Requirements/Certification

All staff must be familiar with the applicable work plans and SOPs. Field personnel will be certified to work on hazardous waste sites as required by the federal and California Occupational Safety and Health Administration (OSHA and Cal/OSHA).

3.3.4 Documentation and Records

The analytical data packages, chains-of-custody, field sampling forms, and field logbooks will be stored for 7 years in an off-site storage facility following the completion of this task.

Vapor phase VOC analytical data reports are submitted in preliminary format within 7 days of sample submittal. Final analytical data reports and electronic data files are submitted within 14 days of sample submittal. This allows timely identification of any unexpected problems, so that resolution can occur quickly. If required, raw GC/MS data may be obtained from the laboratory for further analysis or documentation. In general, all other preliminary sample results are required within 14 days and final reports and electronic data submittals are due within 21 days. Boring data may require faster turnaround time. The turnaround time will be specified in the Site Closeout Work Plan if further sampling is recommended.

3.4 MEASUREMENT/DATA ACQUISITION

3.4.1 Sampling Process Design

The sampling process design is described in Section 2.0 of this document. All DPE turn on, system performance, rebound data, and closure measurements are considered critical.

3.4.2 Sampling Method Requirements

The sampling procedures are described in Section 2.0. Each recommendation for further sampling in the Monitoring Report will identify the site-specific sampling procedures. A SOP for process, SVM well, and DPE well sampling is attached. Table 3-6 lists the analytical methods, preservation, containers, and analytical holding times.

3.4.3 Sample Handling and Custody Requirements

The sample handling and custody procedures used for DPE RA sample collection are described in Section 2.1.4, Sample Documentation and Custody.

3.4.4 Analytical Methods Requirements

The DPE RA analytical methodology and method modifications are summarized below.

Soil Gas Emissions and Ambient Air Analyses

VOCs (GC/MS). Method: TO-15 – “Determination of VOCs in Air using Specially-Prepared Canisters with Subsequent Analysis by Gas Chromatographic/Mass Spectrophotometric (GC/MS) Analysis”

Air samples are collected in specially prepared and evacuated stainless steel canisters. Temperature and pressure are measured in the laboratory, and nitrogen is added to provide positive pressure for removing the sample. A known volume of sample is directed from the canister through a solid multisorbent concentrator. After concentration and drying steps are completed, the VOCs are thermally desorbed, entrained in a carrier gas stream, and focused in a small volume by trapping on a reduced temperature or

multisorbent trap. The sample is then released by thermal desorption and carried onto a GC column for separation. The high resolution GC is coupled to a mass spectrometer.

The DPE RA analyte list and detection limits for VOCs in vapor vary, depending upon the DQO. The analyte list detection limits and precision/accuracy requirements are listed in Table 3-4.

Dioxins/Furans. Method 23 – “Determination of Polychlorinated Dibenzo-p-dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) from Stationary Sources”

This analytical method measures the concentration of PCDDs and PCDFs from stationary sources. A sample is withdrawn from a gas stream isokinetically for 2 hours and collected in the sample probe on a glass fiber filter and on a packed column of adsorbent material. The PCDDs and PCDFs are extracted from the sample, separated by high-resolution gas chromatography (HRGC) and measured by high-resolution mass spectrometry (HRMS). Quantitation is achieved by comparing the response of the quantitating mass to the response of a known concentration of the analyte relative to internal standard areas. The DPE RA analyte lists detection limits and precision/accuracy requirements for PCDDs and PCDFs are listed in Table 3-5.

Hydrochloric Acid and Hydrofluoric Acid (HCl and HF). CARB Method 421 – “Determination of Gaseous Chloride and Fluoride in Emissions from Stationary Sources”

This method is applicable to the quantitative determination of gaseous chloride and fluoride in emissions from stationary sources. It detects gaseous chloride and fluoride compounds which can be adsorbed and ionized in a mildly basic buffer solution, and also detects volatile chloride and fluoride compounds in aerosol mists. HCl and HF are assumed to be the principle compounds detected when testing combustion processes. Gas with entrained aerosols is extracted isokinetically from the stack with a heated glass or quartz probe and passed through a heated filter to a series of chilled impingers where gaseous chlorides and fluorides are absorbed in a solution of sodium bicarbonate and sodium carbonate. Triplicate 60-minute runs are performed. The impinger solution is analyzed for chloride and fluoride by ion chromatography with a conductivity detector. The chloride and fluoride peaks are identified by characteristic retention times and quantified by reference to external standards. The DPE RA detection limits and precision/accuracy requirements are listed in Table 3-5

Sulfur Dioxide, Nitrogen Oxides, and Carbon Monoxide (SO₂, NO_x, and CO). CARB Method 100 – “Procedures for Continuous Gaseous Emission Stack Sampling”

This method is used to determine the emissions of NO_x, CO, and SO₂ from stationary source flowing gas streams in ducts, stacks, and flues. A sample of an exhaust gas stream is extracted, conditioned, and analyzed continuously by various detectors. NO_x is determined using a chemiluminescent detector, CO using a nondispersive infrared analyzer, and SO₂ using an ultraviolet absorption detector. Triplicate 60-minute runs are performed. These analytes are quantitated by comparing the sample response to the response of known concentrations of standards. The DPE RA detection limits and precision/accuracy requirements are listed in Table 3-5

Particulate Matter. CARB Method 5 – “Determination of Particulate Matter Emissions from Stationary Sources”

This method is applicable to the determination of particulate emissions from stationary sources. Particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter. Triplicate 60-minute runs are performed. The particulate mass, which includes any material that condenses at or above the filtration temperature, is determined gravimetrically after the removal of uncombined water. The DPE RA detection limits and precision/accuracy requirements are listed in Table 3-5.

Physical Parameter Determination. “Determination of Moisture Content in Stack Gases”

The moisture content of the stack gases can be determined by measuring the wet/dry bulb temperature (relative humidity) of the gases using a psychrometer.

Residual Liquid and Solid Analyses

VOCs. Method 8260B – “Volatile Organic Compounds (VOCs) by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique”

This method can be used to quantitate most volatile organic compounds and consists of purge-and-trap techniques used with GC/MS. A purge-and-trap technique is used to release the VOCs from the sample matrix on to an adsorbent trap. The trap is backflushed and heated to desorb the purgeable organics onto a GC, where the organics are separated and subsequently detected with a mass spectrometer.

Dioxins/Furans. EPA SW-846 Method 8290 – “Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)” and EPA Method 1613A – “Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS.”

Method E1613B is used to analyze for PCDDs and PCDFs in water, soil, and waste, and provides for the detection and quantitative measurement at part-per-trillion to part-per-quadrillion concentrations. The method uses a high-resolution GC/MS to analyze sample extracts. Typically, one liter of water or 10 grams of soil is extracted using methylene chloride for water and toluene for soil samples. Target analytes include all congener classes, tetra- through octa-dioxins, and furans. Because of the extreme toxicity of these compounds, the analyst must take appropriate precautions during preparation and analysis to prevent accidental exposure. Detection limits vary according to matrix and analyte.

Total Metals. EPA SW-846 Method 6020B – “Inductively Coupled Plasma Mass Spectroscopy”

Water and soil samples are analyzed for trace elements or metals using SW6020B. All matrices, excluding filtered groundwater samples but including groundwater, require digestion prior to analysis. This digestion is performed using U.S. EPA Method SW3005A or SW3010A for water or U.S. EPA Method SW3050B for soil. Following digestion, the trace elements are simultaneously or sequentially determined using ICP/MS.

Hexavalent Chromium. EPA SW-846 Method 7196A – “Chromium, Hexavalent (Colorimetric)”

Dissolved hexavalent chromium, in the absence of interfering amounts of substances such as molybdenum, vanadium, and mercury, may be determined colorimetrically by reaction with diphenylcarbazide in acid solution. A red-violet color of unknown composition is produced. The reaction is very sensitive, with an absorbency index per gram atom of chromium being about 40,000 at 540 nanometers.

(nm). Addition of excess diphenylcarbazide yields the red-violet product, and its absorbance is measured photometrically at 540 nm.

Total Dissolved Solids (TDS). EPA Method 160.1 – “Residue, Non-Filterable”

Total dissolved solids in water are determined using U.S. EPA Method 160.1. In this gravimetric method, the sample is filtered, transferred to a pre-weighed evaporating dish, and evaporated to dryness at 180°C. The sample is cooled and then weighed; the drying cycle is repeated until a constant weight is obtained.

Total Suspended Solids (TSS). EPA Method 160.2 – “Residue, Filterable”

This method is applicable to drinking, surface, and saline waters and domestic and industrial wastes. A well-mixed sample is filtered through a weighed standard glass-fiber filter and the residue retained on the filter is dried to a constant weight at 103 to 105°C. The increase in the weight of the filter represents the filterable solids.

TCLP. EPA SW-846 Method 1311 – “Toxicity Characteristic Leaching Procedure (TCLP)”

Method SW1311 is used to prepare samples for determination of the concentration of organic (semivolatile and volatile) and inorganic (metals and chromium VI) constituents extractable from waste or other material. It is applicable to liquid, solid, and multiphase wastes. Liquids (containing less than 0.5% solids) are filtered through a 0.6 to 0.8 microns (μm) glass fiber filter, and the toxicity characteristic leaching procedure (TCLP) is performed on the filtrate. For samples containing $\geq 0.5\%$ solids, the liquid and solid phases are separated and the solid phase is processed to reduce particle size and then extracted using an appropriate fluid (based on the alkalinity of the solid phase). The sample is filtered to separate the solid from the extracting fluid. The liquid from the initial filtration is combined with the extract from the solid phase for analysis if the two liquids are compatible (i.e., do not form separate phases) and the combined extracts are analyzed. If the liquids are incompatible, the liquids are analyzed separately and the results mathematically combined to yield a volume-weighted average concentration.

WET. CCR Title 22 Part 66261, Appendix II: “Waste Extraction Test (WET) Procedure”

The Waste Extraction Test (WET) described in the California Administrative Code, Title 22, Article 11, Section 66700 can be used to determine the amount of extractable substance in a waste or other material. This method does not meet U.S. EPA requirements, but may be used for samples subject to California waste disposal regulations. Samples determined to have a high potential to contain soluble metals or organic contaminants can be subjected to leachate analysis using the deionized water WET (DI-WET) technique.

Static Acute Bioassay (Fish Toxicity Testing). “Static Acute Bioassay Procedures for Hazardous Waste Samples” – California Department of Fish and Game. 1988.

The well-mixed solid residual sample is weighed and diluted in approximately 10 liters of dilution water and aerated. Duplicates of five concentrations of waste and one control solution are prepared. Ten fish (fathead minnows) are added to each solution. Dissolved oxygen, pH, and temperature are recorded daily. Dead fish are counted and removed every 24 hours for 96 hours. The lethal concentration for 50 percent of the population (LC50) is calculated at a 95 percent confidence limit using the moving average calculation method. The binomial test and prohibit analysis are acceptable calculation methods as well.

3.4.5 Quality Control Requirements

The QC and reporting limit requirements for the SVE RA fixed laboratory methods are presented in Tables 3-4 and 3-5.

3.4.6 Instrument Testing, Inspection, and Maintenance Requirements

Instrument testing, inspection, and maintenance requirements for the DPE RAs will follow minimum EPA requirements

3.4.7 Instrument Calibration and Frequency

The instrument calibration and frequency for each analytical method shall meet minimum EPA requirements.

3.4.8 Inspection/Acceptance Requirements for Supplies and Consumables

Field and laboratory supplies and consumable items must be inspected upon receipt to verify that they are undamaged and that all requested items are present. Government-owned equipment shall be properly tagged to ensure traceability. Each supplier uses their internal purchasing procedures to document acceptance and track these items. In addition to inspection upon receipt from the vendor/manufacturer, supplies carried or shipped to the field site must also be inspected. Inventory checklists may be used in the field to track supplies and equipment for each project. Field instruments must be tested to verify that they have been received in proper working order. Certifications for factory calibration, special preparation or handling, or other documentation must be maintained in traceable files.

3.4.9 Data Acquisition Requirements (Non-Direct Measurements)

Data produced from previous tasks, such as RI/FS, will be used to make decisions regarding DPE RA options and performance. Physical parameters for modeling will be acquired from reputable scientific databases, such as the EPA physical characteristic database.

3.4.10 Data Management

The laboratory data reduction, verification, and reporting procedures and project data management activities, data/information exchange, and reporting procedures ensure that complete documentation is maintained, transcription and reporting errors are minimized, and data received from laboratories are properly reviewed.

Laboratory Data Reduction and Verification

The specific data reduction, verification, and reporting procedures and assigned personnel vary between laboratories; however, equivalent procedures must be performed by each laboratory to ensure that accurate and consistent data handling, review, and reporting are achieved. Laboratory-specific procedures must be documented in controlled documents, and must be available to personnel performing the work.

The analytical process includes verification or a QA review of the data. These includes:

- Verifying the calibration or calibration check sample for compliance with laboratory and project criteria;
- Verifying that batch QC samples were analyzed at the proper frequency and that the results were within specifications;
- Comparing raw data (chromatograms, etc.) with the reported concentrations for accuracy and consistency;
- Verifying that the holding times were met and that reporting units and quantitation limits are correct;
- Determining whether corrective action was performed and control was re-established and documented prior to reanalysis of QC or project samples;
- Verifying that all project and QC sample results were properly reported and flagged; and
- Preparing batch narratives that adequately identify and discuss any problems encountered.

Project Data Flow, Transfer, and Verification

Laboratory and field data must flow properly to the project staff and data users. Procedures must be established to ensure that data are properly reported and undergo QC review before use.

After data is received, data are available for QC data review and preliminary data use. A QA review of the database must be performed by comparison with laboratory data reports, field data forms, and other data sources. At a minimum, 10% of the results must be compared with the laboratory hard copy reports to verify correct data transfer. If systematic discrepancies (e.g., incorrect quantitation limits, sample ID transcription errors, reporting units, missing QC data) or an unacceptably high rate of random errors are found, the verification frequency must be increased to 25% to ensure that all information has been correctly added.

Project Data Review and Validation

The QA staff or other designated supplier staff members perform data quality review and validation as designated in this QAPP and the statement of work for the activity. These procedures apply to data produced by field and fixed laboratories.

Project data review includes, at a minimum:

- Chain-of-custody review;
- Holding time compliance evaluation;
- Adequate batch QC frequency for all data;
- Review of all batch QC and field QC sample results for compliance with objectives established in this QAPP or specifications established for the effort;
- Qualification of all sample results influenced by out-of-specification QC sample results;
- Identification and qualification of outliers; and
- Identification and qualification of results between the MDL and QL as estimated or “trace” levels.

3.5 ASSESSMENT/OVERSIGHT

3.5.1 Assessments and Response Actions

Technical systems and performance evaluation audits, along with data validation, are independent assessments of sample collection and analysis procedures. Audit results and validation are used to evaluate a system's ability to produce data that fulfill program objectives and identify any areas requiring corrective action. A technical systems audit is a qualitative review of the overall sampling or measurement system, while performance evaluation audits and data validation are quantitative assessments of a measurement system.

Laboratory technical systems audits should be performed during analytical services procurement (pre-award audit) whenever possible. A pre-award audit serves to verify that good laboratory practices are followed, and ensure traceability and security of project data. Audits and data validation should be performed for large (more than 100 samples) and/or ongoing sampling programs (i.e., the quarterly groundwater monitoring program). Technical systems audits should be conducted during initial stages of field work to identify and correct problems as quickly as possible.

Each supplier must establish a system for issuing formal Recommendations for Corrective Action (RCAs) to address significant and systematic deficiencies identified during audits or other independent QA reviews of field and laboratory procedures. The specific procedures and structure of corrective action systems varies among suppliers, but the system must provide structure and formats for:

- Recommendations issued by the QAO or auditor;
- Requests addressing specific problems or deficiencies identified during QA audits of laboratory or field operations findings;
- A specific, recommended timeframe for response and implementation of corrective actions;
- Follow up with subsequent audits or system checks to verify that the corrective action has been implemented and that the problem has been corrected; and
- If satisfactory resolution is not obtained, requests transmitted to higher levels of management until a corrective action is agreed upon, or until another response is deemed sufficient.

3.5.2 Reports to Management

Any results or assessment findings that indicate DQOs may be impacted will be brought to the attention of the project manager as soon as possible. The project manager may contact the client or corrective actions may be taken internally which correct the affected data. A data quality assessment is provided in the monitoring report. This data quality assessment will include documentation of all audits, validation, and data quality reviews associated with the data provided in the quarterly report. In addition, a data quality assessment will be provided in any DPE RA closure documents for post-rebound and confirmation data.

3.6 DATA VALIDATION AND USABILITY

3.6.1 Data Review, Validation, And Verification Requirements

Data review (EPA Region IX Tier 1A validation) will be performed for all of the data generated. Full validation (EPA Region IX Tiers 2 and 3 validation) will be performed at varying frequencies depending upon the objective, as described below:

- Soil boring analytical data produced during the RA that are not used for close-out will be validated according to the following scheme: 10 percent of the data will follow EPA Region IX Tier 2 validation and 10 percent of the data will follow EPA Region IX Tier 3 validation.
- During DPE operation, each laboratory will supply one full VOC data package for validation (EPA Region IX Tier 3) every 6 months. The results of this validation represent the data quality for data from all DPE sites produced by the same laboratory.
- Rebound data that are used to support consideration of SVE RA closeout (STOP evaluation) will be fully validated. Fifty percent of the data will follow EPA Region IX Tier 2 validation and fifty percent of the data will follow EPA Region IX Tier 3 validation.
- Confirmation boring data used for closeout or potential closeout will be fully validated. Fifty percent of the data will follow EPA Region IX Tier 2 validation and fifty percent of the data will follow EPA Region IX Tier 3 validation.

The frequency of full validation will be increased if serious analytical problems are identified that affect data usability. Laboratory verification and reduction should be sufficient to assure that the data reported by the laboratory are complete and accurate. Data validation may be performed by either the contractor or a third-party subcontractor but not by the laboratory producing the data.

3.6.2 Validation and Verification Methods

Data Review Procedures

To ensure acceptable data quality for prompt decision making, a preliminary data review will be performed on all preliminary data for completeness and overall compliance with QAPP requirements. In addition, data review incorporating the data review items of EPA Region IX Evaluation Tier 1A will be performed on all final data packages. The data are reviewed for compliance with QAPP requirements and location-specific historical data trends. Data are determined to be usable for the intended purpose or the results are voided. When anomalous operations data are reported or specific data points are determined to be unusable, resampling of critical locations is performed, the data point is removed from the database (and is not used for decision-making).

The laboratory is notified of any anomalous results or missing information. Field personnel are notified if a possible sampling anomaly has occurred. Corrective action is initiated for the non-conformance data. Non-conformance data may be subject to rejection if data usability is determined to be invalid by corrective action measures. The data reviewer effectively communicates with the data user(s) on the limitations of the data and how it may affect the quality of the data set. Qualifiers are added to all final post-rebound data and confirmation boring data.

Data Validation Procedures

Two levels of data validation will be performed depending upon the DQO. The items to be reviewed correspond to those listed in EPA Region IX Tiers 2 and 3. Any issues regarding the completeness of the data package, the content, or data quality will be documented and submitted to the laboratory for a formal response. This response will be incorporated into the validation findings.

EPA Region IX Tier 2 validation includes an EPA Region IX Tier 1 review along with an evaluation and some recalculation of specific contaminants of concern. EPA Region IX Tier 3 validation includes all objectives in a Tier 2 review along with an in-depth review and recalculation of a percentage of raw data. Both Tier 2 and Tier 3 include a comparison of data relative to the DQOs.

Laboratory Verification Procedures

The laboratory quality assurance plan or manual describes the verification and reduction procedures and shall be reviewed prior to sample analysis.

Reconciliation with Data Quality Objectives

The DQOs associated with DPE RA include the collection or the potential collection of analytical data: operations and DPE RA closeout. Data assessment will include data review, validation, and comparison to historical data (trend analysis). Proper and successful operation will be assessed based upon performance criteria (i.e., DRE, emissions requirements, etc.) and trend analysis. Performance criteria are calculated and presented in periodic status reports. Contaminant trend analysis is formally discussed in the DPE RA Periodic Monitoring Reports.

DPE RA closure objectives will be reconciled with the data in both the closure portion of the DPE RA Periodic Monitoring Reports and in the DPE RA closure report. Analytical and cost data will be used as described in the decision rules of the DQO process and in Subsection 3.3 to meet the overall objective of DPE RA closure.

3.7 TECHNICAL DATA MANAGEMENT

Information flow from the field and laboratory to those persons involved in project decision-making is critical. The data management system assists in this process by providing a means of tracking, cataloging, and organizing information. The system includes hardware and software for data handling and processing (i.e., databases), data management protocols such as sample control and tracking and data review, and trained personnel to keep the system updated and operational. The objective of a data management system is to provide the user with data sets that have been verified by auditing processes and are internally consistent. These data can then be used for data analysis, statistics, mapping and reporting.

TABLES

TABLE 3-1
Accuracy and Precision Criteria for Soil Samples
Cooper Drum Removal Action

Contaminant of Concern	Analytical Method	Quantitation Limit (mg/kg)	Cleanup Goals (mg/kg)	Accuracy Objective ⁽¹⁾ (% recovery)	Precision Objective ⁽²⁾ RPD	Completeness Objective
Metals						
Lead	SW7421	0.5	212*	75-125	≤ 25	95%
PCBs						
Aroclor-1254	SW8082	0.05	0.87	50-150	≤50	95%
Aroclor-1260	SW8082	0.05	0.87	50-150	≤50	95%
Surrogate: TCMX	SW8082	NA	NA	50-150	NA	NA
Surrogate: Dechlorobiphenyl	SW8082	NA	NA	60-125	NA	NA
PAHs						
Benzo(a)anthracene	SW8310	0.2	3.78	50-105	≤50	95%
Benzo(b)fluorathene	SW8310	0.067	3.78	55-120	≤50	95%
Benzo(k)fluoranthene	SW8310	0.133	3.78	50-120	≤50	95%
Benzo(a)pyrene	SW8310	0.67	0.38	40-135	≤50	95%
Chrysene	SW8310	0.1	37.3	55-120	≤50	95%
Indeno(1,2,3-cd)pyrene	SW8310	0.125	3.78	55-135	≤50	95%
Dibenz(a,h)anthracene	SW8310	0.133	0.62	45-115	≤50	95%
Surrogate: Terphenyl – d ₁₄	SW8310	NA	NA	54-140	NA	NA
Surrogate: Triphenylene	SW8310	NA	NA	54-122	NA	NA

⁽¹⁾ Determined from matrix spike results

⁽²⁾ Determined from laboratory duplicates, where concentrations are at least 10 times the detection limit. Field Duplicate RPD objective is ≤ 50.

* TTLC = 1000 mg/kg

mg/kg = milligrams per kilogram
 NA = not applicable
 RPD = relative percent difference

TABLE 3-2
Accuracy and Precision Criteria for Water Samples
Cooper Drum Company Removal Action

Contaminant of Concern	Analytical Method	Quantitation Limit (µg/L)	TCLP Regulatory Levels ⁽¹⁾ (mg/L)	STLC ⁽²⁾ (mg/L)	Accuracy Objective ⁽³⁾ (% recovery)	Precision Objective ⁽⁴⁾ RPD	Completeness Objective
Metals							
Lead	SW7421	3	5	5	75-125	25	95%
PCBs							
Aroclor-1254	SW8082	0.5	NA	50*	50-150	≤50	95%
Aroclor-1260	SW8082	0.5	NA	50*	30-145	≤50	95%
Surrogate: TCMX	SW8082	NA	NA	NA	54-140	NA	NA
Surrogate: Dechlorobiphenyl	SW8082	NA	NA	NA	54-122	NA	NA
PAHs							
Benzo(a)anthracene	SW8310	0.2	NA	NA	50-110	≤50	95%
Benzo(b)fluorathene	SW8310	0.4	NA	NA	50-110	≤50	95%
Benzo(k)fluoranthene	SW8310	0.5	NA	NA	50-110	≤50	95%
Benzo(a)pyrene	SW8310	0.2	NA	NA	45-115	≤50	95%
Chrysene	SW8310	0.2	NA	NA	50-115	≤50	95%
Indeno(1,2,3-cd)pyrene	SW8310	0.75	NA	NA	45-110	≤50	95%
Dibenz(a,h)anthracene	SW8310	1.0	NA	NA	20-110	≤50	95%
Surrogate: Terpheyndl - d ₁₄	SW8310	NA	NA	NA	35-100	NA	NA
Surrogate: Triphenylene	SW8310	NA	NA	NA	40-135	NA	NA

(1) Source: 22 CCR Section 66261.24(a)(1)(B)

(2) Source: 22 CCR Section 66261.24(a)(2)(A) and (B)

(3) For laboratory control sample and matrix spike results

(4) For laboratory duplicates, where concentrations are at least 10 times the detection limit. Field Duplicate RPD objective is ≤50.

TCLP = toxic characteristic leaching procedure

STLC = soluble threshold limit concentration

mg/L = milligrams per liter

RPD = relative percent difference

CCR = California Code of Regulations

NE = not established

≤ = less than or equal to

TABLE 3-3

Methods, Preservation, Containers, and Holding Times

Parameter	Analytical Method	Container	Preservation	Holding Times
Lead (soil)	Field XRF	8 oz. Glass jar or stainless steel sleeves	None	6 months
Lead (water)	SW 7421	500 mL plastic bottle	None	6 months
Lead (soil)	SW 7421	8 oz. Glass jar or stainless steel sleeves	4°C	6 months
PAHs (water)	SW 8310	1-liter glass bottle with Teflon liner	4°C	7 days to extraction, 40 days after extraction
PAHs (soil)	SW 8310	8 oz. Jar with Teflon® liner	4°C	14 days to extraction, 40 days after extraction
PCBs (water)	SW 8082	1-liter glass bottle with Teflon liner	4°C	7 days to extraction, 40 days after extraction
PCBs (soil)	SW 8082	8 oz. Jar with Teflon liner	4°C	14 days to extraction, 40 days after extraction

oz. = ounces
 XRF = x-ray fluorescence
 mL = milliliters
 °C = degrees centigrade

TABLE 3-4
Quality Control Acceptance Criteria for Method TO-15

Analyte	Quantitation Limits (ppmv)	Accuracy	Precision
	(Process Samples and Shallow Soil Gas Confirmation Borings)	Daily Calibration (% Difference)	Field Duplicate RPD (%)
1,1-Dichloroethane	0.05	± 30	≤ 25
1,1-Dichloroethene	0.05	± 30	≤ 25
1,1,1-Trichloroethane	0.05	± 30	≤ 25
1,1,2-Trichloro-1,1,2,2-trifluoroethane (Freon® 113)	0.05	± 30	≤ 25
1,1,2-Trichloroethane	0.05	± 30	≤ 25
1,1,2,2-Tetrachloroethane	0.05	± 30	≤ 25
1,2-Dibromoethane	0.05	± 30	≤ 25
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon® 114)	0.05	± 30	≤ 25
1,2-Dichlorobenzene	0.05	± 30	≤ 25
1,2-Dichloroethane	0.05	± 30	≤ 25
1,2-Dichloropropane	0.05	± 30	≤ 25
o-Xylene	0.05	± 30	≤ 25
1,2,4-Trichlorobenzene	0.05	± 30	≤ 25
1,2,4-Trimethylbenzene	0.05	± 30	≤ 25
1,3-Dichlorobenzene	0.05	± 30	≤ 25
m,p-Xylene	0.05	± 30	≤ 25
1,3,5-Trimethylbenzene	0.05	± 30	≤ 25
1,4-Dichlorobenzene	0.05	± 30	≤ 25
4-Methyl-2-pentanone	0.05	± 30	≤ 25
Benzene	0.05	± 30	≤ 25
Bromomethane	0.05	± 30	≤ 25
Carbon tetrachloride	0.05	± 30	≤ 25
Chlorobenzene	0.05	± 30	≤ 25
Chloroethane	0.05	± 30	≤ 25
Chloroform	0.05	± 30	≤ 25
Chloromethane	0.05	± 30	≤ 25
Benzyl chloride	0.05	± 30	≤ 25
cis-1,2-Dichloroethene	0.05	± 30	≤ 25
cis-1,3-Dichloropropene	0.05	± 30	≤ 25
Dichlorodifluoromethane	0.05	± 30	≤ 25
Dichloromethane (methylene chloride)	0.05	± 30	≤ 25
Ethylbenzene	0.05	± 30	≤ 25
Hexachlorobutadiene	0.05	± 30	≤ 25
Styrene	0.05	± 30	≤ 25
Tetrachloroethene	0.05	± 30	≤ 25
Toluene	0.05	± 30	≤ 25
trans-1,2-Dichloroethene	0.05	± 30	≤ 25
trans-1,3-Dichloropropene	0.05	± 30	≤ 25

TABLE 3-4
(Continued)

Analyte	Quantitation Limits (ppmv)	Accuracy	Precision
	(Process Samples and Shallow Soil Gas Confirmation Borings)	Daily Calibration (% Difference)	Field Duplicate RPD (%)
Trichloroethene	0.05	± 30	≤ 25
Trichlorofluoromethane (Freon 11)	0.05	± 30	≤ 25
Vinyl chloride	0.05	± 30	≤ 25

ppmv = parts per million by volume
 ± = plus or minus
 ≤ = less than or equal to

TABLE 3-5
Quality Assurance Objectives for Vapor Emissions

Analyte	Method	Maximum Quantitation Limit	Accuracy	Precision	
			LCS or Surrogate Recovery (%)	Laboratory Duplicate RPD (%)	Field Duplicate RPD (%)
Hydrogen fluoride/hydrogen chloride	CARB 421	0.2 ppmv	90-110	≤ 10 ^a	≤ 10 ^b
Sulfur dioxide	CARB 100	1.0 ppmv	-	-	≤ 10 ^b
Nitrogen oxides	CARB 100	0.1 ppmv	-	-	≤ 10 ^b
Carbon monoxide	CARB 100	10 ppmv	-	-	≤ 10 ^b
Particulate matter	CARB 5	1 mg/m ³	-	-	≤ 10 ^b
Dioxin/furans					
2,3,7,8-TCDD	EPA 23	50 pg/sample	70-130	-	-
1,2,3,7,8-PeCDD	EPA 23	100 pg/sample	-	-	-
1,2,3,4,7,8-HxCDD	EPA 23	500 pg/sample	70-130	-	-
1,2,3,6,7,8-HxCDD	EPA 23	500 pg/sample	-	-	-
1,2,3,7,8,9-HxCDD	EPA 23	500 pg/sample	-	-	-
1,2,3,4,6,7,8-HpCDD	EPA 23	5,000 pg/sample	-	-	-
OCDD	EPA 23	5,000 pg/sample	-	-	-
2,3,7,8-TCDF	EPA 23	500 pg/sample	-	-	-
1,2,3,7,8-PeCDF	EPA 23	1,000 pg/sample	-	-	-
2,3,4,7,8-PeCDF	EPA 23	100 pg/sample	70-130	-	-
1,2,3,4,7,8-HxCDF	EPA 23	500 pg/sample	70-130	-	-
1,2,3,6,7,8-HxCDF	EPA 23	500 pg/sample	-	-	-
2,3,4,6,7,8-HxCDF	EPA 23	500 pg/sample	-	-	-
1,2,3,4,6,7,8-HpCDF	EPA 23	5,000 pg/sample	-	-	-
1,2,3,4,7,8,9-HpCDF	EPA 23	5,000 pg/sample	70-130	-	-
OCDF	EPA 23	5,000 pg/sample	-	-	-

^a Duplicate analyses are those of the MS/MSD.

^b Samples will be collected in triplicate, so precision will be measured in relative standard deviation.

-	Not applicable	ppmv	Parts per million by volume
CARB	California Air Resources Board	ASTM	American Society of Testing and Materials
RPD	Relative percent difference	EPA	U.S. Environmental Protection Agency
mg/m ³	Milligrams per cubic meter	pg	Picograms
≤	Less than or equal to		

Dioxin/furans

CDD	Chlorodibenzo-p-dioxin	CDF	Chlorodibenzofuran
T	Tetra	Pe	Penta
Hx	Hexa	Hp	Hepta
O	Octa		

TABLE 3-6

Sample Container and Holding Time Requirements for Gas, Scrubber Blowdown, Air/Water Separator Liquid, and Sediment Samples

Matrix	Parameter	Sample Container	Holding Time ^a	Preservation
Vapor	VOCs (GC/MS)	SUMMA [®] canister	14 days	None
	Dioxins/furans	Glass fiber filter/XAD [®] resin	30 days until extraction; 45 days from extraction to analysis	None
	HCl/HF	Impinger	NA	None
	SO ₂ , NO _x , CO	Continuous emissions monitoring	NA	None
	Particulate Matter	Glass fiber filter/impinger	NA	None
Residual Water	Total suspended solids	250-ml high-density polyethylene	7 days	4°C
Residual Sediments and Spent Carbon	VOCs (TCLP)	4 oz wide-mouth glass jar with Teflon [®] -lined lid	14 days to TCLP extraction, 14 days from extraction to analysis	4°C
	VOCs (WET)	4 oz wide-mouth glass jar with Teflon [®] lined lid	14 days to WET extraction, 14 days from extraction to analysis	4°C
	Metals (TCLP)	8 oz. wide-mouth glass jar	180 days to TCLP extraction, 180 days from extraction to analysis	None
	Fish Toxicity	8 oz. wide-mouth glass jar	keep to a minimum ^b	4°C
	Metals (WET)	8 oz. wide-mouth glass jar	180 days to WET extraction, 180 days from extraction to analysis	None

^a The holding time is from the time/date of sample collection.

^b The method indicates to analyze as soon as possible

VOCs	Volatile organic compounds	SO ₂	Sulfur dioxide
GC	Gas chromatography	NO _x	Nitrogen oxides
O ₂	Oxygen	CO ₂	Carbon dioxide
°C	Degrees Centigrade	<	Less than
CH ₄	Methane	Na ₂ S ₂ O ₃	Sodium bisulfite
HCl	Hydrochloric acid	ml	Milliliter
HF	Hydrofluoric acid	WET	Waste extraction test
NA	Not applicable	oz.	Ounces
HNO ₃	Nitric acid		
TCLP	Toxicity characteristic leaching procedure		