

## **CERTIFIED UNIFIED PROGRAM AGENCY**

### **POLICIES AND PROCEDURES**

#### **Title: INSPECTION AND ENFORCEMENT**

##### **PURPOSE:**

The purpose of this policy is to gain compliance and correct violations at regulated facilities and in the community within the jurisdiction of the San Luis Obispo County Certified Unified Program Agency.

##### **AUTHORITY:**

Health and Safety Code, Section 25404(c) and any regulations adopted pursuant to those requirements.

CCR Title 22 Division 4.5, Chapter 21, Article 3, Section 66272.60-69

Health and Safety Code, Section 25404.1.1(a)

Health and Safety Code Section 25185

Effective Date: July 25, 2025

#### **POLICY STATEMENT**

It is the policy of the San Luis Obispo County Certified Unified Program Agency (CUPA) to conduct inspections at the frequency required by law with a goal of exceeding the minimum frequency of annual Underground Storage Tank (UST) facilities, every three years for each other CUPA program facility, and an initial inspection of new Tiered Permit facilities within two years and every three years thereafter. The CUPA consists of San Luis Obispo County Environmental Health Services and a Participating Agency (PA), the City of San Luis Obispo Fire Department. CUPA inspectors will utilize the CUPA Hazardous Materials Inspection Form for all inspections. CUPA inspectors include County of San Luis Obispo Environmental Health Specialists I, II, III, and City of San Luis Obispo Hazardous Materials Coordinator. Inspectors will document violations and compliance with applicable laws and regulations using the form. Inspectors will perform inspections at subject facilities and will investigate complaints of alleged violations within the CUPA's jurisdiction according to this policy and the agency's complaint response procedure. Complaints are received and provided to inspectors, who then record results and require corrective action if regulatory authority allows. County of San Luis Obispo Supervising Environmental Health Specialist or the City of San Luis Obispo Fire Marshal will review inspection forms. The CUPA and the PA meet once a month to ensure laws and regulations are consistently implemented. The purpose of the meetings is to discuss code implementation, technical issues, inspection report revision, code and definitions, uniform application of enforcement, efficiency, and minimizing or eliminating duplication and inconsistencies.

The CUPA and PA coordinate enforcement efforts with other local, state and federal agencies through the San Luis Obispo Environmental Enforcement Group (SLOEEG). These agencies include but are not necessarily limited to: San Luis Obispo County District Attorney's Office, County Planning Department, County Air Pollution Control District, California Regional Water Quality Control Board, California Department of Fish and Wildlife, California Department of Motor Vehicles, California Department of Toxic Substances Control, and the US Fish and Wildlife Service. The CUPA and PA participate in quarterly SLOEEG meetings and joint inspections as needed.

The County of San Luis Obispo CUPA and the PA will annually review this policy and adopt revisions as necessary.

Where applicable, the CUPA will utilize informal enforcement as the first step toward gaining regulatory compliance from regulated Respondents. Formal enforcement will be utilized if informal enforcement does not gain compliance. Informal enforcement may include:

1. Verbal and written directions
2. Inspection Reports
3. Compliance letters
4. Consultations
5. Post inspection meetings
6. Reinspections
7. Notice of Minor Violation Letters (MNOV)
8. Notice of Violation letters (NOVH)
9. Notice of Violation Office Hearings
10. Show Cause Letters

Formal enforcement may include:

1. Red Tags
2. Permit revocation
3. Administrative Enforcement Orders (AEO).
4. Referral to the District Attorney for prosecution (DA Referral).
5. Referral to County Counsel for prosecution.
6. Referral to San Luis Obispo City Attorney.
7. Referral to State Attorney General for prosecution
8. Referral to a State or federal agency that has authority to enforce applicable requirements, if approved by each agency.

It is the policy of the CUPA to obtain timely compliance to protect public and environmental health and encourage Respondents to comply with regulations before the use of formal enforcement actions. If informal enforcement fails to attain regulatory compliance, then formal enforcement action may be initiated. If the violations present a significant existing or imminent threat to human health or safety or the environment, then formal enforcement action may be initiated immediately.

Health and Safety Code section 25404.1.1 (a) states “If the unified program agency determines that a person has committed, or is committing, a violation of any law, regulation, permit, information request, order, variance, or other requirement that the CUPA is authorized to enforce or implement pursuant to this chapter, the CUPA may issue an administrative enforcement order requiring that the violation be corrected and imposing an administrative penalty, ...”

Attachment I, Inspection and Enforcement Flowchart, is included to provide a summary of the policy for CUPA personnel in gaining compliance.

## **INSPECTION PROCEDURES**

### **Pre-Inspection Activities**

Inspection priority is placed on facilities with the oldest date of the last completed inspection. Facilities may be inspected outside of date priority based on the CUPA's judgment of risk to public health or the environment. However, priority is placed to meet the required inspection frequency. For underground storage tank (UST) inspections, inspectors coordinate with International Code Council (ICC)-certified contractors to gain access to the entirety of the UST system.

Before performing an on-site inspection, CUPA and PA inspectors conduct a review of the facility information that includes:

- The facility file, to become familiar with facility operations and inspection history, noting open violations or pattern of repeat violations. If the latest inspection was conducted by another inspector, contact that inspector if needed to gain familiarization with the facility and to note unique issues.
- The current Hazardous Materials Business Plan (HMBP) in the file. If the HMBP appears to be outdated, review the facility submission history in the California Environmental Reporting System (CERS).
- If applicable, UST information, Monitoring Response Plans, relevant UST forms (e.g. Financial Responsibility), and test reports in CERS and in the file.
- Any appropriate industry and/or regulatory background information needed to perform the inspection (i.e., process or equipment familiarization, review of the DTSC HWTS, review of aerial photos or maps, etc.).

Inspectors may coordinate with each other and personnel from other agencies and jurisdictions, if necessary.

### **On-Site Activities**

Inspectors will announce their arrival to the appropriate person in charge, present their credentials (ID badge and/or business card), and obtain permission to inspect the facility. A thorough walk-through will be performed. Photographs and samples may be taken, as needed, to document facility conditions. Samples should be taken according to procedures in Attachment III. At the end of the inspection, the inspector will meet with the person in charge, discuss any violations with compliance periods,

and leave or email an inspection report documenting observed violations with directions to return to compliance.

Inspectors utilize computers with inspection software eliminating the need to re-enter data upon return to the office.

Any violations that are discovered during an inspection are tracked by Envision Connect software to document return to compliance, or to initiate further enforcement actions, as described below.

### **Post-Inspection Activities**

A copy of the inspection report will be placed in the applicable file. The inspector may consult with other inspectors and/or supervisor concerning the finding of the inspection. Follow-up phone calls and/or emails may be made to the facility; property owner; city, county, or state agencies having interest in the matter. Return to compliance for any cited violations may be documented by reinspections, phone calls, emails, CERS submissions, or manifests and/or photos indicating compliance with the cited violations. Violations that may be corrected by an updated CERS submission will be reviewed by the inspector who then documents acceptance of the submission. Submissions not accepted will state the reason for nonacceptance with a timeframe to correct and resubmit. Violations that have not been documented or confirmed as returned to compliance may result in informal or formal enforcement actions.

### **Complaint Investigation Procedures**

All complaints received will be entered into the agency's database and given to the appropriate specialist or supervisor. Complaints are received by phone, the County's website, DTSC Envirostor and the Cal-EPA Complaints system. A phone call or site review will be made as soon as possible to determine the validity of the complaint. If valid, the complaint will then be prioritized according to its health risk. An investigation will be conducted to determine the responsible party after which they will be notified either in writing or by phone as to the appropriate action to be taken. If the complaint is not in Environmental Health's jurisdiction a written referral will be sent to the appropriate agency. If the investigation finds the complaint is valid and within the agency's jurisdiction, directions will be provided to the responsible party. Inspectors may coordinate with personnel from other agencies and jurisdictions, if necessary. The CUPA Inspection & Enforcement Policy will be followed as applicable. Investigation results will be recorded into the database and closed at the conclusion. Summary conclusions will be entered into the Cal-EPA Complaints System for complaints received from the System. If sample collection is deemed necessary, the sampling procedure outlined in Attachment III will be followed. Samples will be transported on ice with a chain-of-custody to ELAP-certified OEC Labs in Santa Maria. OEC may be consulted before sampling to confirm proper sample containers, collection methods, holding times, and preservative.

## **ENFORCEMENT PROCEDURES**

### **Informal Enforcement of Minor Violations**

The following procedure identifies the informal enforcement procedure for minor violations. "Minor violation" as used in this policy and procedure is defined in Health and Safety Code section 25404(a)(3)

The CUPA inspection form has a section for documenting compliance and non-compliance. The inspection form provides the code sections for each violation and constitutes the official notice to comply requiring compliance within the time frames specified in this policy. A copy of the written inspection form will be provided to the Respondent at the conclusion of the inspection or within five business days of the inspection except for a CalARP inspection-audit due to the complexity of inspection-audit. The report for these inspections should be issued within 30-days of the inspection-audit.

Pursuant to Health and Safety Code section 25404.1.2 (c) (1) "A person who receives a notice to comply detailing a minor violation shall have not more than 30 days from the date of the notice to comply in which to correct any violations cited in the notice to comply." If after 30 days a reinspection determines that there has been no progress towards compliance with the minor violations, the Respondent will be provided with a Notice of Violation (NOV). Depending on the severity and nature of the violation, the agency may issue either a Notice of Minor Violation letter (MNOV) or Notice of Violation Letter requiring an office hearing (NOVH). If there has been partial compliance or satisfactory progress towards compliance, the Respondent may be provided with additional time to complete the correction of the violations. If additional time is allowed to achieve compliance, a second reinspection will be scheduled. An hourly fee will be charged beginning with the second reinspection and continue until compliance has been reached according to the current Agency Fee Schedule. The time frame between the first reinspection and the second reinspection should not exceed 15 days. However, more time may be granted by the inspector if the situation justifies the extension and if there is no existing or imminent threat to public health or the environment.

If compliance is not achieved at the time of the second reinspection, the inspector may escalate the violation classification from Minor to Class II and will prepare a NOVH within 15 days following the inspection detailing the violations, supporting code sections, and warning of potential penalties. Before the issuance of the NOVH, the inspector will meet with the supervisor to review site conditions and violations. The NOVH will be mailed via overnight delivery with signature required or certified mail to the Respondent with a scheduled NOV hearing date. At the discretion of the CUPA, the NOV hearing may be rescheduled and postponed for up to two weeks. The supervisor, the inspector, and the Respondent will attend the NOV hearing. Depending upon the severity or urgency of the matter, the Director of Environmental Health Services (EHS) or the Fire Chief for the PA may also attend. Depending upon the circumstances and legal issues involved, Deputy County Counsel may also be

present. Respondents may also include legal counsel. The purpose of the NOV hearing is to clarify any remaining compliance issues and if necessary, issue a "Show Cause" letter to the Respondent notifying him/her that the CUPA may initiate formal enforcement action. An inspection should be conducted or contact with the Respondent be made to verify the status of compliance with the cited violations at least a day before the NOV hearing date. If the Respondent has corrected the violations and can provide satisfactory evidence of compliance on or before the NOV hearing, then at the sole discretion of the CUPA, some or all of the penalties may not be assessed. The Agency may cancel the NOV hearing if compliance is achieved before the hearing date.

If the Respondent has not corrected the violations by the NOV hearing a Show Cause letter will be issued following the hearing notifying the Respondent that formal enforcement is forthcoming. The Show Cause letter will include a Show Cause hearing date to discuss further enforcement such as the issuance of an AEO. The CUPA may cancel the Show Cause hearing if compliance is achieved. The goal of the discussions with the Respondent at the Show Cause hearing is to reach an agreement on compliance; determine timelines; discuss possible penalties; and formalize the agreement in a Consent Order. Before the hearing, the inspector will prepare proposed penalties, using the appropriate penalty matrix. The inspector should be prepared to present the proposed penalties to the Respondent during the discussions. In instances where a violation (or violations) cannot be corrected, a Show Cause letter with hearing date will be issued to discuss enforcement actions with potential penalties.

### **Informal Enforcement of Major Violations**

The following procedure identifies the informal enforcement procedure for major violations.

A major violation means the failure of a person to comply with a requirement or condition of an applicable law, regulation, permit, information request, order, variance, or other requirement, whether procedural or substantive, of the unified program that the CUPA is authorized to implement or enforce, and that includes any one of the following:

1. A violation that results in injury to persons or property, or that presents a significant threat to human health or the environment.
2. A knowing, willful, or intentional violation.
3. A violation that is a chronic violation or that is committed by a recalcitrant violator. In determining whether a violation is chronic, or a violator is recalcitrant, the CUPA shall consider whether there is evidence indicating that the violator has engaged in a pattern of neglect or disregard with respect to applicable regulatory requirements.
4. A violation that results in an emergency response from a public safety agency.
5. A violation that enables the violator to benefit economically from the noncompliance, either by reduced costs or competitive advantage.

6. A class I violation as provided in Health and Safety Code Section 25117.6.
7. A class II violation committed by a chronic or a recalcitrant violator, as provided in Health and Safety Code § 25117.6.
8. A violation that hinders the ability of the CUPA to determine compliance with any other applicable local, state, or federal rule, regulation, information requests, order, variance, permit, or other requirement.
9. Significant and or imminent violations relating to underground storage tanks as defined in California Code of Regulations Title 23 §2717.

When a major violation is present the inspector may choose to begin formal enforcement at the time of the initial inspection or the first reinspection. A Red Tag may be used to prohibit use of an Underground Storage Tank (UST) System and removal of fuel from the USTs for violations defined in Article 10.5 of the California Code of Regulations (CCR) Title 23, and Health and Safety Code Section 25292.3.

The CUPA inspection form has a section for documenting non-compliance. The inspection form provides the code sections for each violation and constitutes the official notice to comply requiring compliance within the time frames specified in this policy. A copy of the written inspection form will be provided to the Respondent at the conclusion of the inspection or within five business days of the inspection except for a CalARP inspection-audit due to the complexity of inspection-audit.

Respondents shall return major violations to compliance within the following time periods:

1. A violation that results in injury to persons or property, or that presents a significant threat to human health or the environment or a violation that results in an emergency response from a public safety agency shall be returned to compliance immediately upon notification by the CUPA.
2. All other major violations, with the exception of situations requiring the affixing of red tags on the fill pipes of UST systems (23 CCR Section 2717.1), shall be returned to compliance within 30 days of notification.

If compliance is not achieved by the above indicated deadlines, the inspector will prepare a NOVH detailing the violations, supporting code sections, and warning of potential penalties. The NOVH will be mailed via overnight delivery with signature required to the Respondent or by certified mail with a scheduled NOV hearing date. At the discretion of the CUPA, the NOV hearing may be rescheduled and postponed for up to two weeks. The supervisor, the inspector, and the Respondent will attend the NOV hearing. Depending upon the severity or urgency of the matter, the Director of Environmental Health Services (EHS) may also attend. Depending upon the circumstances and legal issues involved, Deputy County Counsel may also be invited. Respondents may also include legal counsel. The purpose of the NOV hearing is to clarify any remaining compliance issues and if necessary, issue a "Show Cause" letter, to the Respondent, notifying him/her that the CUPA may initiate formal enforcement action. An inspection should be conducted or contact with the

Respondent be made to verify the status of compliance with the cited violations immediately before the NOV hearing date. If the Respondent has corrected the violations and can provide satisfactory evidence of compliance on or before the NOV hearing, then at the sole discretion of the CUPA, some or all of the penalties may not be assessed. The Agency may cancel the NOV hearing if compliance is achieved before the hearing date.

If the Respondent has not corrected the violations before the NOV hearing, a Show Cause letter will be issued, notifying the Respondent that formal enforcement will be initiated and that a Show Cause hearing date will be scheduled to discuss further enforcement such as the issuance of an AEO. The CUPA may cancel a Show Cause hearing if compliance is achieved. The goal of the discussions with the Respondent at the Show Cause hearing is to reach an agreement on compliance; determine timelines and possible penalties; and formalize the agreement in a Consent Order. Before the hearing, the inspector will prepare proposed penalties, using the appropriate penalty matrix. The inspector should be prepared to present the proposed penalties to the Respondent during the discussions.

### **Formal Enforcement**

The following identifies the formal enforcement procedure for major or significant violations. The supervisor will assign enforcement tracking numbers using the Enforcement Tracking spreadsheet. If a settlement agreement regarding penalties is reached during the Show Cause hearing, the CUPA will complete and mail the Consent Order along with the Unilateral Enforcement Order to the Respondent, collect penalties and ensure that compliance is achieved. The Director of EHS makes the final determination of penalties per criteria discussed below. The terms of the Consent Order will be discussed with and agreed to by the Director of EHS and/or the San Luis Obispo City Fire Chief (if the case is in the jurisdiction of the Participating Agency) before issuance.

If the Respondent is unwilling to agree to a Consent Order and/or does not respond to the "Show Cause" letter, the case will be referred to the Technical Review Committee. The CUPA Technical Review Committee (TRC) consists of the CUPA staff from the Environmental Health Services Division and the City of San Luis Obispo Fire Department. Cases are referred to the TRC by the CUPA supervisor or Fire Marshal after review of the facts with the inspector. A meeting of the TRC will be scheduled within two weeks after the CUPA supervisor or Fire Marshal has reviewed the case. The TRC will review the facts of each case and make a recommendation for dismissal, additional investigation, administrative enforcement, referral to City Counsel, County Counsel, or the District Attorney. If the case is approved by the TRC a Unilateral Enforcement Order and/or a CUPA Enforcement Case District Attorney Referral Form (for criminal cases) will be completed (Attachment II).

The EHS Director and the Fire Chief (for cases in the PA jurisdiction) will review the Unilateral Enforcement Order and/or case referral form with the CUPA supervisor and the inspector who initiated the Unilateral Enforcement Order. Proposed



administrative penalties will be calculated by the inspector and his or her supervisor as described in the section titled Criteria for Determining Penalties. Cases for District Attorney referral shall be forwarded to the CUPA Enforcement Committee for review, before being sent to the District Attorney.

Orders will be sent to the Respondent via overnight mail, signature required, or via personal service. The EHS Director will review the Respondent's ability to pay information, if necessary. The Respondent will be offered an opportunity for another settlement hearing with the EHS Director, Deputy County Counsel and CUPA staff. If the CUPA and the Respondent can agree on a schedule for compliance and a penalty, a Stipulation and Order will be issued reflecting the agreed upon terms of the settlement. The penalty will be collected and compliance verified. If the Respondent fails to correct the violations and/or cannot agree on a penalty, the case will be forwarded to the CUPA Enforcement Committee (comprised of the Health Officer and SLO City Fire Chief) for review. The CUPA Enforcement Committee will set the final penalty and/or refer the case to either County Counsel or the District Attorney for civil or criminal prosecution if appropriate. If the Respondent files a timely Notice of Defense (NOD) and requests a hearing on the AEO, the supervisor will forward the NOD to the Office of Administrative Hearings (OAH). The hearing will be conducted by an administrative law judge of the OAH. Deputy County Counsel will represent the CUPA at the hearing. The CUPA will serve the Respondent with the final decision of the administrative law judge. The decision is effective and final upon service to the Respondent.

If the Respondent has agreed to a Consent Order and fails to meet all of the stipulations of the order, the unilateral AEO included with the Consent Order will go into effect or the case will be referred to the appropriate prosecutorial agency. The CUPA supervisor or PA representative (if in the jurisdiction of the PA) will alert the Deputy County Counsel of the breached Consent Order and the unilateral AEO will be sent to the CUPA Enforcement Committee for review before forwarding the order to the Deputy County Counsel for filing with the civil court. The AEO may be accepted "as is" or amended by the CUPA Enforcement Committee. If the order is amended, the revised order will be sent to the Respondent.

### **CRITERIA FOR INITIATION OF AN ADMINISTRATIVE ENFORCEMENT ORDER (AEO)**

An AEO can be initiated without a re-inspection. An AEO shall be considered if a case meets any of the following criteria:

- A. Actions that result in significant environmental degradation (soil and/or groundwater contamination) as determined by the inspector in conjunction with their supervisor and the EHS Director.
- B. Actions that result in injury to the public or pose a significant existing or imminent threat to public health as determined by the inspector in conjunction with their supervisor and the EHS Director.

- C. Continued non-compliance and/or repeated violations at permitted facilities.
- D. Disabling of or tampering with the underground storage tank leak monitoring system.
- E. Knowing discharge or dumping of hazardous waste/materials.
- F. Violations that have or may potentially lead to a release of hazardous waste/materials.
- G. Significant violations of the Cal-ARP Program:
  - i. Operating a new facility without a Risk Management Plan (RMP) submitted to the CUPA.
  - ii. A willful violation that may lead or has led to a release of a regulated substance.
  - iii. Not following emergency response procedures as specified in an approved RMP during a release of a regulated substance.
  - iv. Operating a Cal-ARP facility after a covered process modification without submitting a required updated RMP to the CUPA.

### **TIMELINES FOR AEOs**

The goal is to issue a final AEO within 180 days of the initial inspection. If this is not possible, the inspector will notify the Director of EHS with the reasons for the delay and propose a new timeline.

### **CONFIDENTIAL INFORMATION**

Cases under review for enforcement action by either AEO or the DA are not subject to the Public Records Act and are not available for public review.

### **AGENCY COSTS**

Agency costs, including technical staff, supervision and attorney costs should be included in the Consent Order.

### **PENALTY COLLECTION**

Penalties will be invoiced through Envision Connect's accounts receivable program. Penalties are due and payable in 15 days with a signed AEO in compliance with the pay rate of the Enforcement of Judgments Law (California Code of Civil Proceedings Title 9). For late payments, a security lien may be filed on real property with the County of San Luis Obispo Clerk Recorder and on lienable personal property with the Secretary of State.

Penalties for the PA will be invoiced and collected by the CUPA. County overhead costs for support of Deputy County Counsel will be deducted from the total penalty due to the PA and the remainder will be sent to the PA within 30 days.

## **SUPPLEMENTAL ENVIRONMENTAL PROJECTS (SEPs)**

The County of San Luis Obispo Certified Unified Program Agency (CUPA) finds that it is beneficial to the CUPA, the regulated Respondents, public health, and the environment to offer Supplemental Environmental Projects (SEPs) to offset a facility's first Administrative Enforcement Order (AEO) fines levied by the CUPA. SEPs are voluntary. The CUPA may offer to reduce Consent Order (AEO) total penalties by up to fifty hundred percent (50%) if a SEP is completed within 180 days of acceptance of the AEO. SEP proposals must be provided with a minimum of three work proposals from licensed contractors. Proposals provided by responsible parties (RP) can be evaluated providing an RP is qualified and authorized to complete proposal and provides 3 cost estimates for supplies.

Examples of SEPs include, but are not limited to:

- Solar and/or wind power generation. Other proposals that reduce energy usage or increase energy efficiency may be considered.
- Upgrade of Underground Storage Tank System components to benefit leak detection and/or containment not currently required of a subject system.
- Upgrade of a hazardous material or hazardous waste storage facility by installing an engineering control to prevent the discharge of hazardous materials or waste, which is not currently required by law or regulation.
- A permanent removal of an environmental threat at the subject site.
- A project that assists a facility, the community, or the CUPA in protecting public health and the environment from a potential or actual threat of a release of hazardous materials or hazardous wastes, or aid in the detection of a release.
- A training project to enhance understanding of hazardous materials threats and or regulations the Agency oversees for all or some of the following groups: regulated facilities, regulators, emergency responders and/or the community.

In implementing the SEP, the Respondent must agree to:

1. Correct all violations identified in the Consent Order (AEO).
2. Pay the reduced assessed penalty, if applicable upon acceptance of the Consent Order.
3. Submit to the CUPA within 15 to 30 days of acceptance of the Consent Order a copy of the accepted proposal for the agreed upon supplemental environmental project.
4. Provide evidence of approved project completion to the CUPA within 180 days of acceptance of the Consent Order.

## **DISTRICT ATTORNEY REFERRALS**

The CUPA Supervisor will provide case referral forms approved by the Technical Review Committee to the Environmental Health Director for review and signature. The Environmental Health Director will provide approved referrals to the CUPA Enforcement Committee for review. Following their review of the case, the CUPA Enforcement Committee may direct staff to consult with the District Attorney's office regarding the proper disposition of the case if the Enforcement Committee believes it is appropriate. Based on the DA's recommendation, the case may be referred to them for civil or criminal prosecution, an injunction, or sent back to the inspector for further investigation.

## **PENALTY CALCULATION**

Procedures for calculating maximum penalties in the hazardous waste program are described in CCR Title 22, Division 4.5, Chapter 22, Article 3, Sections 66272.60-69. No corresponding regulatory procedure exists for other hazardous materials programs. However, the statutory factors that must be considered in assessing hazardous waste penalties and any penalty under Health and Safety Code 25404.1.1 authority are essentially the same. The rationale and process also provide guidance for consistent calculations of penalties under other hazardous materials programs. Calculated penalties cannot exceed the statutory maximum for that program. Only the underground storage tank program specifies a minimum daily penalty of no less than \$500 per day. The attached document, "Guidance for Administrative Enforcement Order and Hearing Procedures," dated February 1, 2007 section II Penalties provides references for the maximum penalties contained in statute and regulations. Use the Penalty Calculating Worksheet (Attachment III) when calculating penalties.

The criteria for determining a penalty associated with an AEO uses the following methodology:

- (A) Determine the initial penalty
- (B) Apply appropriate adjustments to the initial penalty
  - (1) Multiple violations
  - (2) Multi-day violations
    - Follow the Underground Storage Tank Secondary Containment Repair Policy to determine Agency timelines for repair and determination of the violation date.
- (C) Calculate the base penalty
- (D) Apply appropriate adjustment to the base penalty

- Repeated Administrative Enforcement Orders

(E) Calculate the final penalty

- Ability to Pay

## **INITIAL PENALTY**

When determining an initial penalty for each violation, the CUPA shall consider potential harm of the violation and the extent of deviation from hazardous materials requirements. The CUPA shall use the appropriate program specific matrix set described below to determine the initial penalty for each violation.

(A) Potential Harm of the Violation

(1) The Enforcement Agency shall consider potential harm to public health and safety and the environment when using the matrix.

(2) The categories for degree of potential harm are defined as follows:

(a) Major - The characteristics, concentration and/or amount of the substance involved present a major threat to human health or safety or the environment and the circumstances of the violation indicate a high potential for harm;

(b) Moderate - The characteristics, concentration and/or amount of the substance involved do not present a major threat to human health or safety or the environment, and the circumstances of the violation do not indicate a high potential for harm;

(c) Minimal - The threat presented by the characteristics, concentration and/or the amount of the substance or by the circumstances of the violation is low.

(3) In determining the degree of potential harm, the CUPA shall consider the following factors:

(a) The characteristics of the substance involved,

(b) The amount of the substance involved,

(c) The extent to which human life or health is threatened,

(d) The extent to which animal life is threatened,

- (e) The extent to which the environment is threatened, and
- (f) The extent to which potable water supplies are threatened.

(B) Extent of Deviation of the Violation

- (1) The CUPA shall consider the extent of deviation from hazardous materials requirements when using the matrices below.
- (2) The categories for extent of deviation from requirements are defined as follows:
  - (a) Major - The violation deviates from the requirement to such an extent that the requirement is completely ignored and none of its provisions are complied with:
  - (b) Moderate - The violation deviates from the requirement, but it functions to some extent although not all of its important provisions are complied with:
  - (c) Minimal - The violation deviates from the requirement. The requirement functions nearly as intended, but not as well as if all provisions had been met.
- (3) For requirements with more than one part, the CUPA shall consider the extent of violation in terms of the most significant requirement.

(C) Initial Penalty Matrices (in dollars)

The matrices below shall be used to determine the initial penalty for a violation. The CUPA shall select the appropriate program then a penalty amount from the range provided in the matrix cell that corresponds to the appropriate extent of deviation and the potential harm categories. The reduction in maximum penalty amounts is at the discretion and practice of this CUPA.

Underground Storage Tank Program (for each tank) (H&SC 25299 (a-c))

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	<b>5,000</b>	<b>4,000</b>	<b>3,000</b>
	4,500	3,500	2,100
	4,000	3,000	1,200
Moderate	<b>4,000</b>	<b>3,000</b>	<b>1,200</b>
	3,500	2,100	1,020
	3,000	1,200	840
Minimal	<b>3,000</b>	<b>1,200</b>	<b>840</b>
	2,100	1,020	670
	1,200	840	500

Underground Storage Tank Program (for each tank) (H&SC 25299 (f))

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	<b>10,000</b>	<b>8,000</b>	<b>6,000</b>
	9,000	7,000	5,500
	8,000	6,000	5,000
Moderate	<b>8,000</b>	<b>6,000</b>	<b>5,500</b>
	7,000	5,500	5,250
	6,000	5,000	5,000
Minimal	<b>6,000</b>	<b>5,500</b>	<b>5,000</b>
	5,500	5,250	
	5,000	5,000	

Aboveground Petroleum Storage Tank Program (H&SC 25404.1.1)

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	<b>5,000</b>	<b>4,000</b>	<b>3,000</b>
	4,500	3,500	2,100
	4,000	3,000	1,200
Moderate	<b>4,000</b>	<b>3,000</b>	<b>1,200</b>
	3,500	2,100	1,020
	3,000	1,200	840
Minimal	<b>3,000</b>	<b>1,200</b>	<b>840</b>
	2,100	1,020	420
	1,200	840	0

Aboveground Petroleum Storage Tank Program (H&SC 25404.1.1)

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	<b>10,000</b>	<b>8,000</b>	<b>6,000</b>
	9,000	7,000	4,200
	8,000	6,000	2,400
Moderate	<b>8,000</b>	<b>6,000</b>	<b>2,400</b>
	7,000	4,200	1680
	6,000	2,400	960
Minimal	<b>6,000</b>	<b>2,400</b>	<b>960</b>
	4,200	1680	480
	2,400	960	

Hazardous Materials Release Response Plan Program (H&SC 25515.2 (a))

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	2,000	<b>1,600</b>	<b>1,200</b>
	1,800	1,400	840
	1,600	1,200	480
Moderate	<b>1,600</b>	<b>1,200</b>	<b>480</b>
	1,400	840	336
	1,200	480	192
Minimal	<b>1,200</b>	<b>480</b>	<b>192</b>
	840	336	96
	480	192	0

Hazardous Materials Release Response Plan Program (H&SC 25515.2(b))

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	<b>5,000</b>	<b>4,000</b>	<b>3,000</b>
	4,500	3,500	2,100
	4,000	3,000	1,200
Moderate	<b>4,000</b>	<b>3,000</b>	<b>1,200</b>
	3,500	2,100	1,020
	3,000	1,200	840
Minimal	<b>3,000</b>	<b>1,200</b>	<b>840</b>
	2,100	1,020	420
	1,200	840	0



Hazardous Materials Release Response Plan Program,  
Failure to Report a Release or Threatened Release (H&SC 25515.3)

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	<b>25,000</b>	<b>20,000</b>	<b>15,000</b>
	22,500	17,500	10,500
	20,000	15,000	6,000
Moderate	<b>20,000</b>	<b>15,000</b>	<b>6,000</b>
	17,500	10,500	4,200
	15,000	6,000	<b>2,400</b>
Minimal	<b>15,000</b>	<b>6,000</b>	2,400
	10,500	4,200	1,200
	6,000	2,400	0

Hazardous Materials Release Response Plan Program,  
Failure to Report a Release or Threatened Release (H&SC 25515.3 second offense)  
[prosecution]

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	<b>50,000</b>	<b>40,000</b>	<b>30,000</b>
	45,000	35,000	21,000
	40,000	30,000	12,000
Moderate	<b>40,000</b>	<b>30,000</b>	<b>12,000</b>
	35,000	21,000	8,000
	30,000	12,000	4,000
Minimal	<b>30,000</b>	<b>12,000</b>	<b>4,000</b>
	21,000	8,000	3,000
	12,000	4,000	2,000

Hazardous Waste (22 CCR § 66272.62)

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
Major	<b>70,000</b>	<b>56,000</b>	<b>42,000</b>
	63,000	49,000	29,400
	56,000	42,000	16,800
Moderate	<b>56,000</b>	<b>42,000</b>	<b>16,800</b>
	49,000	29,400	11,200
	42,000	16,800	5,600
Minimal	<b>42,000</b>	<b>16,800</b>	<b>5,600</b>
	29,400	11,200	2,800
	16,800	5,600	0

California Accidental Release Prevention Program (H&SC 25540 (a)(2))

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
	<b>5,000</b>	<b>4,000</b>	<b>3,000</b>
Major	4,500	3,500	2,100
	4,000	3,000	1,200
	<b>4,000</b>	<b>3,000</b>	<b>1,200</b>
Moderate	3,500	2,100	1,020
	3,000	1,200	840
	<b>3,000</b>	<b>1,200</b>	<b>840</b>
Minimal	2,100	1,020	420
	1,200	840	0

California Accidental Release Prevention Program (H&SC 25540 (a)(4))

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
	<b>25,000</b>	<b>20,000</b>	<b>15,000</b>
Major	22,500	17,500	10,500
	20,000	15,000	6,000
	<b>20,000</b>	<b>15,000</b>	<b>6,000</b>
Moderate	17,500	10,500	4,200
	15,000	6,000	2,400
	<b>15,000</b>	<b>6,000</b>	<b>2,400</b>
Minimal	10,500	4,200	1,200
	6,000	2,400	0

California Accidental Release Prevention Program (H&SC 25540.5) [civil]

Extent of Deviation	Potential Harm		
	Major	Moderate	Minimal
	<b>10,000</b>	<b>8,000</b>	<b>6,000</b>
Major	9,000	7,000	4,200
	8,000	6,000	2,400
	<b>8,000</b>	<b>6,000</b>	<b>2,400</b>
Moderate	7,000	4,200	1680
	6,000	2,400	960
	<b>6,000</b>	<b>2,400</b>	<b>960</b>
Minimal	4,200	1680	480
	2,400	960	

## **ADJUSTMENTS TO INITIAL PENALTY VIOLATIONS**

### **(A) Repeated Occurrence of Violations**

For repeated occurrence of violations, the adjusted initial penalty may be increased by multiplying the initial penalty by 10 percent to 25 percent for the second occurrence and 50 percent to 100 percent for the third or more occurrences.

### **(B) Economic Benefit**

The initial penalty may be increased by the amount of any documented and/or substantiated economic benefit gained or documented/substantiated cost of compliance avoided by the regulated facility because of noncompliance up to the statutory maximum for each violation. Economic benefit includes, but is not limited to, avoided costs, increased profits, having the use of capital from delayed or avoided costs, and avoided interest.

### **(C) Multiple Violations**

At the discretion of the CUPA, a single initial penalty may be assessed for multiple violations. Multiple violations subject to this section are multiple instances of the same violation, where each instance is a violation in itself.

(1) The assessment of a single initial penalty may be appropriate for multiple violations in the following cases:

(a) The facility has violated the same requirement at one or more locations (e.g. units) within the facility at a single location.

(b) When violations are not independent or are not substantially distinguishable, the CUPA shall consider the extent of deviation and potential harm in terms of the most significant violation.

(2) Where it is necessary to deprive the regulated facility of the economic benefit of multiple violations, the CUPA shall cite such violations separately and assess an initial penalty for each violation.

### **(D) Multi-day Violations**

Each day a violation continues is a separate and distinct violation. For multi-day violations, penalties begin to accrue when the violation was first identified. The penalty for a continuing violation shall be determined according to this section.

(1) The initial penalty for the first day of violation shall be determined as indicated above.

- (2) For days following the first day of violation, the multi-day component of the penalty shall be calculated by determining 2 percent of the initial penalty (exception is underground storage tanks see below) and multiplying that value by the number of days the violation occurred after the initial day.
- (3) For repeated occurrences of violations, the multi-day component of the penalty may be increased by multiplying the multi-day component of the penalty by 10 percent to 25 percent for the second occurrence and 50 percent to 100 percent for the third or more occurrences.
- (4) For underground storage tanks, the multi-day component of the penalty shall be calculated by multiplying: the number of tanks involved with the violation by \$500 by the number of days the violation occurred after the initial day.

## **BASE PENALTY**

The base penalty for an enforcement action is the sum of all adjusted initial penalties.

## **ADJUSTMENTS TO BASE PENALTY**

The CUPA shall adjust the base penalty considering the following adjustment factor:

- (A) Repeated Administrative Enforcement Orders: The base penalty may be increased by up to 50 percent for a second AEO issued to the same facility and by up to 100 percent for a third or more AEO's issued to the same facility.

## **FINAL PENALTY**

- (A) The final penalty consists of the base penalty, with any adjustments made pursuant to the adjustment factors.
- (B) Ability to Pay: If the regulated facility has provided the CUPA with the financial information necessary to assess the regulated facility's ability to pay, the payment of the final penalty may be extended over a period of time if immediate full payment would cause, in the judgment of the CUPA, extreme financial hardship. If extending the penalty payment over a period of time would cause, in the judgment of the CUPA, extreme financial hardship, the final penalty may be reduced.
- (C) The final penalty shall not exceed the statutory maximum.

(D)A memorandum shall be completed for the EHS Director that documents any amendments to the initial penalty.

## **PENALTY EXCEPTIONS**

Violations of a particularly egregious or serious nature may be assessed the maximum penalty amounts.

The CUPA encourages settlement discussions with Respondents subject to an AEO or Show Cause letter whenever possible. Maximum calculated penalties may be reduced by the EHS Director. When considering a reduction to the calculated maximum penalty amount, the CUPA will take into consideration the nature, circumstances, extent, and gravity of the violation, the violator's past and present efforts to prevent, abate, or clean up conditions posing a threat to public health or safety or the environment, the violator's ability to pay the penalty, and the deterrent effect that the imposition of the penalty would have on both the violator and the regulated community.

Questions to consider when evaluating the nature, circumstances, extent, and gravity of the violation include but are not limited to the following:

- Did the violation threaten environmental degradation? To what extent?
- Was there an unauthorized release to the groundwater, soil, or air? To what extent?
- Did the violation threaten public health or the employees? To what extent?
- Is this a repeated violation?
- Was the Respondent cooperative?
- Was the violation beyond the control of the Respondent?
- Did the Respondent fail to respond to the CUPA's efforts to gain compliance?

Questions to consider when evaluating the violator's past and present efforts to prevent, abate, or cleanup conditions posing a threat to the public health, or safety or the environment include but are not limited to the following:

- What did the Respondent do to prevent the violation?
- Did the Respondent take immediate and appropriate steps to abate or clean up any release?
- Did the Respondent immediately notify the proper agencies when a release occurred?
- Did the Respondent train their employees on proper procedures for handling hazardous materials/waste?
- Did the Respondent train their employees on proper procedures for responding to an emergency release?
- Did the Respondent intentionally dispose of hazardous waste illegally?

Questions to consider when evaluating the violator's ability to pay the penalty include but are not limited to the following:

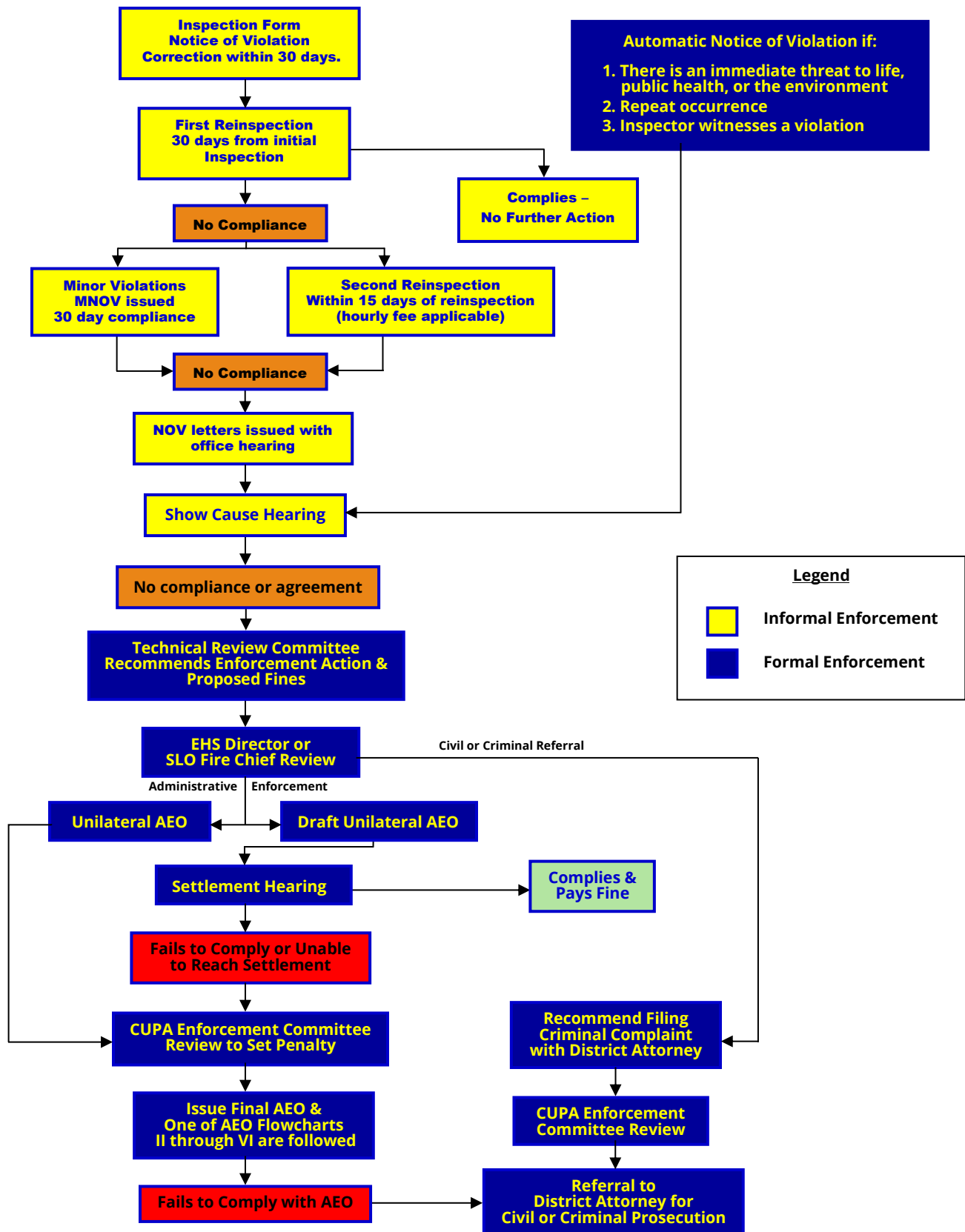
- Will the penalty amount threaten the financial stability of the Respondent?
- Is the penalty amount fair for the Respondent?

Questions to consider when evaluating the deterrent effect that the imposition of the penalty would have on both the violator and the regulated community include but are not limited to the following:

- Will the penalty amount be sufficiently high to deter the Respondent from continuing to violate regulations?
- Does the penalty encourage future voluntary compliance?
- Is the penalty amount sufficiently high to reduce the monetary incentive for non-compliance?
- Does the penalty amount send a message to the regulated community that there are negative financial consequences for non-compliance?

# **Attachment I**

# Inspection and Enforcement Flowchart





## **Attachment II**



Supporting Attachments			
Letter(s):			
NOV (date):			
Photographs:	Attachment 1		
Analytical Results:			
Other:			
Other:			
Other:			
Other:			
Other:			
Witness (1) Name:		Willing to Testify?	Y <input type="checkbox"/> N <input type="checkbox"/>
Residence Phone:	(     )     -	Business Phone:	
Res. Street Address:			
City:		Zip Code:	
Witness (1) Summary Statement			
Witness (1) Signature:		Date:	
Witness (2) Name:		Willing to Testify?	Y <input type="checkbox"/> N <input type="checkbox"/>
Residence Phone:	(     )     -	Business Phone:	
Res. Street Address:			
City:		Zip Code:	
Witness (2) Summary Statement			
see attached			
Witness (2) Signature:		Date:	
Describe Areas of Further Investigation Required			
Inspector Signature:		Date:	

## **Attachment III**

# **County of San Luis Obispo Certified Unified Program Agency Sampling Procedures**

## ***I. General Sampling (Scope of each item completed as needed by each specific event)***

### ***Sampling Event***

A sampling event will include the following sequential activities:

- Complete all preparation and preliminary evaluation activities as needed.
- Arrive at the sampling site with appropriate equipment, supplies, materials, and sampling containers.
- Set-up equipment, work areas and safety areas.
- Collect samples.
- Immediately following sample collection, ensure that each sample container is labeled. The sample label must be traceable to the sample number, date, time sampled, sampler's initials, preservative, and site name/location or unique project identifier.
- Document the exact location of the collected sample(s) in the Field Logbook or Field Notes. Also, record in the Field Logbook or Field Notes, other observations of environmental conditions that could affect or contribute to knowledge of the sampling area and the environment where the sample is collected. Prevailing weather conditions, at the time of sampling, should be recorded.
- Preserve and/or ice samples as appropriate and record preservation method.
- Perform field tests or field screening measurements and record all observations.
- Complete the Chain-of-Custody Record and other field records.
- Pack and seal the shipping container with collected samples and transport the shipping container with the Chain-of-Custody Record and any laboratory required forms to the laboratory. Retain copies of transmitted forms.
- Clean sampling equipment for the next sampling event or storage until next event.
- Breakdown all work area and safety areas as required and return the site to condition found at the start of the sampling event.
- Dispose of all waste materials using appropriate procedures.

### ***Sample Documentation and Chain-Of-Custody Procedures***

Thorough documentation is required to support sample validity. The documentation must verify that the samples are representative and are not vulnerable to tampering before being received by the laboratory. Sample documentation and Chain-of-Custody procedures include:

- A completed sample collection label attached to all sample containers.
- Records of sampling operations. Records include sample type, sample matrix, sampling method, field test methods and quality control procedures. A table maybe used to present this information.
- Identification of every sample container on a Chain-of-Custody Record and all custody transfers documented.
- The following should be used to generate the required sample documentation.

### ***Pre-assigned Sample Numbers***

Each sample consists of all of the material collected for analysis at one place, at one time, and of one matrix.

The sample number provides a common identifying code of all of the analytical results for a single sample. This is particularly useful when the results are entered into a computer database, which should include:

- Sample number
- Sample container number
- Chain-of-Custody Record number
- Matrix
- Location
- Sample type
- Sample date
- Sample time
- Sampler name
- Parameter
- Analytical result
- Quality control data
- Compliance limit
- Data qualifier code (Optional)

Results from analysis of Trip Blanks, Field Blanks, Equipment Decontamination Blanks, Split Samples and Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples may be entered into a computer database. In some testing programs these results are used to generate the data qualifier code for the analytical results from test and Duplicate samples.

It is recommended that the sample number consist of elements describing the sample type, matrix, location, and the time and date of sample collection as required assigning a unique number to each sample. For example, a sample number may consist of one or all of the following elements:

"S-T-MM-Q-L-D"

Where:

S = Site Code (facility)

T = Type

S = grab

X = composite

C = continuous

MM = matrix

SO = soil

SL = sludge

SS = solid waste

GW = groundwater

SW = surface water

DW = drinking water

OW = discharge water

D1 = drum liquid organic (floating liquid)

D2 = drum liquid water (second liquid phase)

DS = drum sludge or bottom solids

AA = ambient air

ST = stack gas

Q = Quality Control Code:

P = Test or Duplicate

B = Field Blank or Equipment Decontamination Blank

L = Location Code Description code shown on site map:

XX/YY/ZZ = Site Grid Coordinates

North in feet (two digits) /

East in feet (two digits) /

Depth below surface in feet (two digits)

DR### = Drum Number

Alphanumeric designation corresponding to a sampling location indicated on the site

D = Date or Sequence Number of Sample

### ***Sample Container Labeling***

Sample labels are an important part of proper documentation to reduce the possibility of confusing sample containers, and to provide the information necessary during handling. Sample containers should be pre-labeled as much as practical before sample collection. The labels may be protected from the sample matrix with a clear tape covering. Sample labels should include sample number, date/time sampled, location, sample type, preservative and the sampler's initials or signature.

Sample numbers may be unique to the sample location, to the sample type or to the container. In some labeling processes, a unique sample number is written on the container label and all information recorded on the accompanying form(s) is traceable to the unique sample number.

Some number schemes uniquely number each sample container. All data reported for the sample includes the sample container number for traceability to the container measured. This is useful when sample containers are cleaned, lot controlled and traceability from container preparation, preservation chemicals, sampling and testing is required.

### ***Field Log Book/Field Notes (Scope completed as needed)***

The Field Logbook/Field Notes is the written record of all field data, observations, field equipment calibrations, and sample collection activities. Potential for future legal actions dictates that the Field Logbook/Field Notes be site-specific, and that they be bound (e.g., ledger, composition book, diary, etc.). All pages (front and back) shall be serially numbered so removal will be apparent. Samplers shall adhere to the following guidelines in using Field Logbooks/Notes:

- Each Logbook shall be annotated with the sampling program name or number.
- List key personnel and telephone numbers on the first page.
- Entries shall be written in waterproof blue or blackball point pen. Avoid felt tip pens.
- Start a new page at the beginning of each day.
- Entries should be chronological — a time notation should introduce each entry.
- Sketch or obtain a map of the area and/or facility. Include sketches of layout, structural features, endpoints of interest or contamination. Include north arrow and rough scale. If possible, obtain a site map (reduced if necessary) and permanently place it in the Log Book/Notes.
- Language should be objective, factual, and free of personal feelings or other inappropriate terminology. Speculation or personal observations may be included if they are clearly identified.
- Do not erase or scratch out. Mistakes shall be lined out with a single line through the error, corrected material inserted, initialed and dated by the person who made the error and the reason for the error annotated.
- Entries or corrections made by individuals other than the person to whom the Logbook was assigned shall be dated and signed by the individual making the entry or correction. An explanation for the correction should be annotated.
- The last entry for each day should include a short summary of the day's activities, weather conditions and the time you leave the site. As appropriate, the last entry for each week should be a summary of the week's activities. Weekly summaries should be thorough and descriptive.
- The Logbook/Notes shall be signed at the end of each day. Signatures shall be written on a single diagonal line drawn across the blank portion of the page following the day's last entry.
- All Field Logbooks/Field Notes shall be returned to the individual designated for review and final storage when sampling is completed as described in the QAP.
- Logbook/Notes entries will contain a variety of information. Information which should be entered at the start of each day of sampling includes:
  - Date(s) of the sampling event



- Time sampling started and approximate time for set-up of equipment
- Weather
- Level of personal protective equipment (PPE) being used
- Names of field sampling team members and others present during the sampling
- Whenever a sample is collected or a measurement is made, a detailed description of the location must be recorded. The source from which the sample is collected should be clearly identified to maintain traceability and allow another person to locate the exact sampling location. The ability to relocate the sample site ensures repeatability of future sampling events. Measurements from permanent features (center line of road, numbered utility pole, etc.) to the sample point must be made and entered into the Field Logbook/Field Notes. Coordinates on a map, or an accurate site sketch with distance measurements to known locations are other options to ensure the exact location of each sample is recorded.
- Describe the site thoroughly so another person will be able to locate the exact sample location. Note signs of contamination such as oily discharges, discolored surfaces, unusual odors, dead or distressed vegetation including types of plants, if possible. Photographs may be taken to provide evidence of visual observations, record site conditions, and assist with locating the sample site in the future. Photographs taken of sample locations should be noted along with the picture number and roll number. The record is logged in the Field Logbook/Field Notes to identify which sampling site is depicted in the photograph. NOTE: The film roll can be identified by taking the first photograph of a informational sign with the sampling program name, number, and the film roll number on it.
- Each time a sample container is filled and labeled, a copy from the multiple part form of the Sample Container Label or reference number with all information recorded shall be put into the Field Log Book/Field Notes.
- Type, manufacturer, and serial number, along with the date of calibration, must identify all equipment used to make measurements. Details of field calibration procedures and results shall also be included in the Field Logbook/Field Notes.
- Decontamination and/or disposal procedures for all equipment, samples, protective clothing, and personnel decontamination procedures should be noted.
- For each delivery or shipment of samples to a laboratory, record the following information in the Field Logbook/Field Notes:
  - Custody procedures and serial numbers
  - Packing and shipping procedures (record air bill numbers)
  - Name, address, telephone number, and contact of the laboratory performing the analysis

### ***Chain-of-Custody***

An overriding consideration for environmental measurement data is the ability to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Documentation of security, field handling criteria, shipment, laboratory receipt, and laboratory custody until disposal, provides evidence of proper processing. The degree of custody is dependent on the regulatory program, data use, and needs. Many state programs for sampling wastewater and drinking water do not require "Legal Custody", but recommend legal custody whenever data is known to be used for evidence. A

review of data use and risk of legal proceedings will dictate the type of custody procedure to be employed. Documentation consists of a Chain-of-Custody Record that is completed by the Sample Custodian.

### ***Field Custody Procedures***

The Field Sample Custodian or sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples. A sample is considered to be "in custody" for legal proceedings if it is:

- In a person's actual possession.
- In view after being in physical possession.
- Locked up so that no one can tamper with it after having been in physical custody.
- In a secured area, restricted to authorized personnel only.

If any one of these is not in place at all times, the chain of custody is broken.

### ***Chain-of-Custody Records***

There are many transfers of custody during the course of a sampling program, from time of collection through final sample disposal. All sample containers must be accompanied by a Chain-of-Custody Record to document these transfers. A separate Chain-of-Custody Record shall be prepared by the Field Sample Custodian or sampler for each sampling event. In some programs a Chain-of-Custody Record accompanies each shipping container and includes a prenumbered Chain-of-Custody Record. This record lists the sample containers that are in the shipping container, and serves as the packing list for the container. The serial number on the form becomes the identifying number for the shipping package.

The Chain-of-Custody Record does identify which pairs of sample containers were collected for the same analysis, and identifies the sample containers that were filled with sample for use as the MS/MSD quality control (QC) samples. Based on the needs and data use, the Chain-of-Custody Record may not list any information as to the exact sample location or whether a sample is a Field Duplicate, Field Blank, Trip Blank or an Equipment Decontamination Blank. This information is kept as blind information from the laboratory to ensure objective reporting. When this process is used records must be maintained that trace the sample collected in the field with the sample as identified to the laboratory. Compliance data for drinking water and wastewater testing does not require blind submissions. The QC sample information is provided to the laboratory to ensure prompt notification when the QC data does not meet specifications.

Whenever samples are split with a second laboratory or government agency, a separate Chain-of-Custody Record may be prepared for the second set of samples. The additional set of Chain-of-Custody Records must be noted. Copies of the original may be sent with the split samples noted or a separate form may be prepared by copying the appropriate information for the samples onto the additional form. In all cases the use and need of the additional form should be duly noted.

After the Chain-of-Custody Record is completed and all samples are packaged and shipped to the appropriate locations, the person relinquishing the samples to the laboratory or agency shall request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses to sign, this is noted in the "received by" space.

Field chain of custody terminates upon laboratory receipt of the samples. The laboratory should complete the "received by" sections and if appropriate, the "preservative checks" sections on the Chain-of-Custody Record and return the original signed record to the program manager.

### **Custody Seals (Optional)**

Custody seals are narrow strips of adhesive paper used to indicate whether a shipping container has been opened during shipment. The seals are placed along the edges of the most exterior container in which samples are enclosed. It is not always necessary to place seals on individual sample containers in the shipping container. Paper custody seals should be applied before the shipping container is shipped to the laboratory. The preferred procedure includes use of a custody seal attached to the front-right and back-left of the container. Custody seals are covered with clear plastic tape.

### **Custody Transfer**

Transfer of custody and shipment procedures are as follows:

- Each sample shipping container shall be accompanied by a properly completed Chain-of-Custody Record. The original of the record shall be included in the container. The Field Sample Custodian shall keep a copy of the completed form as part of permanent documentation and send a copy of the Chain-of-Custody Record to the Program Manager.
- When transferring possession of samples, individuals relinquishing and receiving shall sign, date, and note the time of the transfer. This record documents custody transfer from the Field Sample Custodian to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

### **Request for Analysis**

In more complex sampling programs an additional form may be used to request testing. The request for analysis form is often incorporated into the Chain-of-Custody Record since the Chain must accompany the samples.

When contracting for laboratory services and prior to submitting the samples, the laboratory should be contacted and the following information presented. The Request for Analysis form may be used as a preliminary contact mechanism to ensure that the scope of work is understood. This form:

- Specifies the analyses, procedures and QC data to be performed on each sample container and the compliance protocols to be followed.
- Specifies the accreditation/certification required to be maintained during the period of the contract.
- Authorizes the payment for the analyses.

- Alerts the laboratory to any anticipated hazards associated with the samples and custody procedures to be followed while the samples are in the possession of the laboratory.
- Specifies the reporting requirements and content for the final report from the laboratory.
- Instructs the laboratory as to the disposition of the samples after the completion of the analyses.

### **Quality Assurance/Quality Control (QA/QC) Protocol**

Quality control (QC) is a normal part of good field and laboratory practice. QC includes all of the procedures applied to data collection and generation activities in order to achieve and maintain the level of pre-established data quality. The desired level of data quality should be based on the intended use of the data. Therefore, the QC protocol should include all technical controls (sampling and analytical methods, use of Field Blanks, Field Duplicate samples, inclusion of performance or Standard samples, statistics, etc.). The controls start with the regulatory requirements of the data acquisition project and carry through to the ultimate data reporting and completion of all of the documentation of the use of these controls.

Quality assurance (QA) refers to the procedures used by management to assure that the QC is what is required and that it is being adhered to at any point in the project. QA constitutes the overview and monitoring processes designed to ensure that the quality of the data generated meets the desired levels as established by management. These controls include establishing data quality objectives based on the intended use of the data, the institution of procedures for formalizing planning documents prior to the initiation of data collection activities, and the use of audits to identify problems in both QC and QA.

The quality assurance/quality control (QA/QC) protocol is specified in the Quality Assurance Plan for each job that involves field sampling. QA/QC requirements are based on the level of data reliability required for the project and may address specific regulatory requirements. The purpose of QA/QC protocol is to ensure that:

- The laboratory receives samples which accurately represent the conditions existing at the sample site.
- The results of the analysis are traceable to the specific sample location.
- Compliance requirements are met.

The methods used to attain this purpose include training of personnel, providing detailed procedures for preparation, collection, marking/handling, packaging, packing, transfer of samples, and validation and verification of the administrative process and sampling techniques.

### **Decontamination of Sampling Equipment**

Sampling may be performed using separate laboratory cleaned equipment for each sample location. Procedure effectiveness should be checked for each matrix by submitting Equipment Decontamination Blank samples to the laboratory for analysis.

### **Sample Container Cleanliness Requirements**

Sample containers are a possible source of sample contamination. Pre-cleaned containers meeting EPA CERCLA cleanliness endurance criteria are available from several suppliers. If these containers are used, the serial number and QA batch number of each one should be recorded in the Field Logbook/Notes or Field Form. A review of the cleanliness should be made to ensure all parameters are checked to be below the detection limit of the contaminants to be tested for compliance. Some Safe Drinking Water Act (SDWA) and Clean Water Act (CWA) parameters may require laboratory-cleaned containers proven to be below the limit of detection for the method.

NOTE: In no case should an effort be made in the field to decontaminate a sample container. If a container becomes contaminated, it should be replaced, with a note to that effect being made in the Field Logbook/Notes.

### **Sample Container Type and Size Requirements**

The types and sizes of sample containers to be filled for each sample will depend on the analytical method requirements. General sample container requirements are shown in Appendix A for different matrices and analytical parameters. If specified sample containers are not available, permission must be obtained from the laboratory for the use of other sizes and types of sample containers.

### **Sample Preservation and Storage Requirements**

Special preservation and storage requirements ensure that samples do not undergo chemical changes from the time they were collected until their analysis by the laboratory. General requirements are specified in Appendix A.

Preservation is required for most water samples. Two practices exist for adding preservative: (1) addition of the chemicals to the samples in the field, and (2) addition of the chemicals to the sampling containers prior to sending the containers to the field. Adding the reagents to the sample containers at the time the samples are collected requires the sampler to maintain records of addition and quality of the reagents and to follow proper chemical handling techniques. In some cases, it may be advisable to have the laboratory add the reagents to specially labeled sample containers before they are sent to the field. This may reduce the fieldwork required and the possibility of field error resulting from contaminating the preservatives. Addition of the correct amount of preservative can be estimated for samples collected on a routine basis having little to no outside environmental or process effects. When using containers filled with preservative, use caution when filling the bottles to ensure the preservative is not released to the environment and the correct amount of preservative has been added to adequately fix the sample.

The quality of the reagents, water and materials used for preservation should be verified to ensure these items do not invalidate the reported results. Chemicals used as preservatives may be traced by lot number and quality by maintaining a reagent record keeping system. The water and acid preservatives used for trip and field blanks may be checked prior to use in the field and lot controlled to ensure no contamination is present prior to the QC sample leaving the laboratory.

## **Sample Holding Time Limits**

Many samples have short holding times prior to analysis. Review the holding time requirements and coordinate the schedule with the laboratory so that the samples are analyzed within the required holding times. Holding times are dictated by the analysis requested and data may be invalidated when holding times are not met. Even with preservation and special storage procedures, the composition of samples can change over time. The holding time for samples is the time from collection to laboratory preparation and/or analysis. Holding time limits summarized in Appendix A are method and program requirements.

## **Quality Control (QC) Samples (As needed)**

Field QC samples are prepared and analyzed to determine whether test samples have become accidentally contaminated, check on the repeatability of the method and are representative of the site or matrix sampled. A number of different QC samples may be specified. Each of the following types check for a potential problem, which can affect data reliability.

## **Test Sample (As needed)**

The test sample consists of one or more sample containers filled with material collected at one sampling point within a stated time. Several sampling containers may be required if material collected for analysis for different parameters must be preserved differently or sent to different laboratories. For a specific test sample, all containers are designated by the same sample location number, but may be different sample container numbers or designations to indicate variations made to the samples. The term "test sample" is synonymous with the general term "sample" mentioned throughout the text. Test samples are those samples taken from the field for analysis.

## **Field Duplicates and Split Samples (As needed)**

Field duplicate samples are two separate samples taken from the same source and are used to determine data repeatability based on field conditions. Field Duplicate samples are:

- assigned different container numbers
- specified in the Field Logbook/Notes or on the Field Form
- distinguished from the test samples on the Chain-of-Custody Record or Field records
- often submitted blind as to designation so the laboratory data assures objectivity

Exception: each test sample collected for a specific organic analysis may consist of two containers filled with the same material; these may be given different container numbers but are designated as the same sample on the Chain-of-Custody Record. Only one container will be analyzed, the other being saved as a backup in case the laboratory must repeat the extraction and/or analysis. Duplicate samples for analysis consist of four containers, with two pairs of containers being designated on the Chain-of-Custody Record.

Field duplicate samples may be submitted to one laboratory for analysis for the same parameters. The comparability of the results provides information on the repeatability of the field extraction

and analytical procedures. The containers may be submitted to different laboratories for identical analyses to obtain information on inter-laboratory repeatability and field extraction. This is a split sample.

### **Equipment Decontamination Blanks (As needed)**

Equipment decontamination blanks provide information on the levels of cross-contamination resulting from field or laboratory sample preparation actions. An Equipment Decontamination Blank is an organic or aqueous solution that is free of the analyte of interest and is transported to the site, opened in the field, and poured over or through the sample collection device, collected in a sample container, and returned to the laboratory and analyzed. This serves as a check on sampling device cleanliness. For example:

- A Field Groundwater Equipment Decontamination Blank, for metals analysis consists of ASTM Type II water or better that is handled by the bailer, filtered, placed in a sample container, and preserved using the same procedures as used for the test and duplicate samples.
- A Soil Sampling Equipment Decontamination Blank for semi-volatile organics analysis consists of rinsing the field equipment prior to its use and collecting the solvent or materials for analysis.
- A PCB Wipe Sample Equipment Decontamination Blank consists of a wipe pad used to wipe the sampling template in the same way that the pad is handled during the actual wipe sampling of a surface. One Equipment Decontamination Blank is collected for each type of equipment used in sampling during the day or sampling event. Equipment Decontamination Blanks are assigned container numbers from the same sequence as the test samples, and may not be distinguished from the test samples on the Chain-of-Custody Record. More blanks may be collected depending on the data quality needs.

### **Field Blanks (As needed)**

Field blanks are prepared and analyzed to check cleanliness of sample containers, environmental contamination, purity of reagents or solvents used in the field. A sample container is filled with laboratory ASTM Type I or II water, preserved, and is submitted for analysis for the same parameters as the test sample. The reported results will indicate the presence of contamination. Field blanks are most often used when measuring for volatile analytes.

### **Trip Blanks (As needed)**

A trip blank is used with Volatile Organic Analyte (VOA) analysis of water. A blank may consist of two 40-mL VOA Vials filled at the laboratory with laboratory ASTM Type I or II water, transported to the sampling site and returned to the laboratory without being opened. This serves as a check on sample contamination during sample transport and shipping. NOTE: The caps used on VOA vials have silicone rubber and Teflon septums. If a high concentration of volatile chemicals is present in the air in a shipping container, these chemicals can pass through the septum and contaminate the sample. A Trip Blank is included in each shipping container used to ship VOA water samples. One VOA Trip Blank (two vials) is submitted to the laboratory in each cooler

or per sampling event. Trip Blanks are assigned container numbers from the same sequence used for the test samples, and are not designated as blanks on the Chain-of-Custody Record.

### **Matrix Spike / Matrix Spike Duplicates (MS/MSD)**

Project or compliance QC procedures require that the laboratory spike a portion of the matrix at a frequency dependent on the heterogeneity of the sample matrix or laboratory certification requirements, with a pre-determined quantity of analyze(s) prior to sample extraction/digestion and analysis. The frequency of performing a matrix spike is dependent on the data quality needs.

For a matrix spike duplicate, a second portion of the matrix is spiked. The need for performing a matrix spike duplicate is regulatory dependent.

A spiked sample is processed and analyzed in the same manner as the sample. The results of the analysis of the spike compared with the non-spike sample indicates the ability of the test procedures to repeat recovery of the analyte from the matrix, and also provides a measure of the performance of the analytical method.

Depending on the matrix and analysis, additional sample containers may be specified to provide enough material for this laboratory procedure. These sample containers are assigned container numbers from the same sequence as the test samples and are designated Matrix Spike/Matrix Spike Duplicate (MS/MSD) material on the Chain-of-Custody Record.

Matrix Spikes are routinely performed by the laboratory as part of its internal quality control on randomly chosen samples. If matrix spike data is required for SDWA or CWA reporting requirements, a request must be made to the laboratory to ensure the matrix spike is performed and reported on the appropriate sample.

## **II. Waste Sampling**

### **Container Hazards**

If drums or containers show signs of swelling or bulging, do not move or sample them until the pressure can be safely relieved. Relieve the excess pressure prior to opening. If pressure must be relieved manually, place explosion resistant plastic barriers between the worker and the drum/container.

NOTE: The integrity of the drums may dictate that over-packing is necessary prior to sampling. Therefore, over-pack drums should be available.

Re-seal the open bungs and drill openings as soon as possible with new bungs or plugs to avoid vapor release. If open drums cannot be resealed then put them into the over-pack drum.

Bulging drums are extremely hazardous. Wherever possible, do not move drums that may be under internal pressure, as evidenced by bulging or swelling.



Laboratory packs can be an ignition source for fires at hazardous waste sites. They sometimes contain shock sensitive materials. Consider such containers as explosive materials and use extreme care in opening these packs. Prior to opening lab packs, make sure all non-essential personnel are moved to a safe place. Whenever possible, use a grappler unit constructed for explosive containment for initial handling or sampling of such lab pack. Finally, maintain continuous communication with the Site Safety Officer until operations are complete.

### **Preparation for Sampling**

In a case where the nature of the hazardous waste is unknown, such as an abandoned disposal site, sampling personnel should take additional precautions to protect themselves from direct contact with waste materials. To characterize waste materials or to verify the contents of a container, drum, or tank, it is important that representative samples be collected and analyzed.

### **Preparation for Drum Sampling**

The opening of closed drums prior to sampling entails considerable risk if not done with the proper techniques, tools, and safety equipment. Prior to sampling, all drums should be staged in easy access areas. Also, any standing water or other material should be removed from the top of the container so that the representative nature of the sample is not compromised when the container is opened. Also, there is the possibility of water reactive compounds being in the drums. Manual and remote drum sampling techniques are discussed below.

### **Manual Drum Opening**

**Bung Wrench.** The most common method for opening drums manually is the use of a universal bung wrench. These wrenches have fittings to remove nearly all commonly encountered bungs. They are usually constructed of cast iron, brass, or a bronze-beryllium non-sparking alloy formulated to reduce the likelihood of sparks. The use of the non-sparking wrench is highly recommended. However, the use of a non-sparking wrench does not completely eliminate the possibility of a spark being produced.

The fitting on the wrench matching the bung to be removed is inserted into the bung and the tool is turned counter-clockwise to remove the bung. Proper protection and safety is necessary while opening drums.

If drums or cylinders show signs of swelling or bulging, do not move or sample them until the pressure can be safely relieved.

**Drum De-header.** The drum can be opened manually when the bung is not removable with a bung wrench by using a drum de-header. This tool is constructed of forged steel with an alloy steel blade and is designed to cut the lid off a drum or part way off by means of a scissor-like cutting action.

Drums are opened with a drum de-header by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so that the header is held against the side of the

drum. Moving the handle of the de-header up and down while sliding the de-header along the chime of a drum that has been damaged or badly dented, it may not be possible to cut the entire top of the drum. Since there is always the possibility that the drum is under pressure, cut the drum a little to release the pressure before cutting the whole lid off the drum. Proper health and safety procedures must be followed using a drum de-header.

### **Underground Storage Tanks (USTs), Vacuum Trucks, Process Vessels and Other Large Containers (Applicable to Agency Sampler or Contractor)**

Prior to the initiation of the sampling event, all containers should be inventoried. All available information concerning each container should be recorded in the Field Logbook/Field Notes including:

- Type of container
- Total capacity estimate
- Actual capacity (if container is open)
- Markings
- Labels
- Color
- Origin
- Condition
- Existence and condition of ladders and catwalks

Each container should be marked with an identification number for present and future reference. Enamel spray paint is often suitable for this purpose. Photographs of the numbered vessels can prove useful in documenting the container's condition and can provide a permanent record.

The procedure used to open a large containment vessel to provide access to its contents will vary with different containers. Most large tanks and vacuum trucks will have valves near the bottom of the tank and hatches near the top. It is most desirable to collect samples from the top of a tank for several reasons. The integrity of valves near the bottom of the tank cannot be assured. The valve may be immobile or may break or become jammed in the open position resulting in the uncontrolled release of the tank's contents. Secondly the contents of a large vessel may become stratified. Collecting a sample from the bottom will not permit the collection of a sample of each stratum. Instead a cross-sectional sample of the tank's contents should be obtained from the top access.

In opening and sampling larger containment vessels, precautions must be considered to assure personal health and safety. Accessing storage tanks requires a great deal of manual dexterity. It usually requires climbing to the top of the tank through an arrow vertical or spiral stairway while wearing protective gear and carrying sampling equipment. At least two persons must always perform the sampling; one to open the hatch and/or collect the actual samples, and the other to stand back, usually at the head of the stairway and observe, ready to assist or call for help.

Prior to opening the hatch, sampling personnel should check the tank for a pressure gauge. If necessary, the release valve should be opened slowly to bring the tank to atmospheric pressure. If the tank pressure is too great or venting releases gases or vapors, discontinue venting immediately.

Measure releases to the atmosphere with portable field instrumentation and record in Field Log Book/ Field Notes.

If no release valve exists, slowly loosen hatch cover bolts to relieve pressure in the tank. Again, stop if pressure is too great or if a release occurs. Do not remove hatch cover bolts until tank is at atmospheric pressure.

If a discharge to ambient air occurs, sampling may need to be postponed until the proper equipment is available to control the release.

#### Sample Collection Procedures (Applicable to Agency Sampler or Contractor)

**Large Tanks.** After the tank has been stabilized, sample collection may begin using one of the previously recommended samplers for containerized liquids and solids and employing the proper safety precautions and backup personnel. If the contents of the tank have stratified, each stratum should be sampled discretely. At a minimum, a top, middle and bottom sample should be collected. If the container has separate compartments, each should be sampled separately at varying depths, as required.

Depending on the objective of the sampling event (e.g., characterization for disposal), compositing of samples in the laboratory on a weight/weight or volume/volume basis prior to analysis may be permissible. Knowledge of the process for filling the tank will assist with the decision to composite. Hotspots and separation of materials in compartments maybe advantageous in reducing disposal costs where only a portion of the tank is contaminated. Compositing of the sample may result in low reported results from the laboratory that may not reflect overall concentration. A well-designed sampling plan is needed to ensure sampling and provides the data necessary for the decision. Upon retrieval of the sample, immediately transfer the sample into the sample bottle.

**Surface Sampling.** This recommended protocol outlines procedures and equipment for the collection of representative wipe, chip, sweep, and rinsate samples.

Surficial sampling is used to assess the existence and/or extent of contamination on various surfaces rather than in a soil, water, or air matrix. For example: the interior of a building may be assessed by collecting wipe samples of the process vessels and interiors of ventilation ducts. Though all four types of sampling are for similar purposes, these types of sampling are performed in very different ways because they are intended to assess different surface areas.

**Wipe Samples.** This method of monitoring surficial contamination is intended for non-volatile species of analytes (e.g., PCB, lead, Tetrachlorodibenzo-p-dioxin (TCDD) and Tetrachlorodibenzofuran (TCDF)) on non-porous surfaces (e.g., metal, glass). Sample points should be carefully chosen and should be based on site history, manufacturing processes, personal practices, obvious contamination, migration pathways and available surface area. Suggested sampling points include process vessels, ventilation ducts and fans, exposed beams, windowpanes, etc. The area wiped should be large enough to provide a sufficient amount of sample for analysis (smaller sample volumes cause higher detection limits).

To collect a wipe sample, the following equipment is needed:

- Ruler or measuring tape to measure out the area being wiped
- Disposable surgical gloves, to be changed prior to handling clean gauze, sample container or solvent
- Gauze pad inside a pre-cleaned container

To facilitate the collection of a wipe sample, 3-in.x 3 in. gauze should be utilized. The use of filter paper for wipe sampling is not recommended. Filter paper will tend to rip and crumble if the surface wiped is slightly rough. If filter paper is to be used, it should be before inch diameter heavy gauge paper, such as Whatman #4 Filter Paper.

Once the sample location has been determined, sample collection can begin. For each sample, a new pair of disposable gloves should be worn to avoid contamination of the collected samples (i.e., natural body oils from hands). The following is for wipe sample procedures:

1. It is recommended that an area be pre-measured (e.g., 25 cm x 25 cm) to allow for easier calculation of final results. However, this is not always feasible and may be done after the area is wiped.
2. Wearing a new pair of disposable surgical gloves, remove the gauze pad from its sterile wrapping container and soak it with the appropriate solvent.
3. Wipe entire area to be sampled once in the horizontal direction and once in the vertical direction, applying moderate pressure.
4. Wipe the entire area so that all the sample material is picked up.
5. Place the gauze pad into the sample container.

A field blank should be collected for every lot of wipe material or solvent used. In some cases, blanks may be collected every 10 wipes in order to provide additional data for interpretation. The field blank will help to identify potential introduction of contaminants from the pad, solvent, sample container, or ambient air conditions. To perform a wipe blank, start by wearing new gloves, then wet a gauze pad with the solvent or water (for each collection parameter) and place the pad directly into the sample bottle.

In some cases, the laboratory should be told to rinse the sample jars with the appropriate extraction or digestion solvent (depending on the analysis to be performed) when transferring sample to the extraction glassware. This will ensure that the entire sample has been removed from the container.

**Chip Samples.** This method of monitoring surficial contamination is intended for non-volatile species of analytes (e.g., PCB, TCDD and TCDF) on porous surfaces (e.g., cement, brick, wood). Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination and available surface area. Suggested sampling points include floors near process vessels and storage tanks, loading dock areas, etc. The sampling area should be large enough to provide a sufficient amount of sample for analysis (smaller sample volumes cause higher detection limits). To facilitate the calculations once the analytical data is received, the area sampled should be measured. To collect a chip sample, the following equipment is needed:

- Ruler or measuring tape to measure out the area to be sampled
- Disposable surgical gloves, to be changed prior to collection of each sample
- Decontaminated chisel of borosilicate construction
- Hammer or electric hammer
- Natural bristle brush
- Dust pan lined with aluminum foil or one that is dedicated, decontaminated and constructed of a pre-approved material which will not interfere with the contaminants of concern
- Container for sample

Once the sample location has been determined and marked off, sample collection can begin. For each sample, a new pair of disposable gloves should be worn to avoid contamination of the collected samples (i.e., natural body oils from hands). The following is for chip sample procedures:

1. Break up the surface to be sampled using a decontaminated chisel and hammer.
2. An effort should be made to avoid scattering pieces out of the sampling boundary. Any pieces that fall outside the sampling area should not be used.
3. The area should be chipped to less than one-quarter inch (preferably 1/8 in.).
4. Record how deep chips were taken and write in Field Logbook/Field Notes.
5. Collect the chipped pieces using a dedicated, decontaminated dustpan and natural bristle brush and transfer the sample directly into the bottle.

**Sweep Samples.** This method of monitoring surficial contamination is intended for non-volatile species of analytes (e.g., PCB, TCDD and TCDF) in residue found in porous (e.g., asphalt) or non-porous (e.g., metal) surfaces. Sweep sampling allows the collection of dust/residue samples that may help in the assessment of contaminant determination and delineation. Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, migration pathways, and available surface area.

Suggested sampling points include areas in ventilation systems where dust can collect, floor surfaces near process vessels and storage tanks (e.g., linoleum floors where a solvent cannot be used or too much residue exists for a wipe sample to be easily collected), street gutters where contaminated sediments may have migrated and accumulated, etc. The area sampled should be large enough to provide a sufficient amount of sample for analysis.

To collect a sweep sample, the following equipment is needed:

- Natural bristle brush
- Decontaminated stainless steel spatula and/or a dust pan lined with aluminum foil, or one that is dedicated, decontaminated and constructed of a pre-approved material which will not interfere with the contaminants of concern
- Disposable surgical gloves to be changed prior to collection of each sample
- Container for sample

Once the sample location has been determined, sample collection can begin. Wearing a new pair of disposable gloves, sweep all residues in the area to be sampled onto a decontaminated or dedicated dustpan or directly into the sample container. A decontaminated or dedicated spatula may be used to aid in transferring the sample into the sample bottle.

**Rinsate Samples.** This method of sampling is utilized to determine if surfaces contain hazardous waste residue after being cleaned. It is normally associated with drum storage pads, floors of buildings, and the inside of waste tanks.

Rinsate samples are performed by collecting the water from the last rinse when cleaning a tank or surface area. This water is then analyzed for the known chemical contaminants and compared against a blank consisting of the same type of water.

**Containerized/Drum Sampling.** Some of the most difficult liquids to sample are those stored in a container. Several factors play an important role in determining the sampling method to be used. These include the location of the container, the location and size of the opening on the container, and the type of equipment that is available for sampling. The health and safety of sampling personnel also plays a key role in determining which sampling method should be used.

No matter what type of sampler is chosen, it must be utilized in such a manner that allows collection of all phases present in the container. Rarely does a container hold a homogeneous mixture of material.

Sampling devices for containerized liquids and their procedures for use are presented below. Other sampling devices, which may be considered appropriate, include the Bacon Bomb, Kemmerer Depth, and a Weighted Bottle sampler. Additional updated references on sampling containerized liquids are found in ASTM Volume 14.03 for waste sampling. Material sampling of oils, paints and other containerized chemicals are found in ASTM volumes relating to these materials. Sampling containerized materials presents unique obstacle to sampling personnel, whether the container involved is a fiber drum or vacuum truck. Container staging, identification, and opening are all issues to be considered. Health and safety precautions associated with sampling containerized materials are generally more stringent. Quality assurance (QA) guidelines for waste samples, as opposed to environmental samples, are unique; therefore, each site should be considered individually. When sampling waste materials, high levels of contaminants can be expected. Therefore, trip and field blanks may be inappropriate. However, if residual or low-level waste/chemicals are expected (e.g., sampling contaminated soils in drums or containers) trip and field blanks may be appropriate.

Prior to the initiation of the sampling event, all containers should be inventoried. All available information concerning each container should be recorded in the Field Logbook/Field Notes including the:

- Type of container
- Total capacity estimate
- Actual capacity (if container is open)
- Markings, labels, color, origin, condition, etc. Photographs may be taken to provide a permanent record.

Depending on the location and position of the containers, it may be necessary to upright and/or relocate them prior to sampling. Drums containing liquid waste can be under pressure or vacuum. A bulging drum should not be moved or sampled until the pressure can be safely relieved. Containers that can be moved should be positioned so that the opening, or bung, is upright (if the integrity of the container will allow). Containers should not be stacked.

The sampling of tanks, containers, and drums present unique problems not associated with natural water bodies. Containers of this sort are generally closed except for small access ports, man ways, or hatches on the larger vessels or taps and bungs on smaller drums. The physical size, shape, construction material, and location of access will limit the types of equipment and methods of collection.

When liquids are contained in sealed vessels, gas vapor pressures build up, sludges settle out, and density layering develops. The potential for explosive reactions or the release of noxious gases when containers are opened requires considerable safeguards. The vessels should be opened with extreme caution. Preliminary sampling of any headspace gases may be warranted. As a minimum, a preliminary check with a combustible gas indicator will determine levels of personnel protection and may be of aid in selecting a sampling method.

In most cases it is impossible to observe the contents of these sealed or partially sealed vessels. Since some layering or stratification is likely in any solution left undisturbed over time, a sample must be taken that represents the entire depth of the vessel.

Agitation to disrupt the layers and re-homogenize the sample is physically difficult and almost always undesirable. In vessels greater than 1 meter in depth the method of choice is to slowly, in known increments of length, lower the suction line from a peristaltic pump. Discrete samples can be collected from various depths then combined or analyzed separately. If the specific depth of the sample is important, a discrete sample such as the Kemmerer type may be required. In situations where the reactive nature of the contents is known, a small submersible pump may be used.

When sampling a previously sealed vessel, a check should be made for the presence of bottom sludge. This is easily accomplished by measuring the depth to apparent bottom then comparing it to the known interior depth.

Liquid samples from opened containers (55-gallondrums) are collected using lengths of glass tubing (Drum Thief). The glass tubes are normally 122 cm in length and 6 to 16 mm inside diameter. Larger diameter tubes may be used for more viscous fluids if sampling with the small diameter tube is not adequate. This method should not be attempted with less than a two-man sampling team and protective gear should be worn.

Use of a Drum Thief is simple, relatively inexpensive, quick and collects a sample without having to decontaminate equipment. It does, however, have serious drawbacks. Most low-density fluids do not hold well in the glass tubes. A great deal of the potential sample flows out of the bottom of the tube as it is raised from the drum, thereby reducing the representativeness of collected

material. Many variations to this technique have been reported. These include the incorporation of a small suction device (i.e., pipette bulb) to the top of the tube as well as the use of various tube sizes. Some success has been reported with tubes that have been heated at one end then drawn to form a much smaller orifice. This allows the use of larger diameter tubing; therefore, a greater volume of sample per attempt, while reducing the material loss from the tube bottom normally associated with larger diameter tubes. The COLIWASA is a much-cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. The sampler is commercially available or can be easily fabricated from a variety of materials including PVC, glass, or Teflon®. In its usual configuration it consists of a 152 cm by 4 cm (inside diameter) section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper. A current recommended model of the COLIWASA is shown in Figure 12-1, however, the design can be modified and/or adapted somewhat to meet the needs of the sampler. The COLIWASA is primarily used to sample most containerized liquids. The PVC COLIWASA is reported to be able to sample most containerized liquid wastes except for those containing ketone, nitrobenzene, dimethylformamide, mesityl oxide and tetrahydrofuran. A glass COLIWASA is able to handle all wastes that are otherwise unable to be sampled with the plastic unit except strong alkali and hydrofluoric acid solutions. The major drawbacks associated with using a COLIWASA concern decontamination and costs. NOTE: Disposable COLIWASAs are commercially available and are recommended.

It should be noted that in some instances disposal of the tube by breaking it into the drum might interfere with eventual plans for the removal of its contents. The use of this technique should, therefore, be cleared with the project officer or other disposal techniques evaluated. Heat shrinkage Teflon® tubing or other types of Teflon® coating can also be used to cover the stainless-steel rod if contact of the stainless steel with the waste is undesirable.

### **Procedures for Drum Sampling Using Glass Tubes (Drum Thief).**

1. Record the drum identification number or label. The drum should be labeled to ensure the identity of drum for later confirmation sampling or disposal. Open drum to be sampled.
2. Remove cover from sample container.
3. Lower glass tubing to the point that it almost touches the bottom of the container. Try to keep at least 30 cm of tubing above the top of the container.
4. Allow the waste in the drum to reach its natural level in the tube.
5. Cap the top of the tube with a safety-gloved thumb or a rubber stopper.
6. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container.
7. Release the thumb or stopper on the tube and allow the sample container to fill to approximately 90 percent of its capacity or no headspace for volatiles.
8. Repeat steps 2 through 7 if more volume is needed to fill the sample container.
9. Remove the tube from the sample container and replace the tube in the drum.
10. Cap the sample container tightly with a Teflon®-lined cap and affix the sample identification tag. NOTE: See the initial discussion in this section for exceptions.
11. Replace the bung or place plastic over the drum.
12. Place sample container in a resealable plastic bag (one per bag). Place bag in paint can for



transport.

13. Mark the sample identification number on the outside of each paint can and complete Chain-of-Custody Record and Field Logbook/Field Notes.

Optional Method (if sample of bottom sludge is desired):

1. Remove cover from container opening and sample container.
2. Lower glass tubing to the point that it almost touches the bottom of the container. Try to keep at least 30 cm of tubing above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Gently push the tube towards the bottom of the drum into the sludge layer. Do not force it.
5. Cap the top of the tube with a safely gloved thumb or rubber stopper.
6. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container.
7. Release the thumb or stopper on the tube and allow the sample container to fill to approximately 90 percent of its capacity. If necessary, the sludge plug in the bottom of the tube can be dislodged with the aid of a stainless-steel laboratory spatula.
8. Repeat if more volume is needed to fill sample container and recap the tube.
9. Proceed as in steps 9 through 13 above.

NOTE:

1. If a reaction is observed when the glass tube is inserted (violent agitation, smoke, light, etc.) the sampling personnel should leave the area immediately.
2. If the glass tube becomes cloudy or Smokey after insertion into the drum, the presence of hydrofluoric acid is indicated and a comparable length of rigid plastic tubing should be used to collect the sample.
3. When a solid is encountered in a drum (either layer or bottom sludge) the optional method described above may be used to collect a core of the material, or the material may be collected with a disposable scoop attached to a length of wooden or plastic rod.

**COLIWASA Use Procedures.** Procedures can be adapted for use with other versions of COLIWASA samplers.

1. Choose the material to be used to fabricate the COLIWASA and assemble the sampler.
2. Make sure that the sampler is clean.
3. Check to make sure the sampler is functioning properly. Adjust the locking mechanism if necessary to make sure the neoprene rubber stopper provides a tight closure.
4. Wear necessary protective clothing and gear and observe required sampling precautions.
5. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
6. Slowly lower the sampler into the liquid waste. (Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample).
7. When the sampler stopper hits the bottom of the waste container, push the sampler tube

- downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the handle until it is upright and one end rests tightly on the locking block.
8. Slowly withdraw the sample from the waste container with one hand while wiping the sampler tube with a disposable cloth or rag with the other hand.
  9. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T handle away from the locking block while the lower end of the sampler is positioned in a sample container.
  10. Cap the sample container with a Teflon®-lined cap, attach label and seal, record in Field Logbook/Field Notes, and complete sample analysis request sheet and Chain-of-Custody Record.
  11. Unscrew the T handle of the sampler and disengage the locking block. Clean sampler on-site or store the contaminated parts of the sampler in a plastic storage tube for subsequent cleaning. Store used rags in plastic bags for subsequent disposal.

### **Containerized Solids**

The sampling of containerized solid materials (sludges, granulars, powders) is generally accomplished through the use of one of the following samplers:

- Scoop or trowel
- Waste pile sampler
- Veihmeyer sampler
- Grain sampler

Once the container to be sampled is opened, insert the decontaminated sampling device into the center of the material to be sampled, where possible. Retrieve the sample and immediately transfer it into the sampling bottle. When using the same sampling device, decontaminate the device thoroughly before collecting the next sample. Each sample should be sampled discreetly. Depending on the objective of the sampling event (e.g., characterization for disposal) compositing of samples in the laboratory on a weight/weight basis prior to analysis may be permissible.

### **Waste Pile Sampling**

This recommended protocol outlines general procedures for collecting samples from waste piles and other waste materials, equipment necessary for sampling, and the adequate presentation of the material. Also presented will be necessary factors for consideration when formulating a sampling plan. Because of the variables involved in waste material sampling, including: shape and size of piles; size, compactness and structure of the waste material; and make-up throughout the material, exact procedures cannot be outlined for every sampling situation. Considerations must be made for the abovementioned variables, the purpose of sampling, and the intended use of the data to help determine correct sampling methodology.

### **Considerations for the Sampling Plan.**

The physical and chemical make-up of the waste pile and the purpose of sampling should be considered in planning for the sampling. Information about these items is presented below.

**Shape and Size.** Shape and size of waste material and waste piles may vary greatly in a real extent and height. The pile may be cone shaped, long and rectangular, square, oval or irregularly shaped. State and Federal regulations often require a specified number of samples per volume of waste; therefore, size and shape may be used to calculate volume and to plan for the correct number of samples. Shape must also be considered when planning physical access to the sampling point and the type of equipment necessary to successfully collect the sample at that location.

**Sampling Procedures.** Sampling devices most commonly used for small waste piles are thieves, triers, and shovels. Evacuation equipment, such as backhoes, can be useful for sampling larger waste piles.

A thief consists of two slotted concentric tubes, usually made of stainless steel or brass (See Figure 12-2). The outer tube has a conical pointed tip that permits the sampler to penetrate the material being sampled. The inner tube is rotated to open and close the sampler. A thief is used to sample dry granules or powdered wastes whose particle diameter is less than one-third the width of the slots.

A trier consists of a tube cut in half length wise with a sharpened tip that allows the sampler to cut into sticky solids and to loosen soil (See Figure 12-3). A trier samples moist or sticky solids with a particle diameter less than one-half of its diameter. Triers 61 to 100 cm long and 1.27 to 2.54 cm in diameter are available. A larger trier can be fabricated.

**Characteristics of the Material.** Materials to be sampled may be homogeneous or heterogeneous. Homogeneous material, such as sand blast abrasive, may not require an extensive sampling protocol. A composite sample composed of five individual samples taken with a shovel, six inches beneath the surface, should represent a sampling point. Depending upon the size of the waste pile, three, five, or seven such composite sampling points should be representative of the waste pile. A thief or trier sampler would provide amore representative sample compared to a shovel, if such is a practical substitution for the shovel.

When the waste pile is composed of heterogeneous material, an effort should be made to determine the source, nature, and extent of the deposited waste. If it is possible to sample the waste sources contributing to the waste pile, the waste characteristics could be easily obtained. If it is determined that any of the waste within a heterogeneous waste pile is a hazardous waste, the entire waste pile is a hazardous waste by definition, and should be managed as such, unless the waste pile can be segregated into hazardous and non-hazardous components.

Waste piles containing unknown waste can be sampled using a three-dimensional random sampling strategy where the pile is divided into a three-dimensional grid system, the grids sections assigned numbers, and the sampling points then chosen using random-number tables or random-number generators. This strategy can be employed only if all points within the pile can be accessed. In completing the TCLP tests, the first one that indicates the material to be a hazardous waste should be sufficient ground to cease further testing on the waste pile. If any part of the waste pile is a hazardous waste, the entire pile becomes regulated in such a manner.

**Composite Samples.** Compositing of a number of individually collected samples in the field may be used to reduce analytical cost. The disadvantage of sample compositing is a loss of concentration variance data, whereas the advantage is amore representative sample from the universe that is being sampled. This sample collection technique is especially valuable when the waste pile is believed to be homogeneous. When a waste pile is believed not to be homogenous, individual random sampling is the preferred sampling technique. Compositing requires that equal amounts of material from each of the number of samples to be composited be combined and sufficiently mixed so that an aliquot sample can be removed for laboratory analysis. If the concentration of a regulated material exceeds a regulated level, the entire waste pile must be managed as regulated waste, or additional sampling and analyses must be performed to define regulated and non-regulated material.

To avoid the necessity of re-sampling in the event that a composite sample exceeds the regulated limit, it is essential to collect a sufficient volume of each initial sample so that sufficient sample will remain following compositing to allow for a different compositing scheme or even for the analysis of the component samples themselves. This requires that the initial field samples be retained until the laboratory results on the composite sample become available.

**Sampling for Lead in Paint.** To collect a paint sample suitable for lead determination, use a sharp knife to cut through the paint. Lift off the paint with a clean putty knife and place the sample in a clean re-sealable plastic bag or appropriate container. Label the plastic bag or container and record pertinent sample collection information in the field log book\field notes.

A sample of about 2 inches by 2 inches is required for a determination. Be sure to take a sample of all layers of paint, because only the lower layer may contain lead. Avoid including any of the underlying wood, plaster, metal, or brick in the sample. Wipe the sampled surface and any paint dust with a wet cloth or paper towel and discard the cloth or towel.

As a minimum, a paint sample should be collected from the door, window and wall of each room in the building being investigated. If it is determined that a painted surface is homogeneous throughout the building and the same paint was applied at the same general time throughout, the number of samples can be reduced. As a minimum, three or five samples each from doors, windows, and walls for each floor of a building should be collected.

The U.S. Department of Housing and Urban Development recommends that action be taken to reduce exposure to lead in paint when the lead content is greater than 0.5 percent by laboratory testing or greater than 1.0 mg/cm<sup>2</sup> by X-ray fluorescence. When the first sample from a door, window, or wall results in a lead content exceeding the recommended action level, all similar areas should be inspected. Action is especially important when paint is deteriorating or when infants, children, or pregnant women are present. Generally, buildings constructed after about 1980 would not be expected to contain paint with elevated lead concentrations.

**Oil Spill Sampling.** The methods outlined in this section are for the collection of surface samples whenever the spill occurs from a site or vessel. In this case, use of a suction device can be made to collect samples. The statistical design of the sampling should be the same no matter what devices are used to collect samples. Oil spill samples can be collected using the same methodology

used for offshore sampling, such as inverting the 4 fluid oz. jar and collect the liquid oil sample. Shallow pollution samples can be collected by using one of the following methods:

**Soil Punch Sampling.** This is a thin wall tube, 15 to 20 cm long, used to extract short cores from contaminated locations at beaches. The following steps are used to collect samples with this equipment:

1. Drive the tube into the potentially contaminated location with a wooden mallet.
2. Extract the tube and core.
3. Push out collected materials in mixing bowl, collect sample into label jar, store the sample at 4°C.
4. Fill out Chain-of-Custody (COC) Record.

**Scoop or Shovel Sampling.** Surface samples due to an oil spill are collected with a scoop and shovel. The small plastic disposable scoop can be used to collect representative samples. In this case proper Quality Assurance/Quality Control (QA/QC) procedures should be followed to ensure cross-contamination cannot occur during sampling events. Larger representative samples can be collected with the help of a shovel at the site.

**Hand Auger Sampling.** Shallow surface oil spill samples can be collected with a Hand Auger. Samples should not be used for the examination of a core sample because soil is mixed when the auger is pushed into the ground. The following procedure is used to collect a sample with a Hand Auger:

1. Force the Hand Auger to the location where the sample is to be collected.
2. Auger should be twisted or screwed, extract the sample, pull the auger, and retrieve the sample in the jar.
3. Follow step 3 of the soil punch sampling procedure.

NOTE: Power Augers can be used to collect samples. The procedure is the same as the Hand Auger.

### **Quality Assurance/Quality Control (QA/QC)**

Appropriate protocols should be followed to ensure the accuracy of data collected during sampling. A QA/QC plan involves the establishment of a sampling protocol, which is designed to minimize source of error in each and every stage of the process, from sample collection to analysis and reporting of analytical data. Key elements are as follows:

- Development of a statistically sound sampling plan for spatial and temporal characterization of the drums, waste pile and tanks.
- Installation of a vertical and horizontal sampling network, which allows collection of sub-surface samples.
- Use of a sampling device that minimizes disturbance of the chemistry of the media formation.
- Use of field decontamination procedures to minimize cross-contamination during

sampling. Collection of QA/QC samples and following Chain-of-Custody procedures.

### **III. Soil Sampling**

The characterization of soil contamination requires that samples be collected from identifiable locations and that samples received by the laboratory represent actual soil conditions. Soil sampling programs:

- Determine site lithology (presence and location of different types of soil, bedrock, or groundwater).
- Define the extent, depth, type, and severity of soil contamination.
- Determine soil "cleanliness" during underground storage tank (UST) removal, polychlorinated biphenyl (PCB) transformer operation, or background monitoring at a treatment, storage, and disposal facility (TSD) or hazardous waste handling areas.

Sampling personnel are critically important to sampling program success, since the sampler is often in the best position to detect areas of suspicion. Even though sampling techniques may be sophisticated, these should not be relied upon to replace good judgment and common sense on the part of sampling personnel in discerning the difference between routine and extreme case scenarios. Sampling personnel must be alert to their surroundings (unusual circumstances, odors, presence of dead animal or plant life in the area, etc.) while:

- Collecting and recording visual and physical data
- Collecting soil samples, both surface and subsurface
- Adhering to procedures
- Maintaining the Chain-of-Custody (COC) Record
- Preserving program integrity

The Quality Assurance Plan (QAP) must define the uses of the data. The resulting Field Sampling Plan (FSP) will be based on existing knowledge of what chemicals may be present, the possible areas of contamination, and the possible migration of the chemicals through the soil. This existing knowledge can come from spill reports and preliminary surveys that identify discolored soil or distressed vegetation. Preliminary surveys may be performed to determine site lithology and identify the chemicals that pose the greatest hazard.

#### **Background on Contamination of Soils**

Soil contamination by elemental heavy metals such as lead or by chemicals such as pesticides that are relatively insoluble in water may be limited to the top few inches of soil. However, the area that is contaminated can be affected by soil erosion or by tracking or movement of the soil as a result of construction activities. Soil contamination by soluble metals such as plating wastes or by spills of concentrated organic chemicals such as gasoline, aviation fuel, solvents, transformer oil, etc. may extend to considerable depths and the concentration of the chemicals at any depth may not be easily predictable. Soluble metals and organic liquids are often carried through soil by percolating rainwater, and the extent of movement of the contamination is affected by a number of factors including:

- Solubility of the contaminant in water: Some metals and most organic chemicals are

soluble in water to the extent that the water becomes unfit for use as drinking water.

- Density of organic liquids: Light organic liquids such as gasoline, fuel, and oils will settle through soils which are not saturated with water, until they reach a confining surface such as clay, bedrock, or groundwater. It is not unusual to find a concentrated layer of organic liquid moving along the surface of a tilted clay layer or forming a pool or lens on the groundwater. The extent to which the underlying groundwater is contaminated then, is a function of the solubility of the organic liquid in the water. Dense, non-aqueous liquids, such as chlorinated solvents (trichloroethylene, tetrachloroethylene, carbon tetrachloride) or heavier chlorinated organic liquids such as chlorinated benzenes and PCBs can continue to sink through groundwater until they reach a confining layer such as clay or bedrock. These chemicals can flow along tilted surfaces or pool in the cracks in bedrock and then slowly leach into groundwater.
- Susceptibility to biodegradation: Many organic chemicals can be degraded by microorganisms in the soil. However, the microorganisms require oxygen, and generally are not active at depths of more than a foot or so. Therefore, the surface soils may be relatively uncontaminated by organic chemicals because of biodegradation, while deeper soils may be quite contaminated because this process is not effective without oxygen.
- Type of soil: Subsurface layers of clay are relatively impermeable to groundwater and organic liquids, but the clay particles can absorb some hazardous chemicals from the water resulting in increases in their concentration. Organic liquids may form pools in the low reaches of clay layers, or may flow down the surface of tilted clay layers. Soils that are high in organic material, such as peat, can absorb and concentrate some hazardous chemicals. A layer of organic soil may therefore be more contaminated than the soil layers above and below it. Porous non-organic soils such as sand or gravel allow for rapid movement of liquids (groundwater or spilled organic liquids). These soils do not absorb contaminants. For example, PCBs from spilled transformer fluid and from buried electrical capacitors have been found several hundred feet from the source of the contamination. Gasoline from leaks in underground storage tanks can be carried hundreds of feet by moving groundwater. Bedrock may provide a confining layer underground water. However, fractured bedrock may provide channels for the movement of ground water and heavy organics, or low spots for the accumulation of pools of heavy organic liquids. The chemistry of the soil, such as its pH, can change the chemistry of the water percolating through it, which in turn affects the solubility of metals in the water. For instance, acidic rainwater can dissolve metals at the surface, but the metals may come out of solution and accumulate in the soil if the percolating water contacts a buried layer of lime.
- Presence of groundwater: Moving groundwater can carry hazardous contaminants for considerable distances. The rate at which groundwater will cause contaminants to spread is affected by both the speed at which the groundwater moves through the soil and the extent to which the soil absorbs the contaminants. The contamination of groundwater with resultant damage to its usability as drinking water is one of the most serious effects of accidental spills and improper disposal of hazardous chemicals. A definition of a hazardous waste under RCRA is measured by determining whether its solubility in acidic water percolating through a municipal landfill will damage the drink ability of the underlying aquifer. An aquifer is a layer of soil or porous rock saturated with water. The aquifer surface confines vertical movement of organic liquid and percolating groundwater. Where the surface is exposed, as in stream valleys, contaminants in the groundwater can

re-appear as surface seeps. Several different aquifers may be present at any given location, but may be separated by confining layers of clay or rock. If sampling holes penetrate the confining layer, contamination can move through the hole and contaminate deeper aquifers, resulting in increased environmental damage. Alternatively, the deeper aquifers may be under hydrostatic pressure, and a sampling hole that pierces a confining layer may allow contaminated water from deeper aquifers to flow into shallower layers of soil.

## **Data Requirements**

Ideally, a FSP should be based on knowledge of what contaminants are likely to be present and how the distribution of the contaminants may be affected by the lithology of the site. However, the purpose of the fieldwork may be to define the lithology and obtain chemical data for determining compliance with Federal, state or local requirements. It is possible for soil sampling to be conducted in a number of phases, with the field observations and field test results providing data for guiding subsequent work.

The most important data requirement from any field sample is the identification of exactly where the sample was collected. Stakes or flags should be installed to indicate the locations of soil samples. However, since sites will probably be disturbed by subsequent construction work, it is also important that the location of each sample be measured with reference to permanent features such as survey monuments, measurements to a reference point, or latitude/longitude location. For soil sampling programs, it is generally acceptable for the survey to define each sample location to an accuracy of one foot horizontally and a few inches vertically. Unless the area to be sampled is flat, an initial survey should be made to define the surface contour. Measuring the depth from the surface at which a sample is taken and at which different soil layers and groundwater are encountered is insufficient, unless the elevation of the surface at that point is known and will remain un-disturbed.

The second most important data requirement from any field sample is the collection of soil samples that represent field conditions and that address the data needs of the program. For instance:

- In determining whether the contamination of surface soil presents a hazard by skin contact or ingestion, the samples should consist of soil from the surface to a depth of only two inches and the soil should be sieved to eliminate stones larger than 2 millimeters in diameter.
- EPA cleanup requirements for soil contaminated with PCBs are based on the concentration of PCBs in the soil, including rocks. The samples taken to define the location of PCB contaminated soil that must be excavated for proper disposal should not eliminate rocks, since the cleanup standards are based on the maximum allowable average concentration of PCBs in the remaining soil. The disposal requirements for PCB contaminated soil depend on when the spill occurred: Soil contaminated with PCBs during 1987 or after is classified as hazardous based on the concentration of PCBs in the material spilled. Soil contaminated with PCBs before 1987 is based on soil samples representative of the area to be excavated, including rocks, since the definition of PCB wastes is based on the average concentration of PCBs in the material.
- To determine whether excavated soil is classified as a hazardous material under RCRA,



soil samples should be representative, including rocks and hard chunks. The extraction procedure specified by EPA may require that the lab screen the soil to eliminate rocks larger than 3/8" in diameter, but the criteria are too complicated to allow a decision to be made in the field as to whether the soil should be screened when it is collected.

Special sampling procedures must be used when collecting soil samples that will be analyzed for volatile organic chemicals because these chemicals rapidly evaporate from soil once exposed to the air. Unless precautions are taken to minimize this evaporation, the samples will not be representative of the actual level of contamination of the soil.

The third data requirement is the geology and lithology of the site. Most permit applications for compliance require this information to be provided prior to starting any activities. Therefore the information may be referred to in the application documents. The following information should be noted or referenced to on a site map:

- Surface information:
  1. Location of erosion patterns and accumulated runoff sediments.
  2. Locations of possible sources of soil contamination, such as surface tanks, under-ground storage tanks, lagoons, waste pits, fire pits, or piles of trash or waste.
  3. Locations of discolored soil.
  4. Locations of areas covered by impermeable material, such as pavement and buildings.
  5. Extent of areas of distressed vegetation. Indications of geology and lithology, such as types of surface soil, exposed bedrock, standing water, and groundwater seeps.
- Subsurface information:
  1. Type of soil as a function of depth at each sample location (layers of clay, peat, sand, silt, shale, etc.; layers having different colors; presence of large stones; etc.).
  2. Moisture of soil at different depths, and depth at which the soil becomes saturated with water (i.e., depth to groundwater).

For some investigations of soil contamination by organic chemicals, field measurements may be made of the concentration of organic vapors in the air in bore holes as a function of depth, or next to newly exposed soil.

### **Toxic Chemicals**

Collecting soil samples inherently involves the risk of exposure to hazardous chemicals. Major exposure scenarios that should be evaluated include:

- Skin contact with contaminated soil. The personnel who are involved in collecting the samples should wear disposable boot covers and rubber gloves as a minimum, and should consider the use of disposable Tyvek® coveralls to prevent contamination of clothing. The sample custodian should wear appropriate protective equipment when handling samples.
- Skin contact with contaminated water. Deep soil samples usually result in the requirement to handle wet soil that can drip and splash. Decontamination of sampling equipment also

can result in splashes of contaminated water. The personnel who are collecting the samples and decontaminating the sampling equipment should wear waterproof raingear or coated Tyvek® coveralls if there is a possibility of contact with contaminated water.

- Ingestion of contaminated soil. This usually occurs when food or drink is exposed to contaminated dust or is picked up with contaminated gloves. No eating, smoking or chewing of gum or tobacco should be allowed when working with contaminated soil. Drinking water should be kept in closed squirt bottles or should be stored outside the contaminated area.
- Inhalation of contaminated dust. Inhalation of contaminated dust may be a problem on dry windy days at sites where the surface soil is contaminated. Digging and drilling activities may also generate contaminated dust. Personnel should remain upwind of any source of dust. If the site is generally contaminated, full-face air purifying respirators equipped with particulate filters should be worn.
- Inhalation of toxic vapors. Exposure of contaminated soil may generate toxic vapors from the evaporation of volatile organic chemicals. The HASP should establish air monitoring requirements for intrusive work, including specifying what air monitoring equipment is to be used and the criteria for the use of respirators. Either air purifying respirators or supplied air respirators may be required, depending on the toxicity of the chemicals that may be present, the capabilities of the monitoring equipment, and the warning properties of the vapors.
- Confined space hazards. In general, pits more than four feet deep are considered to be confined spaces if there is no way for personnel to walk out. However, when digging into contaminated soil, there is a chance for the accumulation of flammable vapors or toxic gases including hydrogen cyanide and hydrogen sulfide. Any pit should be considered to be a confined space if there is any chance of generating toxic or flammable vapors from the soil and if one is required to put one's face below the top of the pit for any purpose, such as to examine soil conditions or collect soil samples. Normal confined space procedures shall be implemented, including air monitoring, the assignment of a confined space observer, and the possible use of respiratory protection.

### **Sample Collection Items (Items selected as needed per specific job)**

The collection of useful information about soil contamination requires documentation of site surface conditions (locations of buildings, pavements, standing water, seeps, sediment runoff, discolored soil, etc.) and subsurface conditions (depth of various layers of soil, depth to groundwater, depth to bedrock at different locations). The chemical data obtained from analysis of soil samples is only useful within the context of site conditions, so it is very important that the exact location of each sample be documented and that the soil samples accurately represent the conditions at the site.

**Preparation of Site Map.** Documentation of site conditions and sample location requires a site map. A site map showing required sample locations should be included with the FSP. The site map may be based on facility drawings, but should be verified in the field and augmented with additional information on the drainage of rainwater and other surface conditions that affect the movement of contaminated soil. If the FSP does not include a site map, one should be prepared by sampling personnel based on available facility drawings and field measurements.

**Surface Contour.** Unless the site is completely flat, it is important that the surface contour be indicated on the site map. The depth of soil samples is measured from the surface, but the surface reference can be lost due to excavation or filling activities at the site. If a contour map of the site is not available, it may be necessary to have one prepared by a survey team prior to sampling.

**Surface Information.** Sampling personnel should validate the site map before starting sampling activities. Any discrepancies should be noted on the map, and the following surface information should be recorded if not already shown:

- Buildings
- Paved areas
- Unpaved roads and parking areas
- Surface areas of different types of soils, including fill areas (gravel roads, clay, sand, peat, etc.)
- Standing water (both permanent such as ponds and streams and temporary such as persistent puddles)
- Water seeps
- Water runoff patterns and accumulations of runoff sediments
- Exposed bedrock
- Discolored soil
- Stored materials, debris, soil piles, etc.
- Distressed (dead, wilted, or discolored) vegetation

It is recommended that photographs also be taken to document the site surface features. Photography requirements should be established by the Program Manager to ensure compliance with the policy and regulations of the facility.

**Documentation of Sampling Locations.** The location of each sample and the designated sample numbers should be shown on the site map. Samples should be collected at the designated sample points. Depth of samples from the surface should be recorded. If it is necessary to sample more than a foot from the required location because of interferences such as trees, pavement, subsurface rocks, or buried utilities, the new sample location should be noted on the map and the reason for moving the sampling location should be explained in the Field Logbook/Field Notes.

**Preliminary Tests and Observations.** A number of field tests and observations may be required to document sampling and subsurface conditions.

**Weather Conditions.** The weather conditions at the time of sample collection should be noted in the Field Logbook/Field Notes. Weather data should include temperature, relative wind speed and direction, relative humidity, and the presence of rain or snow. Recent weather conditions at the site should be summarized, including recent rain events (how much, how recently) and freezing conditions (how cold, how deeply is the soil frozen).

**Description of Soil Types and Lithology.** The movement of groundwater and the transport of hazardous chemicals are strongly influenced by the presence and depths of different types of soil.

Knowledge of subsurface lithology is necessary for an understanding of the dynamics of soil contamination.

A professional geologist should describe the soil if this information will be used to support the computer modeling of groundwater flow. If this level of detail is not required, the soil layers and the soil samples should be described by sampling personnel. Chapter 3 of the EPA Description and Sampling of Contaminated Soils - A Field Pocket Guide, is an excellent guide to the field description of soils. As necessary, the following soil features, when present, shall be described as a function of the depth from the surface:

- Color: soil colors should be determined with the use of a color chart (e.g., Munsell).
- Mottles: blotches or spots of contrasting color interspersed with the dominant soil color.
- Soil Texture: this is the amount of sand, silts and clays in a soil.
- Particle shape: shape of individual soil particles.
- Structure: shape of the natural soil aggregates.
- Consistency: degree of resistance to breaking or crushing; descriptions will vary with moisture condition.
- Presence of visible oil, gasoline, solvents or other organic liquids.
- Horizon thickness: layers of soil with distinct changes of the above features.

**Soil Gas.** Soil gas measurements, using field monitoring instruments such as photoionization detectors (PIDs) or flame ionization detectors (FIDs) can give an indication of the presence of volatile organic chemicals (VOCs) in the soil. The concentration of volatile organics measured with these instruments is not closely related to actual organic compound concentrations in the soil as the gas concentration depends on the following soil conditions:

- Temperature of the soil (higher temperatures increase the volatility of organic chemicals).
- Moisture content of the soil (organic chemicals vaporize faster from wet soils).
- Absorption capacity of the soil (organic contaminants vaporize slower from peat and other soils that contain significant organic material).
- Instrument response factors for the particular organic chemicals that are present in the air (both types of detectors respond differently to different chemicals).
- Depth of the bore hole and time that it has been open (organic vapors can sink to the bottom of an open bore hole, increasing the concentration at the bottom). However, the following techniques can obtain at least qualitative information on the presence of VOCs in soil.

**Down Hole.** This technique measures the concentration of the organic vapors that have accumulated in the air in a borehole. It is subject to all of the variables listed above. Stick the intake port of the instrument into the borehole and record the maximum response. If the instrument has a sample pump, connect a sampling tube to the intake port and lower the tube down the borehole, recording the maximum instrument response.

**Sniff.** This technique measures the concentration of VOCs in air directly adjacent to freshly exposed soil. In addition to the variables listed above, the measured levels of organics will depend on the porosity of the soil and the wind velocity. Break open a soil sample and immediately hold the intake port of the instrument close to the newly exposed surface; record the maximum instrument response.

**Head Space.** The technique used should control moisture content, temperature and the tendency for organic vapors to settle. Blanks and background measurements should be made to aid with the evaluation of the final results. In some methods, water or a non-chlorinated solvent is added to the container. The sealed container is gently shaken and may be placed in the sun, water bath, or controlled temperature device and heated to a known temperature. After a stated period of time, a probe to detect organic vapors is inserted into the headspace of the container and the maximum instrument reading is recorded.

**Access to Soil.** It is important that soil samples consist of reasonably undisturbed soil from the specified sampling depths. Access to the soil often requires drilling or excavation down to the specified depth. In all cases, care should be taken to avoid buried utilities.

**Surface Samples.** Soil samples should be of undisturbed soil, and not material that is temporarily lying on the ground. Unless the FSP specifically requires the sampling of surface debris, remove organic debris (leaves, etc.) and accumulated trash (paper, cans, bottles, demolition rubble) to expose the soil. The FSP should define the depth of surface samples. Specific state and local compliance programs may define surface samples as the first three, first six, or first twelve inches below the vegetation layer. Note in the Field Logbook/Field Notes how much and what kind of material was removed.

**Subsurface Samples.** Subsurface samples should consist of undisturbed soil starting at the depth below the surface specified in the FSP. Subsurface samples should be defined as to the depth, and may not contain material from different layers of soil. Collection of subsurface soil samples requires that the overlying soil be removed. The FSP should detail material separation and depths of subsurface sampling including sample mixing, splitting, and representativeness.

**Test Pit.** Under unusual circumstances, the excavation of a test pit may be useful in determining the depth and thickness of different types of soil or any apparent band of soil contamination. Samples should be collected from undisturbed material from the walls or bottom of the pit, not from soil that is excavated from the pit.

Advantages:

- Visibility: provides the best information on the location of soil layers.
- Versatility: may be the only way to access subsurface soil where large rocks are present.

Disadvantages:

- Safety: The backhoe may have to be completely decontaminated before removing it from the site. Trench walls deeper than 3 feet may be unstable. Shoring may be required prior to having anyone enter the test pit to collect samples. Toxic or flammable vapors may accumulate in the test pit. Any entry into a test pit that requires a person's nose to be below the level of the surface should be considered a confined space entry, and all air monitoring and use of personnel protective

equipment (PPE) requirements must be complied with. Excavation of contaminated soil can lead to the vaporization of significant amounts of toxic chemicals, or generation of considerable contaminated dust, resulting in an inhalation hazard to the sampling personnel. The FSP should address this potential hazard.

- Environmental: If soil contamination is suspected, a large amount of soil may have to be put into containers such as drums and stored or disposed of as hazardous waste. If the pit is refilled with excavated soil, contaminated surface material may be buried at a greater depth or contaminated soil from subsurface layers may be exposed on the surface.

Before digging a test pit, four stakes should be driven into the ground far enough from the sample location that they will not be disturbed by the backhoe or other activities. The stakes should be located such that strings attached to opposite posts will intersect directly above the sampling location.

**Augers.** An auger is a hole-making tool that is screwed into the soil (See Figures 5-3 and 5-4). In general, augers should only be used to gain access to the soil that is to be sampled. Augers churn the soil and destroy its structure, making soil classification more difficult and causing rapid release of volatile contaminants. In addition, when augers are lowered into bore holes, they can scrape soil off the sides of the hole so samples collected from the bottom of the hole may be contaminated with soil from shallower levels.

A hand auger can be used to expose soil as deep as four feet. Gasoline powered portable augers may be able to reach up to 12 feet depending on soil conditions, but are heavy, require two people to operate, and may contaminate samples when volatile organics are to be sampled.

Various types of augers are available. The major types, their advantages, and their limitations are summarized in Table 5-1. A typical auger consists of a handle, a stainless-steel extension rod, and a bit. Additional extensions can be added for deeper holes. Place the auger over the desired sampling location and turn the handle while exerting downward pressure. The turning motion of the handle will rotate the bit down into the soil. To remove the auger, turn the handle in the opposite direction; the soil will remain in the bit and can be removed by using a clean stainless-steel scoop or spoon.

#### Auger Use Procedures:

1. Clear the area to be sampled of any surface debris such as twigs, rocks, or litter. It may be advisable to remove the first 3 to 6 inches of surface soil from an area one foot in diameter to prevent loose near-surface soil particles from falling down the hole.
2. Attach the auger bit to a drill rod extension and then attach the drill rod to the T handle or the power unit.
3. Begin drilling; periodically removing accumulated soils to prevent accidentally brushing loose material back down the borehole when removing the auger or adding drill rods. Shovel the loose soil onto a piece of plastic sheeting.
4. After reaching the desired depth, slowly and carefully remove the auger from the borehole.
5. Remove the auger from the drill rods and replace with a pre-cleaned tube sampler. Install proper cutting tip. (An optional step is to first replace the auger tip with a planer auger to clean out and flatten the bottom of the hole before using the tube sampler.

**Drill Rig.** Truck mounted drill rigs can gain access to soil at any reasonable depth and can penetrate hard layers. When used with a hollow stem auger, a drill rig can retrieve reasonably undisturbed cores for purposes of classification. Disadvantages of using a drill rig include increased labor (the drilling crew) and equipment rental costs.

**Use of Soil Sampling Equipment** (Items selected as needed per specific job)

Soil sampling equipment should be selected according to the objectives of the sampling activity. It is important to determine the depth at which samples will be collected prior to sampling visit. Sample depth will determine the types of sampling equipment required. All sampling equipment shall be decontaminated prior to use at each sampling location. It is preferable that this be done in a controlled area before entering the site. Field decontamination of equipment between sampling locations must be performed.

**Trowel, Scoops, and Spoons.** Small hand tools can be used to collect surface samples and samples of undisturbed soil from the sides and bottoms of sampling pits. These small tools are also used to mix and handle soil obtained from deeper locations. All stainless-steel scoops, spoons, and tulip bulb planters should be decontaminated and wrapped in aluminum foil prior to use. If the equipment is not pre-wrapped in aluminum foil or other clean wrap material, sampling personnel should assume that it is not clean and should not use it. A trowel is a small shovel. A laboratory scoop is similar to a trowel, but the blade is usually more curved and has a closed upper end to contain the soil. Scoops come in different sizes and makes. Many are chrome plated; these are unacceptable because the plating can peel off and get into the soil sample. Stainless steel scoops are preferred. However, scoops made from other materials may be acceptable in certain instances. The decision for equipment construction of material other than stainless steel will be made by the Program Manager or designee.

**Tube Samplers.** Tube samplers are hollow tubes that are driven or screwed into the soil. The soil fills the tube and is retained when the sampler is withdrawn. Various types of tube samplers are available.

**Split Spoon Sampler.** A split spoon sampler is a length of carbon or stainless-steel tubing split along its length and equipped with a drive shoe and drive-head. Split spoon samplers are available in a variety of lengths and diameters. A standard 2-foot split spoon is advanced ahead of the auger with a 140-pound hammer. Because of its weight, the split spoon sampler is generally used with a drill rig. The advantages of split spoon samplers include the ability to be driven into hard soils and the ease of extraction of the soil sample.

**Split Spoon Sampler Use Procedures:**

1. Use an auger or drill rig to open a borehole down to the depth to be sampled.
2. Assemble the split spoon sampler by aligning both sides of the barrel and then screw the drive shoe with retainer onto the bottom and the heavier headpiece onto the top.
3. Place the sampler over the borehole in a perpendicular position.

4. Drive the tube utilizing a drop hammer, sledgehammer or well rig if available. Do not drive past the bottom of the headpiece as this will result in compression of the sample.
5. Record the number of blows required to advance the sampler each 6-inch increment.
6. Carefully pull the sampler out of the hole. Open the sampler by unscrewing the drive shoe and head and split the barrel. Discard the top two or three inches of soil. If split samples are desired, a decontaminated stainless-steel knife should be used to divide the tube contents in half vertical.
7. For samples to be analyzed for volatile organics, transfer the sample directly into clean volatile organic analyte (VOA) vials, minimizing exposure to air. (VOA vials are special wide mouthed bottles with lids that have a thin Teflon<sup>®</sup> liner under a silicone septum. VOA vials are used for samples that will be analyzed for volatile organic analytes.) For samples to be analyzed for other parameters such as semi-volatile organics or metals, place soil into a stainless-steel bowl and mix it thoroughly using a stainless steel scoop or trowel; place homogenized soil into the required sample containers.

**Sample Preparation.** Proper sample preparation ensures that each sample container is filled with soil that represents the entire sample and that large rock fragments are either removed or are included in each container in an amount proportional to their presence in the soil, as specified by the FSP.

**Split Samples.** Material from a single sampling event, made homogeneous and divided into separate samples for submission to different laboratories.

**Volatile Organic Analysis.** For splitting samples to analyze for volatile organic chemicals, collect two core samples from adjacent locations. Alternatively, split a soil core longitudinally with a clean knife and place one half of the core in each sample container, minimizing air contact as much as possible. The method of splitting the sample may greatly affect the results. Documentation and execution of the splitting technique must be uniform to ensure data comparability.

**Semi-volatile Organic and Metal Analysis.** Place soil in a clean stainless-steel bowl. Crush and thoroughly mix the soil with a clean stainless-steel spoon. One method of sample selection is to form the soil into a cone and divide the cone in half vertically. Fill each set of sample containers with the soil from one half of the pile. The method used for sample mixing and placing in the sample container should be documented and uniform to ensure data comparability.

**Composite Samples.** Composite samples are only to be collected after full justification and documented rationale are presented in the sampling plan. Composite sample collection techniques should not be used if justified solely on the basis of reducing the sample testing cost. The method of compositing the sample should be documented and uniform to ensure future data comparability. The method for splitting the sample either for compositing or for purposes of analysis should be the same for both field operations and the laboratory.



If composite samples are collected, the first step is to collect a soil sample from the sampling location specified in the sampling plan using the documented procedure. Any variation from the stated procedure or field-sampling plan must be recorded.

Composite samples may be collected on the basis of biased sampling, or a variety of statistical sampling techniques. Biased sampling is used when visual, odor, or volatile organic detection is found and a portion of the material is collected and combined with other positive areas. In most cases, equal amounts of material are collected and mixed in the sampling container. Protocols for combining the sample are based on the site conditions, the parameters being measured, the regulatory limit, and the data quality objectives. The rationale for the use of glass, stainless steel and polyethylene equipment for combining samples, and the rationale for combining the soil in equal amounts, proportional amounts, or other amounts should be documented. An example of collecting a sample for detection of petroleum products using a composite sampling technique is to use an appropriately sized, disposable, re-closeable freezer storage bag. Collect a minimum of three equally sized samples (ten is preferred) from designated sample locations and place in the sample bag. Close and secure the bag using care to eliminate trapped air. Mix the sample by tumbling and kneading until well mixed. Separate sample(s) into appropriate containers.

NOTE: Soil samples collected for determination of volatile organic chemicals should never be composited or mixed.

**Restoration of Sample Locations.** Sample locations are to be restored to grade so that they do not result in a tripping hazard. Precautions should be taken to prevent introducing contaminated soil into uncontaminated soil horizons, or leaving contaminated soil exposed on an otherwise clean surface.

**Backfill Sample Holes.** Soil pits and boreholes will be backfilled after samples have been collected. For shallow pits and boreholes where only one soil horizon is involved, it may be allowable to backfill with the material from the pit or hole. This is to be determined by the Program Manager and specified in the FSP.

If backfilling with removed material is not authorized by the FSP, or where more than one soil horizon was involved, the pit or bore hole is to be backfilled with clean soil or sand. The fill material should be added in layers no more than 6" thick. Each layer should be compacted before more soil is added. This procedure will minimize subsequent settling.

**Grouting Bore Holes.** Boreholes that penetrate a confining layer (silt, clay or rock that acts as the base of an aquifer) must be grouted to prevent migration of contaminated water between aquifers. Grouting consists of filling the borehole with concrete or bentonite slurry as specified by the Program Manager in the FSP. Details of the grouting (depth of bore hole, depth to confining layer, mix ratio of the grout and amount used) should be recorded in the Field Logbook for each borehole.

**Decontamination of Sampling Equipment.** It is generally not possible to have a separate set of pre-cleaned stainless steel sampling equipment for each sample if significant numbers of samples are to be collected. Sampling equipment must be decontaminated before being used to prevent

contaminants from being carried over from one sample to the next. If sampling equipment must be reused, it must be decontaminated prior to sampling and between each sample location.

All field decontamination must take place on a decontamination pad lined with plastic. Solvent rinse liquids must be collected in dedicated containers.

Cleaning and decontamination procedures for equipment used to collect soil samples for analysis for organic chemicals are as follows. Decontamination must be carried out over separate containers to separate used water and solvents. All liquid wastes from equipment decontamination procedures shall be collected in appropriate DOT approved compatible containers for storage and possible disposal as hazardous waste.

1. Remove heavy soil deposits with high-pressure water or steam.
2. Wash equipment with water and laboratory grade glassware detergent.
3. Rinse generously with tap water.
4. Rinse with distilled water.
5. Rinse with acetone, hexane or biodegradable organic cleaner. At least once a day, collect samples of the cleaner and water that have been used to rinse the equipment for submission to the laboratory as an equipment decontamination blank.
6. Air dry.
7. Wrap trowels and other small sampling tools in aluminum foil if they are not used immediately after being decontaminated.
8. Information concerning decontamination methodology, date, time, and personnel should be recorded in the Field Logbook/Field Notes.

The cleaning procedures for field sampling equipment used to collect soil samples for metals analysis are as follows. Decontamination must be carried out over a container to catch used water and solvents. All liquid wastes from equipment decontamination procedures shall be collected in DOT approved compatible containers for storage and possible disposal as hazardous waste. Add one half cup of lime to each drum to neutralize the nitric acid.

1. Remove heavy soil deposits with high-pressure water or steam.
2. Wash equipment with water and laboratory grade glassware detergent.
3. Rinse generously with tap water.
4. Rinse with distilled or deionized water.
5. For low-level contamination or where equipment decontamination blanks demonstrate metals contamination, rinse stainless steel equipment with 10% nitric acid (trace metal or higher grade HNO<sub>3</sub> diluted with distilled or deionized water). NOTE: Personnel protective equipment recommended for handling nitric acid includes nitrile rubber gloves, boot covers, rubber apron or coated Tyvek® coveralls, and eye protection such as face shields or goggles.
6. Rinse with distilled or deionized water. NOTE: At least once each day, collect the rinse water as an equipment decontamination blank.
7. Air dry.
8. Wrap the sampling equipment with aluminum foil unless it will be used immediately.
9. Information concerning decontamination methodology, date, time, and personnel should be recorded in the Field Logbook/Field Notes.

The following procedures should be used to decontaminate field-sampling equipment that will be used to collect a soil sample to be analyzed for both metal and organic chemicals. Aqueous and organic liquid wastes from equipment decontamination procedures shall be collected in DOT approved compatible containers for storage and possible disposal as hazardous waste. Add one half cup of lime to each aqueous waste drum to neutralize the nitric acid.

1. Remove heavy soil deposits with high-pressure water or steam.
2. Wash equipment with water and laboratory grade glassware detergent.
3. Rinse generously with tap water.
4. Rinse with distilled water.
5. For low level contaminants or if equipment decontamination blanks are contaminated, rinse with acetone, hexane or biodegradable organic cleaner. NOTE: the Program Manager must approve all substitutes. At least once each day collect samples of the solvent and water as an equipment decontamination blank.
6. For low level metal contaminants or if equipment decontamination blanks are contaminated, rinse stainless steel equipment with 10% nitric acid (trace metal or higher grade HNO<sub>3</sub> diluted with distilled or deionized water). NOTE: At least once a day, collect the rinse water as an equipment decontamination blank.
7. Rinse with distilled or deionized water.
8. Air dry.
9. Wrap sampling equipment with aluminum foil unless the equipment will be used immediately.
10. Information concerning decontamination methodology, date, time, and personnel should be recorded in the Field Logbook/Field Notes.

**Preparation of Equipment Decontamination Blanks.** Equipment decontamination blanks provide a check on the cleanliness of sampling equipment and the purity of the water or solvent used for the final rinse(s). At least one equipment decontamination blank should be submitted each day for each type of rinse solvent (water, acetone, etc.) that is used. The FSP should specify the size and material of each sample bottle required for equipment decontamination blanks, and should also specify any required preservatives for these liquid samples.

**Waste Material Storage and Disposal.** All material generated during soil sampling projects must be stored as hazardous waste until disposal decisions are made based on generator knowledge or test results. This includes soil cuttings, equipment decontamination wastes, and used disposable personnel protective equipment.

**Soil Cuttings.** Soil cuttings from bore holes and test pits may be classified as hazardous waste and should therefore be containerized and stored in accordance with EPA and facility requirements. Soil cuttings must not be used to fill the boreholes or test pits unless specifically authorized by the FSP or regulatory authority. Soil cutting should be placed on plastic sheets when generated. The soil should be stored in metal drums that are marked to indicate the source of the contents. The plastic sheets should be disposed with the used personal protective equipment.

**Used Disposable Personal Protective Equipment.** All disposable solid contaminated equipment (plastic sheets, screens, coveralls, boot covers, gloves, etc.) should be placed in plastic bags for

temporary storage and sealed in metal barrels for final storage, transport and disposal based on generator knowledge or test results.

**Soil Sampling Procedures.** The procedures described here generally apply to any type of soil sampling. Departures from procedures contained in the FSP must be documented and justified.

**Preparation.** Thorough preparation is the key to a successful field-sampling program. Necessary steps include:

- Review the FSP and safety plan or HASP (as appropriate to the scope of the project) to identify special equipment and procedures.
- Coordinate access to the sampling location with facility management, including facility security, industrial hygiene, respirator program, and confined space program personnel as relevant to the planned work.
- Coordinate with the facility to ensure the availability of emergency response personnel if needed and to ensure the proper disposal of hazardous wastes generated during sampling. Establish communication requirements and procure communication equipment required to ensure access to emergency response services.
- Coordinate with the laboratory to ensure that someone will be available to receive the samples when they are delivered, and to ensure that the laboratory can meet the required holding time requirements given the prior commitments of the lab to other programs.
- Obtain the required equipment.
- Inspect the site to ensure that present conditions are the same as indicated in the FSP and that all designated sample locations are accessible.
- Survey site as necessary to locate defined sampling points.
- Set decontamination facilities for personnel and equipment.
- Set up and mark required Exclusion Zone(s) and Contamination Reduction Zone(s) and establish required site security when necessary.

**Sample Collection.** Field sampling personnel should be familiar with all of the technical issues and documentation requirements. All samples shall be collected using the procedures specified in the FSP. The following sampling procedures can be used when there are no special conditions present or special requirements specified by the FSP.

**Surface Samples.** The simplest and most direct method of collecting surface soil samples for subsequent analysis is with a spade and scoop. Very accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sampler. A flat, pointed trowel can be used to cut a block of soil two inches deep. Chrome-plated tools, common with garden implements such as potting trowels, should be avoided.

**Sampling Procedure:**

1. Clear the area to be sampled of any surface debris (twigs, rocks, litter). Cut grass down to the level of the soil and remove.
2. Define a sample area such that a two-inch deep soil sample will provide enough material for all required sample containers.
3. Dig a trench at least 2 inches deep around the sample block using a clean spade.
4. Cut the sample loose from the ground using a pre-cleaned stainless-steel trowel. Place the

- soil in a clean stainless-steel bowl.
5. Remove all roots and other debris, rocks and pebbles. Describe the amount and kind of material that is removed in the Field Logbook.
  6. If instructed by the FSP, sieve the sample. Crush the soil sample and screen the soil through a 2-mm mesh stainless steel (for organic analysis) or Teflon® (for metals analysis) sieve. Note in the Field Logbook the amount, size and type of material that does not pass the sieve and is discarded. If the soil is too wet and cohesive to pass through the sieve, note in the Field Logbook that the required sieving was not done and enter this notation of the Field Sampling Form. Inform the Program Manager that the sample was not sieveable.
  7. Fill the required sample containers.
  8. Label the sample containers.
  9. Complete Field Logbook documentation.
  10. Pack samples for shipping and complete COC Record for each shipping container.
  11. Deliver samples to the laboratory.

**Subsurface Samples.** Hand-held augers and thin-walled tube samplers can be used separately or in combination. Where rocky soils do not limit the use of tube samplers, a combination of augers to remove soil material to the depth of interest and tube samplers for actual sample collection allows the most precise control of sample collection. Depths to 2 meters can be readily sampled and up to 6 meters where conditions are favorable. A drill rig should be used to gain access where deeper samples are required or where soil conditions are not favorable for the use of augers. Tables 5-1 and 5-2 summarize the advantages and disadvantages of different types of augers and tube samplers for sampling under different soil conditions.

Specific sampling tools may require slightly different handling methods. For example, if sampling devices and drill rod extensions do not have quick connect fittings, crescent or pipe wrenches may be required to change equipment configurations. The procedure described below is for hand-held equipment. Procedures for power-driven augers or tube samplers are essentially the same.

1. Attach the auger bit to a drill rod extension and attach the "T" handle to the drill rod.
2. Clear the area to be sampled of any surface debris (twigs, rocks, litter). It may be advisable to remove the first 8 to 15 cm of surface soil for an area approximately 15 cm in radius around the drilling location to prevent near-surface soil particles from falling down the hole.
3. Begin drilling, periodically removing accumulated soils. This prevents accidentally brushing loose material back down the borehole when removing the auger or adding drill rods.
4. After reaching the desired depth, slowly and carefully remove auger from boring.

For thin-walled tube samplers:

1. Remove auger tip from drill rods and replace with a pre-cleaned thin-walled tube sampler. Install proper cutting tip. (An optional step is to first replace the auger tip with a planer auger to cleanout and flatten the bottom of the hole before using the thin-walled tube sampler).
2. Carefully lower corer down bore hole. Gradually force corer into soil. Care should be

taken to avoid scraping the borehole sides. Hammering of the drill rods to facilitate coring should be avoided, as the vibrations may cause the bore walls to collapse.

3. For samples to be analyzed for volatile organics: if a sufficient number of tube samplers are available, seal the ends of the sampler with aluminum foil, mark the top and bottom ends of the sample, put a sample container label on the sampling tube, and put the tube into a re-sealable clear plastic food bag. Submit the sampling tube to the laboratory.
4. For samples collected for analysis for parameters other than volatile organics or if a sufficient number of tube samplers are not available or if the FSP specifies that the samples are to be submitted to the laboratory in glass containers, remove corer and unscrew drill rods. Remove core from device (this may require removing cutting tip) and discard top of core (approximately 2.5 cm), to eliminate soil that may have fallen down from higher horizons.

For split-spoon samplers:

1. Assemble the split spoon sampler by aligning both sides of the barrel and then screw the drive shoe with retainer onto the bottom and the heavier headpiece onto the top. Place the sampler over the borehole in a perpendicular position.
2. Drive the tube utilizing a drop hammer, sledgehammer or well rig if available. Do not drive past the bottom of the headpiece as this will result in compression of the sample. Record the number of blows required to advance the sampler each 6-inch increment.
3. Withdraw the sampler and open by unscrewing the drive shoe and head and splitting barrel. Discard the top two or three inches of soil. If Split samples are desired, a decontaminated stainless-steel knife should be used to divide the tube contents in half longitudinally.

**Volatile Organic Chemicals.** Tube samplers are preferred when collecting for volatiles. Soil samples should be taken from auger cuttings only if soil conditions make collection of undisturbed cores impossible. Soil recovery probes with dedicated or reusable liners, will minimize contact of the sample with the atmosphere.

1. Record in the Field Logbook/Field Notes the depth from the surface to the top and the bottom of the core.
2. Fill sample containers as follows:
  - It is preferable to submit the soil samples in the sampling tubes.
  - Where samples must be submitted to the laboratory in glass containers, use the first adequate soil core to fill a 120 mL septum vial or in a glass wide mouth jar with a Teflon®-lined cap, maintaining and handling the sample in as undisturbed a state as possible. Do not mix or sieve soil samples. Ensure the sample containers are filled to the top to minimize volatile loss. Secure the cap tightly.
  - If Field Duplicate samples are required, it is preferable to collect separate samples from adjacent locations. If this is not possible, split the core vertically before filling the sample jars.
3. Examine the hole from which the sample was taken with an organic vapor instrument after each sample increment. Record any instrument readings.
4. Label and tag sample containers, and record appropriate data in Field Logbook/Field Notes (depth, location, etc.).
5. Place glass sample containers in sealable plastic bags, if required, and place containers in

iced shipping container. Samples should be cooled to 4°C as soon as possible.

6. Complete COC Records and deliver the samples to the laboratory as soon as possible to minimize sample holding time (see Appendix H for maximum holding times for various constituents).
7. Follow specified decontamination and disposal procedures.

**Other Parameters.** For each sample, approximately one liter of soil will be placed into a clean stainless-steel bowl. This soil will be homogenized by mixing with a clean trowel. Sample container jars will be filled with portions of this soil as required for Test samples, Field Duplicate samples and Matrix Spike/Matrix Spike Duplicate samples.

1. Record in the Field Logbook the depth from the surface to the top and the bottom of the core.
2. Describe the soil color, type, etc. in the Field Logbook. If the sample consists of two different types of soil (sand and clay, different color layers, etc.) split the core as required so that only one soil type is present in the sample; record the depth of the change of soil types in the Field Logbook/Field Notes.
3. Mix the sample in a stainless steel, aluminum (not suitable when testing for aluminum), or glass mixing container using the appropriate tool (stainless steel spoon, trowel, or pestle).
4. If required by the FSP, sieve the soils through a mesh screen of the specified size. Use a pre-cleaned stainless-steel screen for semi-volatiles, or Teflon® lined screen for metals (some metals in stainless steel could contaminate the sample).
5. Divide the screened soil into quarters, and fill each sample container with portions of soil from each quarter. Separate sample containers may be required for semi-volatiles, metals, Duplicate samples, Field Duplicate samples, Split samples, and Matrix Spike/Matrix Spike Duplicate samples.
6. Secure the cap tightly. The chemical preservation of soils is generally not required.
7. Label sample containers, and record appropriate data in the Field Logbook/Field Notes (depth, location, other observations).
8. Place glass sample containers in sealable plastic bags. Place containers in an iced shipping container. Samples should be cooled to 4° C as soon as possible.
9. Complete COC Records and ship the samples to the laboratory as soon as possible to minimize sample holding time (see Appendix H for maximum holding times for various constituents). Schedule arrival time at the analytical laboratory to give as much holding time as possible for scheduling of sample analyses.
10. Follow required decontamination and disposal procedures.

#### **IV. Surface Water Sampling**

This chapter provides procedures for surface water sampling. Surface water samples are collected and analyzed to characterize surface water quality and/or determine pollutant concentrations. The role of sampling personnel is critical to the water sampling program relative to:

- Collection of visual and physical field data.
- Adherence to sampling and preservation procedures.
- Maintenance of the Chain-of-Custody (COC) Record.
- Integrity of the program.
- Sampling personnel must be properly trained in sample collection.

**Scope.** This chapter provides guidance for:

- Surface water sampling.
- Identifying and evaluating the potential impact of a discharge on a body of water.
- Determining the type and extent of contamination in nearby surface water, which may adversely affect the human environment or drinking water supplies.
- Evaluating the impact of the discharge on sensitive environments (e.g., habitats, wildlife).
- Determining contaminant concentration upstream and downstream of the discharge.

**Sampling Procedures.** All monitoring instruments and personnel protective equipment (PPE) should be checked thoroughly. Prior to sampling at each location, the water monitoring equipment probes should be rinsed thoroughly with ASTM Type II or better quality water.

Sampling of surface water includes the collection of samples from lakes, ponds, streams, and rivers. It may be necessary to collect liquid samples from lagoons, surface impoundment, sewers, and leachate seeps. Actual sampling situations encountered in the field vary to best fit each situation. The most important goal of surface water sampling is to collect the sample representative of all the horizons or phases present in the liquid. Approach each sample location from downstream, being careful to minimize disturbing any sediments, which might become entrapped in the sample.

Specific regulations for grab and composite sampling are defined differently on the federal and state level. A Grab Sample is an individual sample of at least 100 milliliters collected at a randomly selected time over a period of not exceeding 15 minutes. A composite sample is a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of facilities over a 24-hour period. The composite must be flow proportional; either the time interval between each aliquot or the volume of each aliquot must be proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot. Aliquots may be collected manually or automatically. For GC/MS Volatile Organic Analysis (VOA), aliquots must be combined in the laboratory immediately before analysis. Four (4) rather than eight aliquots or grab samples should be collected for VOA. These four samples should be collected during actual hours of discharge over a 24-hour period and need not be flow proportioned. Only one analysis is required. Since state and local regulations must be at least as stringent as the federal regulations, many states and localities possess more stringent regulations. The State specifies that grab samples are individual discrete or single influent or effluent portion of at least 100 mL collected at a time representative of the discharge.

Composite samples are defined as being one of the following:

- An influent or effluent portion collected continuously over a specified period of time at a rate proportional to the flow.
- A combination of not less than 8 influent or effluent grab samples collected at regular (equal) intervals over a specified period of time, properly preserved, and composited by increasing the volume of each aliquot in proportion to flow. If continuous flow measurement is not used to composite in proportion to flow, the following method will be used: take an instantaneous flow measurement each time a grab sample is collected. At the



end of the sampling period, sum the instantaneous flow measurements to obtain a total flow to determine the partial amount (percentage) of each grab sample to be combined to obtain the composite sample.

- A combination of not less than 8 influent or effluent grab samples of equal volume but at variable time intervals that are inversely proportional to the volume of the flow. That is, the time interval between aliquots is reduced as the volume of flow increases.
- A combination of not less than 8 influent or effluent grab samples of constant (equal) volume collected at regular (equal) time intervals over a specified period of time, while being properly preserved.
- Continuous flow or the sum of instantaneous flows measured and averaged for the specified compositing time period shall be used with composite sample results to calculate quantity. It is therefore imperative to check state and local regulations before conducting surface water sampling for regulatory compliance.

### **Operation of Sample Collection Devices.** (Items selected as needed per specific job)

**Laboratory Cleaned Sample Bottle.** The most widely used method for collecting surface water samples is simple immersion of a laboratory cleaned sample bottle or certified pre-cleaned bottle. Using the sample bottle for actual sampling eliminates the need for other equipment. This method also reduces the risk of introducing other variables into the sampling event.

#### **Advantages:**

- Easy operation
- No field decontamination necessary
- No other equipment needed

#### **Disadvantages:**

- Outside of bottle comes in contact with sample
- Labeling may be difficult
- Is not possible when bottles are pre-preserved
- Sample collected from top of surface water depending on bottle filling technique

#### **Sample Bottle Use Procedures:**

1. Make sure bottles are intact, with proper fitting lids. Collect samples for volatile organics analysis first to prevent loss of volatiles due to disturbance of the water.
2. Immerse bottle into surface water and allow water to run slowly into bottle until full to zero headspace.
3. Follow preservation procedures.
4. Transport sample to laboratory after proper Quality Assurance/Quality Control (QA/QC) actions (See Section 7.6).7.5.1.2

**Pond Sampler.** The pond sampler is used to collect liquid waste samples from disposal ponds, pits, lagoons, and similar reservoirs (See Figure 7-1). It consists of an adjustable clamp attached to the end of a two- or three-piece telescoping aluminum tube serving as the handle. The clamp is used to secure a sampling beaker. Though commercially

available, the sampler is easily and inexpensively fabricated. Tubes can be readily purchased from most hardware or swimming pool supply stores. The adjustable clamp and sampling beaker (stainless steel or Polytetrafluoroethylene) can be obtained from most laboratory supply houses.

Advantages:

- Relatively inexpensive to make
- Can sample depths or distances up to 3.5m

Disadvantages:

- Difficult to obtain representative samples in stratified liquids
- Difficult to decontaminate when viscous liquids are encountered

Pond Sampler Use Procedures:

1. Assemble the sampler. Make sure that the sampling beaker or sample bottle and the bolts and nuts securing the clamp to the pole are tightened properly.
2. Slowly submerge the beaker with minimal surface disturbance.
3. Retrieve the pond sampler from the surface water with minimal disturbance.
4. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the dipper/device edge.
5. Empty the sampler slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence. When applicable, always fill VOA vials first, to zero headspace.
6. Repeat steps 1-5 until a sufficient volume is drawn.
7. Follow preservation procedures.
8. Transport samples to the laboratory after proper QA/QC actions.
9. Dismantle the sampler and store in plastic bags for subsequent decontamination.

**Weighted Bottle Sampler.** The weighted bottle sampler can be used to sample liquids in storage tanks, wells, sumps, or other reservoirs that cannot be adequately sampled with another device. Sampler consists of a bottle, usually glass, a weight sinker, a bottle stopper, and a line used to open the bottle and to lower and raise the sampler during sampling. There are a few variations of this sampler. However, the preferred one is that recommended in ASTM procedures, which uses a stainless steel or carbon steel bottle basket that also serves as the weight sinker. The weighted bottle sampler can either be fabricated or purchased.

Advantages:

- Sampler remains unopened until at sampling depth

Disadvantages:

- Cannot be used to collect liquids that are incompatible with the weight sinker, line or actual collection bottle
- Laboratory supplied bottle may not fit into sampler, thus requiring additional equipment (constructed of PTFE or stainless steel)
- Some mixing of sample may occur when retrieving the sampler from depth

### **Weighted Bottle Sampler Use Procedures:**

1. Assemble the sampler.
2. Lower the sampling device to the pre-determined depth.
3. When the sampler is at the required depth, pull out the bottle stopper with a jerk of the sampler line and allow the bottle to fill completely. (This is usually evidenced by the cessation of air bubbles.)
4. Retrieve sampler.
5. Transfer sample into laboratory cleaned sample bottles (if applicable, fill VOA vials first).
6. Follow preservation procedures.
7. Transport sample to laboratory after proper QA/QC actions.

**Wheaton Dip Sampler.** The Wheaton Dip sampler is useful for collecting samples in shallow areas. Sampler consists of a glass bottle mounted on a metal pole of fixed length. Attached to the bottle's screw cap is a suction cup mounted on another metal pole. When the sampler is lowered to the desired sampling depth, the bottle cap is released by turning the metal pole attached to the suction cup. When the bottle is full (usually evidenced by the cessation of air bubbles), the cap is screwed back on to seal the sampling container and the bottle is retrieved.

#### **Advantages:**

- Sample bottle is not opened until specified sampling depth is obtained
- Sampler can be closed after drawing sample to ensure sample integrity
- Ease of operation

#### **Disadvantages:**

- Depth of sampling is limited by length of poles
- Exterior of sample bottle (to be sent to lab) may come in contact with sample

### **Wheaton Dip Sampler Use Procedures:**

1. Assemble the sampler in accordance with the manufacturers' instruction.
2. Operate the sampler several times to ensure proper adjustment, tightness of the cap, etc. Collect samples for volatile organics analysis first to prevent loss of volatiles due to disturbance of the water.
3. Submerge the sampler into liquid to be sampled.
4. When desired depth is reached, open sample bottle.
5. Once sample is collected, close sample bottle.
6. Retrieve sampler.
7. Follow preservation procedures.
8. Transport sample to laboratory after proper Quality Assurance/Quality Control (QA/QC) actions

**Kemmerer Depth Sampler.** The Kemmerer depth sampler is used to collect liquid waste samples in lakes, storage tanks, tank trailers, vacuum trucks, or elsewhere, where collection depth prevents use of other sampling devices. It consists of an open tube with two sealing

end pieces or stoppers. The end pieces can be withdrawn from the tube and set in the open position. These remain in this position until the sampler is at the required sampling depth and then a weighted messenger is sent down the line or cable, releasing the end pieces and trapping the sample within the tube.

**Advantages:**

- Ability to sample at various depths
- Ability to sample at great depths

**Disadvantages:**

- Sampling tube is exposed to material while traveling down to sampling depth

If the lagoon or surface impoundment contains known or suspected hazardous substances, the need to collect samples versus the potential risk to sampling personnel, must be considered. If sampling is determined to be necessary, appropriate protective measures (use of a flat-bottomed boat for increased stability, life preservers, back-up team, etc.) must be implemented.

**Kemmerer Depth Sampler Use Procedures:**

1. Set the sampler so that the sealing end pieces are pulled away from the sampling tube, allowing the substance to pass through the tube.
2. Lower the pre-set sampling device to the predetermined depth.
3. When the sample is at the required depth, send down the messenger, closing the sampling device.
4. Retrieve sampler.
5. Pour sample into laboratory cleaned sample bottles (if applicable, fill VOA vials first).
6. Follow preservation procedures.
7. Transport sample to laboratory after proper QA/QC actions (See Section 7.6).7.5.1.6

**PACS Grab Sampler.** The PACS Grab sampler can be used to collect water and liquid waste samples from lagoons, ponds, or containers with restricted access. For water and liquid waste sampling, the narrow neck model is useful. The sampler consists of a 1000 mL bottle screwed onto the end of a six-foot long handle. The control valve is operated from the top of the handle once the sampler is at desired depth.

**Advantages:**

- Allows discrete samples to be taken at depth.

**Disadvantages:**

- Depth of sampling is limited by length of pole.
- Difficult to decontaminate.

**PACS Grab Sampler Use Procedures:**

1. Assemble the sampler in accordance with the manufacturers' instruction.
2. Operate the sampler several times to ensure proper adjustment, tightness of the cap,

- etc.
3. Submerge sampler into liquid to be sampled.
  4. When desired depth is reached, open sampler bottle.
  5. Once sample is collected, close sample bottle.
  6. Retrieve sampler.
  7. Pour sample into laboratory cleaned sample bottles (if applicable, fill VOA vials first).
  8. Follow preservation procedures.
  9. Transport sample to the laboratory after proper QA/QC actions.

## **Collection Procedures.**

### **Sampling for Volatile Organic Chemicals (VOCs):**

1. Remove the cap from a 40-mL septum (Teflon®-faced silicon rubber) vial. Avoid contact with the inner surface.
2. When acid preservation of VOA is required follow steps 2 to 4. An extra VOA vial should be used to determine the minimum amount of Hydrochloric acid (HCl) required to bring the sample pH to  $< 2$ .
3. Fill the vial with sample water, then add 1:1 HCl drop by drop to VOA vial and test pH until it is  $< 2$ . Record the amount of HCl added.
4. Add the established amount of HCl to each remaining VOA vial and screw vial tightly to achieve zero headspace.
5. Inspect the VOA vial for air bubbles. If air bubbles are present then discard the vial and start again at step 1.
6. Attach a number label and tag to the vial, seal it in a sealable bag and place it into a cooler with ice. Place sufficient ice bags in the cooler to completely surround the samples and to maintain a temperature of  $4^{\circ}\text{C}$  until the laboratory receives the samples.
7. Record all appropriate data in Field Logbook/Field Notes.7.5.2.2

### **Samples for Extractable Organic Chemicals:**

1. Remove the Teflon®-lined cap from a one liter, amber, glass bottle. Avoid contact with the inner surface of the cap.
2. Fill about 80% of the bottle with surface water. Add chemical preservatives as required by the permit or method. Record the amount, preservative and other preservation data per the FSP.
3. Replace the cap tightly, attach the sample label, and place the sample bottle in a cooler with bagged ice sufficient to cool to  $4^{\circ}\text{C}$ .
4. Fill the additional bottles by repeating steps 1 through 3.
5. Record all appropriate data in a Field Logbook/Field Notes.

### **Sampling for Metals:**

1. Fill the bottles for metals analysis to about 90% and preserve to a pH  $< 2$  with Nitric

Acid.

2. Record the amount, preservative and other preservation data per the FSP. Replace the cap tightly, attach label, and place the sample bottle in a cooler with bagged ice sufficient to cool to 4°C, if required.
3. Fill any additional bottles required for separate processing about 90%. Preserve as required by the FSP. Repeat step 2 above. (See Appendix A for guidance on various preservation methods.)
4. Record all appropriate data in Field Log Book/Field Notes.
5. Pack samples and deliver to laboratory.

#### **Sampling for Other/Additional Parameters:**

1. Remove caps from the bottles.
2. Fill the bottles per the FSP or method requirements.
3. Add appropriate preservative to the samples (see Appendix A).
4. Replace the caps tightly.
5. Attach label.
6. Place sample bottles in a cooler with enough bagged ice to cool them to 4°C, if necessary.
7. Record all appropriate data in the Field Log Book/Field Notes.

**Quality Assurance/Quality Control.** The following protocol should be used to ensure integrity and accuracy of the data collected during surface water sampling. The laboratory analysis should be performed by an appropriately certified or accredited laboratory for the method desired in a potable or non-potable water matrix. A complete Chain-of-Custody (COC) Record must accompany all samples. The Field Blanks, Trip Blanks, Field Decontamination Blanks and Field Duplicates should be collected as part of a QA plan to enable data evaluation for accuracy and integrity of surface water sampling. The field decontamination process must be followed properly to ensure QC of the field sampling. Two Field Duplicate samples and a field equipment blank sample, if necessary should be collected and analyzed. Matrix spikes and matrix spike duplicates may be performed one time per matrix to validate the method selected with the matrix being analyzed.

## **V. Groundwater Sampling (Items selected as needed per specific job)**

**PURPOSE.** This chapter provides procedures for obtaining representative samples of groundwater.

**Scope.** These procedures describe recommended methods as well as minimally acceptable methods for obtaining representative groundwater samples for organic, inorganic, residue, nutrient, bacteriological, and other general chemical analysis. Groundwater monitoring wells, homeowners' private supply wells, underground injection wells, industrial or municipal supply wells are the potential sources of these samples. This chapter includes the minimum criteria to be followed to obtain representative samples. Variations from these criteria should only be necessary when required by regulatory practices or site historical

data gathering practices. Analytical data derived from samples obtained in a way, which does not follow the documented sampling plan, should not be accepted.

**Preparation.** The equipment utilized for specific groundwater sampling events can vary greatly, depending on the following factors:

- Type of well (e.g., monitoring well, supply well)
- Depth of well
- Diameter of well casing
- Depth to water
- Contaminants likely to be encountered
- Analytes of interest
- Length of open hole (bedrock well)
- Type, slot size, and length of screen
- Expected recharge rate of well

A relatively new development in groundwater sampling technology has been the design of in-situ sampling probes, which allow collection of groundwater samples without the installation of permanent wells. A hydropunch operates in conjunction with conventional cone penetrometer rigs. This category also includes a variety of driven probes, which can be retrieved after sampling, or left in place as permanent sampling points. These devices often are used during the preliminary site characterization stage, or where only a shallow water table is to be sampled. The portable in situ samplers can be valuable in deciding the best location of permanent monitoring wells.

Equipment to be utilized for groundwater sampling generally fall into two categories: (a) that used to evacuate water in the well casing, and (b) that used to collect a discrete sample for analysis. However, in some instances, the device used for evacuation may be the same as that used for sample collection.

Types of equipment available for groundwater sample collection include the following:

- Bottom fill bailer (single or double check valve)
- Peristaltic pump
- Bladder pump
- Packer pump
- Inertial pump
- Syringe sampler
- Disposable equipment

Site-specific sampling conditions will dictate the optimal sampling equipment. Generally, sampling equipment, which minimizes agitation, air content, gas exchange, and depressurization, is preferred.

Sampling devices must be cleaned, preferably by the laboratory performing the analysis, utilizing recommended equipment cleaning procedures. The sampling device should be

dedicated to the individual well location for one day of sampling and wrapped inappropriately cleaned aluminum foil or paper. The sampling device should remain wrapped in this manner and stored in an area where contamination will not occur prior to its use. Down hole devices should not be transported in a vehicle storing gasoline or gasoline powered equipment or other volatile contaminants such as degreasers, cleaning solvents, and other volatile organics.

Types of equipment available for well evacuation include:

- Suction lift pump/Centrifugal pump
- Portable submersible pump
- Peristaltic pump
- Air lift pump
- Bladder pump (Gas Squeeze pump)
- Packer pump
- Gas piston pump
- Gas displacement pump
- Inertial pump

In addition to evacuation and sampling devices, other equipment necessary for a sampling event is included at the end of the chapter.

**Sampling Monitoring Wells.** Evacuation of the water column in a monitor well is required prior to sample collection. This removes the standing water column and induces groundwater flow from the surrounding formation into the well. One exception to this standard procedure is if the objective of the sampling event is to determine the presence of dense or light phase non-aqueous phase liquids or stagnant water.

Access to monitor wells may be difficult and the wells themselves hard to locate in the field. Obtain information on the location, access, permission, etc. before visiting the site. Monitor wells usually have a friction cap or screw cap, and should be locked. Therefore, keys to unlock the wells and tools for removing caps are often necessary.

If several monitor wells must be sampled, proper identification of each well is essential. The well permit number or any other assigned number should be known. If numbers are not assigned, a precise field description of each well location is essential to avoid confusion of sample results. When several monitor wells of known or suspected contamination will be sampled, the least contaminated well should be sampled first, and thereafter, sampled in ascending order of contamination. Well head readings using photo or flame ionization detectors (PIDs or FIDs) can aid in determining the order in which wells should be sampled by providing information on levels of contamination.

**Water Level Measurements.** Various measuring devices can determine well depths and water table depths. A commonly used device is the electronic water level indicator. These units have a tape divided into incremental measurements of 0.01feet, and two conductors forming a probe. When groundwater is encountered, the circuit is complete causing a signal



(e.g., light, meter, or audible buzzer) to activate. The depth to groundwater is then measured from this point to the reference mark on the inner casing of the monitor well.

Water indicator paste/gel acts as a colorimetric test method when the paste comes in contact with water. It is applied to the bottom few feet of a measuring tape or rod. The tape or rod is then lowered into the well and remains for less than one minute. The wetted tape/stick gives the depth to the top of the liquid and the color change section indicates the depth to water. This procedure is good to  $\pm 0.02$  feet.

Wells with a non-aqueous phase liquid layer on the surface pose a problem when measuring the level of groundwater.

A more accurate and easier device to use is the interface probe. This probe uses an optical sensor to determine if the probe is in liquid and a conductivity sensor to determine if the probe is in water. When using this probe, each phase can be measured independently. The hydrocarbon-air interface reading should be taken first, going from the air to the hydrocarbon surface to prevent dripping hydrocarbons from enhancing the thickness reading. The hydrocarbon-water reading is best taken going up from the water to the hydrocarbon layer to prevent hydrocarbons from coating the conductivity probe which would also enhance the hydrocarbon thickness reading. This is best done by lowering the probe quickly through the hydrocarbon layer, minimizing the contact time of the probe in the hydrocarbon phase.

The key to accurate readings by any method is proper collection of measurements from the same survey point, preferably by the same person and tape to avoid any procedural differences. Readings should be made three to four times. All well measurements should be performed the same day and prior to evacuation of any wells which may influence groundwater elevations in the area of investigation.

Water level elevation equipment should be properly decontaminated to avoid cross-contamination. In certain circumstances, sensitive components of an interface probe may be compromised by the use of standard decontamination solvents. Alternative solvents may be used upon approval of the customer.

Once a well has been located and properly identified, the field measurements listed below should be noted in the Field Logbook/Field Notes. Be certain that the proper well is being selected. The misidentification of a sampling point in the field will result in false data that may affect important decisions.

### **Physical Measurements:**

- Diameter of protective outer casing.
- Security and integrity of the well.
- Well number and well permit number.
- Inner diameter and construction material of inner well casing.
- Total depth of well from the top of the inner casing or surveyor's mark, if present

(measured to 0.01 foot, or as appropriate).

- Depth from casing top to water (recorded to 0.01 foot, or as appropriate).
- Thickness of floating product, if any.
- Calculation of the linear feet of water in well by subtracting the depth to water from the total depth of well.

NOTE: Water levels should be obtained from all wells prior to sampling the first well, thus avoiding interference problems. This also allows one to determine if any well is damaged or may pose a problem for sampling.

The capacity of common casing diameters are as follows:

The amount of water within the well casing is calculated by multiplying the linear feet of water by the volume per foot for the proper diameter casing.

Casing Diameter (in inches)	Gallons/Linear foot
2	0.1632
4	0.6528
6	1.4688
8	2.6112
10	4.0800
12	5.8752

Example:

Total depth of well casing: 100 ft.  
Depth to water: -20 ft.  
Linear feet of water: 80 ft.  
2 inch casing: x 0.1632 gallons/linear foot  
Amount of water in casing: 13 gallons

The amount of standing water in the casing should then be multiplied by three (3) to determine the minimum volume to be purged from the well prior to sample collection. The total volume purged should not exceed five (5) times the amount of standing water in the well.

Alternately, one can use this formula to determine the gallons in any diameter well:

Number of gallons =  $5.8752 \times C^2 \times H$   
where: C = casing diameter in feet and  
H = height of water column in feet

**Physio-Chemical Parameters.** In addition to the physical measurements taken above and other information that may identify the well, information including specific conductance, pH, temperature, and turbidity may be recorded during well evacuation and before and after sample collection.

## **Well Purging or Evacuation Procedures.**

Obtaining representative groundwater samples from monitor wells is required for groundwater pollution investigations. The length of time (stabilization period) for groundwater conditions to become representative at and near the monitor well will vary, depending on site hydro-geologic conditions, drilling methods, and monitoring well development methods. Groundwater flow velocities are typically less than one foot per day and natural flushing rates are generally slow. If a monitor well is drilled, installed, and developed so that a 14-foot radius around the well was left as unrepresentative, and a natural groundwater flow rate was one foot per day, it would take 14 days for representative groundwater to reach the well. Sampling a monitor well immediately after development will generally not be representative of the static groundwater quality conditions at the horizontal and vertical location of the monitor well's intake interval. Therefore, all newly constructed and developed monitor wells must be allowed to stabilize and equalize with the aquifer for a minimum of two weeks prior to sampling.

Monitoring well development is required to:

- Remove drilling fluid residues remaining in the borehole or surrounding aquifer.
- Remove imported drilling water lost to the aquifer during the drilling procedure.
- Remove groundwater in the borehole or surrounding aquifer, which has been affected by the drilling process or drilling or well construction materials.
- Restore the hydraulic properties of the formation immediately surrounding the monitor well.
- Allow groundwater to freely flow to the monitor well.

Installation and construction of monitor wells may, by themselves, alter the quality of groundwater in the surrounding aquifer. Site-specific subsurface conditions should be used to determine the appropriate well development techniques. Many times it is a combination of the techniques mentioned below which will be necessary to produce a properly developed monitor well. Also discussed are certain outcomes inherent to well development techniques, which can be mitigated by following the 14-day stabilization period:

- High velocity air jetting, air lift, or surge block development methods may introduce air into the aquifer surrounding the monitor well. This air has the potential for altering groundwater quality, particularly for VOCs.
- Over-pumping of a monitor well for development may draw groundwater to the monitor well from considerable distances. This water may not be of the quality representative of the horizontal and vertical location required by the monitor well, especially so for isotropic and/or bedrock aquifers.
- Organic drilling fluid residues and inorganic residues of bentonite have been found to remain in and near wells, even after proper development. These residues have been found to affect water quality, including chemical oxygen demand of groundwater samples, for up to 100 days after completion of development.
- Non-aqueous phase liquid contaminants may be pushed away or drawn to a monitoring well location during development, depending on the development method, resulting in non-representative groundwater samples being obtained.
- Suspended sediment in groundwater of a monitor well which is not completely

removed by development and not allowed to settle out may affect the quality of groundwater samples obtained from the well. Therefore, a period of time is required to allow a sand/gravel pack to settle around a monitor well screen.

Groundwater pollution investigations often base expensive site-related investigatory and remedial action decisions on initial (first sampling event after development) groundwater sample analyses. Therefore, before groundwater samples are collected, a complete understanding of the monitor well's design, construction, and hydro-geological setting is necessary in order to properly interpret any analytical results.

The well evacuation procedure allows representative groundwater to enter the well. Air sensitive parameters such as dissolved oxygen, pH, temperature, and specific conductance are best analyzed with the use of a flow-through cell, eliminating sample exposure and influence by air. However, monitoring of these air sensitive parameters for well stability may not be a reliable indicator as to when to collect a representative sample. Therefore, if a constant monitor is not used during well purging, a sample should be collected within two hours after three to five volumes of water have been purged from the well. The volume evacuated and the evacuation rate should be recorded after each purge and sample event, and repeated for subsequent sampling events. This procedure should provide consistent samples from each well.

Every reasonable effort must be made to keep pumping rates low to avoid over-pumping or pumping the well to dryness. To accomplish this, pumped rates may be adjusted and pumping times extended in order to remove the required three to five well volumes. In no case should the time of sampling exceed 24 hours after purging. To avoid altering the hydro-geological properties of the aquifer in the vicinity of the well, the evacuation rate of a monitor well should not exceed that of the development of the well.

In some situations evacuation of three to five volumes may be impractical in wells with slow recoveries. If a well has been pumped to near dryness at a rate less than 0.5 gallons per minute, the well should be allowed to recover to a volume sufficient for sampling. If necessary, sampling within the two-hour limit may be exceeded to allow the well to recover sufficiently for sampling. If a well has been pumped to dryness, a minimum of 20 minutes waiting time is required prior to sampling or follow regulatory requirements.

There are several reasons why the well should not be pumped below the level at which the groundwater enters the well. In certain formations, water entering the well at the top of the screened area will fall into the pumped dry well. This cascading effect may aerate the groundwater to be sampled, thus resulting in the loss of volatile organic chemicals (VOCs). Secondly, pumping to dryness can cause dehydration of the saturated zone; again VOCs may be lost due to aeration within this zone. Additionally, other contaminants may absorb to formation materials where a dehydrated zone is created. As a result, samples collected upon the charge of a well pumped to dryness may not correctly characterize groundwater quality due to one or more of the above effects.

There are certain circumstances where a well should not be screened across the water table, such as the following:

- Wells screened for collection of depth discrete groundwater samples.
- Bedrock wells with several water-bearing zones.
- Very slow recovering wells.

In these circumstances, the well must not be pumped as to allow the groundwater level to fall below the zone where water enters the well. If a well is evacuated to dryness or below the well screen, sample records should document the event since sample integrity may be severely altered.

**Evacuation Methods.** Many methods may be used for well evacuation. Not all are acceptable under all conditions. The depth to water usually dictates the selection of a method. The preferred and most commonly used methods involve the use of a centrifugal or peristaltic pump (when the depth to water is less than 25 feet) and a submersible pump (when the depth to water is greater than 25 feet).

It is important to ensure that the evacuation procedure does not cause cross-contamination from one well to the next. Therefore, the preferred method employs dedicated tubing (new dedicated linear polyethylene ASTM drinking water grade) and pumps. Since in many cases it may not be practical to dedicate a pump to a specific well, it is permissible to decontaminate this equipment between wells, if approved methods are used. Tubing should always be dedicated to each individual well.

Prior to evacuation, check the well for floating product. During evacuation, the pump intake or tubing should be kept at a maximum distance of six feet below the water level. The pump intake or tubing should be lowered as the water level decreases to maintain this distance. In instances where the total depth of standing water in the well casing is less than six feet, begin evacuation near the top of the water column and lower as stated above. Following this procedure should ensure that all static water is removed prior to sampling.

NOTE: The disposal or discharge of floating product or hydrocarbons, and the discharge of highly contaminated water may require special purge water collection and disposal procedures. Regardless of the evacuation procedure used, the evacuation rate should not exceed that of well development. This would cause a "redevelopment" of the well, resulting in a turbid sample. Cleaned equipment entering the well should not be allowed to contact the ground or any other potentially contaminated surfaces (e.g., gasoline pumps). If this should occur, the item should not be placed in the well or utilized for evacuation.

Finally, the following information should be recorded in the Field Log Book/Field Notes for each monitoring well sampled:

**Before Purging:**

- Date, time, and weather conditions
- Well number and permit number
- PID or FID reading taken from the well immediately after the cap is removed

- Check for free product, measure thickness if present
- pH, dissolved oxygen, temperature, and specific conductivity
- Total depth of well from the top of inner casing or surveyors mark if present
- Depth from the top of inner casing to the top of screen
- Depth from the top of inner casing to water
- Estimated water volume in well

**After Purging:**

- Start and end time purging
- Purge method• Purge rate(s)
- Total volume purged
- pH, dissolved oxygen, temperature, and specific conductivity

**After Sampling:**

- Start and end time for sampling
- pH, dissolved oxygen, temperature, and specific conductivity
- Sampling method

Any comments concerning field observations during the groundwater sampling event (e.g., slow recharge, turbidity, odor, sheens, PID or FID readings, etc.) should also be reported.

**Evacuation Procedure Using Suction Lift Pumps/Centrifugal Pumps**

Suction lift pumps (i.e., diaphragm and centrifugal) are pumps utilized at the ground surface with polyethylene tubing inserted into the well. They are used to evacuate the well prior to sampling. The tubing must be new and dedicated to a particular monitor well. The tubing should be equipped with a decontaminated foot check valve to avoid having aerated water from the pump fall back into the well.

If a foot check valve is not used, care must be taken to ensure that the entire pump impeller chamber is drained after being used and then thoroughly de-contaminated. Also, when removing tubing without a foot check valve after evacuation, the pump must continue to operate to keep purged water remaining in the tubing and pump chamber from falling back into the well.

The limitation posed by this type of pump is its suction capability. Generally the water level must be within 25 feet of the ground surface. Care must be taken as to the source of the water used in priming the centrifugal pump; ONLY ASTM Type II or better quality water free of chlorine residual and potential contaminants should be used.

NOTE: These pumps may only be used for well evacuation, not for groundwater sampling.

**Evacuation Procedure Using Portable Submersible Pumps**

When the depth to water is greater than 25 feet, and if the diameter of the well casing will allow, a portable submersible pump should be utilized. The pump must be carefully lowered

into the well, trailing a discharge hose, electrical cables, and a security cable constructed of approved material (e.g., single-strand stainless steel or polyethylene). The security cable should support most of the weight of the pump. These items can be bundled together at ten-foot intervals with plastic electrician's ties or stainless-steel clamps.

Duct or electrical tape must not be used at a level that will be submerged into the water column. It is important that the hose and electrical line be fed so they do not jam between the pump and the casing. Similarly, the hose and electrical line must be pulled up ahead of the pump during removal.

Once the end of the purged line is fitted with a gate valve in the closed position, lower the submersible pump to the appropriate depth. The pump can then be turned on and the gate valve adjusted to provide the correct flow rate. During evacuation, it may be necessary to lower the pump as the static groundwater level drops.

If a portable gasoline generator is used, it should be placed downwind and at some distance away from the well so fumes from the generator will not affect sample quality. The generator should not be operating while a sample is being collected.

The pump should be fitted with dedicated tubing for the discharge of evacuation water. As with suction lift pumps, submersible pumps should be equipped with a check valve to avoid having water from the pump fall back into the well. If the same submersible pump is to be used for more than one well, then the pump should be decontaminated between well locations to ensure that no cross-contamination from the previous well occurs.

Submersible pumps are susceptible to clogging. Turbid groundwater or poorly developed monitor wells are likely to impede the evacuation process. Care should be taken not to let the pump draw from the bottom of the well where silts and sands may be taken up by the pump.8.5.3.5

### **Evacuation Procedures Using Peristaltic Pumps**

A peristaltic pump is a self-priming suction lift pump, utilized at the ground surface. It consists of a rotor with ball bearing rollers. One end of dedicated tubing is inserted into the well. The other end is attached to a flexible tube, which has been threaded around the rotor, out of the pump, and connected to a discharge tube. The liquid moves totally within the sample tube, with no part of the pump contacting the liquid. Tubing used for well evacuation may also be used for sample collection. Flexible polytetrafluoroethylene (PTFE) tubing is recommended for sampling. However, other materials may be acceptable, with approval on a case basis. The bottom length of tubing should be equipped with a foot check valve to avoid having water from the pump and tubing fall back into the well.

Use of a peristaltic pump for well evacuation is limited to its suction capabilities. Generally, a peristaltic pump cannot be used to evacuate wells with a depth to water greater than twenty-five feet. Also, due to the volume present in large diameter and high yield wells, peristaltic pumps are not recommended.8.5.3.6

### **Evacuation Procedure Using Air Lift Pumps**

This method is generally used for well development and is not recommended for well evacuation prior to sampling. If logistics dictate that air lift pumps are the only alternative to evacuation, then the procedure can only be applied to wells screened below the water table. Tubing connected to air lift pumps must be placed above the well screen since air may become trapped in the screen and/or filter pack. Entrapped air can alter the oxidation-reduction potential of the aquifer material around the well bore, which can affect the chemical composition of groundwater samples. In addition, only oil-free compressors should be used.8.5.3.7

### **Evacuation Procedures Using Bladder Pumps (Gas Squeeze Pumps)**

A bladder pump consists of a stainless-steel cylindrical housing that encloses a flexible membrane (See Figure 8-2). Below the bladder, a screen is attached to filter any material that may clog the check valves that are located above and below the bladder. The pump works as follows: Water enters the membrane through the lower check valve, compressed gas is injected through a separate line to the space between the bladder and the pump housing. As the bladder is squeezed, the water in the bladder closes the lower check valve and goes out through the upper check valve. As the air pressure is released, the upper check valve closes and water enters the pump through the lower check valve. There is no contact of compressed gas with the sample water.

The bladder pump is utilized much like a portable submersible pump, except that no electrical lines are lowered down the well. The source of gas for the bladder is either bottled gas or an on-site oil-less air compressor. Disadvantages include the large gas volumes needed, especially for greater depths, and the potential for bladder rupture and slow evacuation rates.

The preferred material of construction for bladder pumps and any tube, joint or other fixture that remains in contact with the groundwater is PTFE (Teflon®) or stainless steel.8.5.3.8

### **Evacuation Procedure Using Packer Pumps**

Packer pumps consist of two expandable bladders that, when inflated, isolate a section of the well bore between them. They deflate for vertical movement within the well. The advantage of this type of pump is that a smaller volume of water is required for evacuation prior to sampling. Also, several zones within a single well can be sampled.

Packer pumps are constructed of rubber and can be used with submersible, gas lift, and suction pumps. Exposures to high-level contamination may deteriorate the rubber with time.

The use of packer pumps for evacuation must be approved by the customer on a case basis. The sampler must be sure the zone being sampled and packed is isolated from the other zones.



## **Evacuation Procedures Using Gas Piston Pumps**

The gas piston pump provides continuous sample withdrawal at depths greater than possible with most other methods. The pump consists of a stainless steel alternating chamber between two pistons. Pressurization of the alternating chamber activates the pistons, which allows water entry during the suction stroke and forces the water to the surface during the pressure stroke.

The use of gas piston pumps for evacuation must be specified in the Field Sampling Plan (FSP) on a case basis.

## **Evacuation Procedures Using Gas Displacement Pumps**

Gas displacement pumps work by gas forcing water out of a discharge line. They consist of a cylinder with a check valve and two lines, an air supply line and a water discharge line, and a connection to the top. As the pump is lowered into the water, it fills by hydrostatic pressure. When air pressure is applied, the check valve seats and water is forced out the discharge line. When the air pressure is released, the pump chamber fills and the cycle repeats.

## **Evacuation Procedures Using Inertial Pumps**

The inertial pump consists of a single tube or pipe with a foot check valve at one end. The check valve allows water to enter the pipe but stops it from draining out.

The pump is operated by raising and lowering the tube over a short distance with rapid strokes. This causes the water inside the pump to be moved up a distance due to its inertia. This can be accomplished manually or automatically utilizing a powered unit.

The advantages of this type of pump are its ease of operation and inexpensive cost. It has several disadvantages, such as:

- Its manual operation is labor intensive, although mechanical advantage devices are available.
- The tubing and foot assembly must be dedicated to a well.
- Use in slow recharge wells may cause the water level to drop significantly and result in aeration of the water column during the physical act of purging the well. Conversely, the inertial pump device may be overwhelmed in a rapidly recharging well leading to insufficient evacuation of the water column.

The use of inertial pumps for evacuation must be specified in the FSP on a case-by-case basis.

## **Evacuation Procedures Using Hand Bailing Techniques**

Hand bailing may be utilized if no other method of evacuation can accomplish the task and the procedure is specified in the FSP. However, bailing is the least recommended procedure for well purging due to the potential to aerate the well water or possibly introduce contaminants during the bailing procedure. Specifically, bailing is the least recommended method of purging when samples are to be collected for VOC analysis.

If hand bailing is the method of evacuation, it must be performed with a laboratory cleaned and dedicated PTFE or stainless-steel bailer. An additional laboratory cleaned and dedicated bailer should be required for sample collection.

NOTE: Hand bailers come in a variety of sizes and volumes to accommodate most well casing diameters.

The bailer must be slowly lowered into the well, exercising care not to aerate the groundwater to be sampled. The preferred method is by using a Teflon®-coated, stainless steel cable attached to a low-gear-ratio winch which is connected to a tripod standing over the well. This is the most reproducible method of bailing a well. If this apparatus is not available, the bailer may be lowered by hand using a Teflon®-coated, stainless steel leader. (Due to the manufacturing oils associated with braided stainless-steel cable, Teflon®-coated, stainless steel is required for the bailer leader contacting groundwater, unless decontaminated single strand stainless steel cable is utilized. Lower the bailer until it is submerged. Retrieve it and transfer the water to a container or other device to measure the volume evacuated. The bailer utilized for well evacuation along with any other equipment entering the well for sample collection must be handled with new surgical gloves to prevent potential contamination. It is good to have extra laboratory-cleaned bailers available at the site.

## **Groundwater Sampling Procedures**

After evacuation of the required volume of water from the well, sampling can begin. If the well is a quick re-charger, sampling of the well should occur as soon as possible after evacuation, preferably immediately. In most cases, the time lapse between evacuation and sampling should not exceed two hours. When several wells are to be sampled of known or suspected contamination, the least contaminated well should be sampled first, with remaining wells then sampled in ascending order of contamination. Wellhead readings can aid in determining sample order by providing information on contaminant levels in the wells.

Attention to decontamination procedures must be strictly followed. Information on the various methods of sample collection is provided as follows:

### **Sampling Procedures Using Bottom Fill Bailers**

Bailers come in a variety of sizes and volumes to accommodate most well casing diameters. The preferred materials of construction are PTFE (Teflon®) and stainless steel. The use of

bailers constructed of other materials for groundwater sample collection must be specified in the FSP on a case basis.

The bailer must be cleaned and wrapped using approved methodologies, preferable by the laboratory performing the analysis. The bailer must be slowly lowered into the well, exercising care not to aerate the groundwater to be sampled. The preferable method is by the use of a Teflon®-coated, stainless steel cable attached to a low gear ratio winch which is connected to a tripod standing over the well. If this apparatus is not available, the bailer may be lowered by hand using three to six feet of Teflon®-coated, stainless steel leader wire attached to the bailer and to an appropriate length of dedicated polypropylene rope.

Due to the manufacturing oils associated with braided stainless-steel cable and its decontamination difficulty, Teflon®-coated, stainless steel is required for the bailer leader contacting groundwater.

Care should be taken if using stainless steel cable clamps when securing the leader to the bailer. The integrity of the Teflon® may be compromised by compression while tightening the clamps, thus exposing the braided wire. Also, all cut ends of leaders must have an end cap so as to eliminate exposure of the stainless wire.

Slowly lower the bailer into the well until it is submerged. Retrieve it and transfer the sample to appropriate containers. Caution must be used in transferring the water from the bailer to the sample container because this action allows the greatest chance of sample aeration.

Due to manufacturing oils associated with braided stainless-steel cable and its decontamination difficulty, Teflon®-coated stainless steel is required for the bailer leader contracting groundwater.

Some bailer manufacturers have small stopcocks with an attached sample line. The valve is inserted into the bottom of the bailer, pushing the check valve up and supplying water to the sample line. The sample flow for the VOCs may then be reduced to eliminate aeration of the sample. The valve should be in the open position when inserting into the bailer, after which it may be closed. This procedure should prevent an air bubble from rising up inside the bailer through the sample, thereby causing aeration.

The order in which samples should be collected from each well, regardless of sampling device, is as follows:

1. Volatile organic analytes (VOAs)
2. Purgeable organic carbons (POCs)
3. Purgeable organic halogens (POXs)
4. Total organic halogens (TOXs)
5. Total organic carbon (TOC)
6. Base neutrals/acid extractables
7. Total Petroleum Hydrocarbons (TPH)/ Oil and Grease
8. Polychlorinated biphenyls (PCBs)/pesticides

9. Total metals
10. Dissolved metals
11. Phenols
12. Cyanide
13. Sulfate and chloride
14. Turbidity
15. Nitrate and ammonia
16. Preserved inorganics
17. Radionuclides
18. Non-preserved inorganics
19. Bacteria

Note: The first bailer recovered after well evacuation must be utilized for sample collection. This collection order takes into consideration the volatilization sensitivity of groundwater samples.

The bailer and any other equipment entering the well must be laboratory-cleaned and handled with new surgical gloves to prevent potential contamination. Surgical gloves must be changed between each sample locations. Clean sampling equipment and any other objects entering the well should not be allowed to contact the ground or any other potentially contaminated surfaces (e.g., gasoline pumps). If this should occur, that item should not be placed in the well or utilized for sampling. It is good to have extra laboratory cleaned bailers available at the site. Additionally, bailers and sample bottles must be physically separated from pumps or generators during transport and storage.

Dedicating a bailer and leaving it in a well for long term monitoring is not recommended due to the potential risk of contamination resulting from excessive handling (it would be necessary to remove bailer first in order to purge the well therefore increasing the risk of contamination).

### **Sampling Procedures Using Peristaltic Pumps**

A peristaltic pump is a self-priming suction lift pump, which consists of a rotor with ball bearing rollers. It is operated at the ground surface. One end of the dedicated tubing is inserted into the well and the other end is attached to a flexible tube, which has been threaded around the rotor, out of the pump and connected to a discharge tube. PTFE and polyethylene are the preferred materials for the tubing associated with a peristaltic pump. Other material may be acceptable, particularly for threading through the pump, but must be specified in the FSP on a case basis.

The sample moves totally within the sample tube and no part of the pump contacts the liquid. If Teflon® tubing was used for well evacuation, the same length of tubing may be used for sample collection at that well. If another approved material was used for well evacuation, a new dedicated piece of Teflon® tubing may be required for sample collection.

The tubing should be equipped with a foot check valve to avoid having water from the pump and the tubing fall back into the well. A foot check valve is not required if the pump is not shut off in between evacuation and sampling of the well however, a foot valve is still desirable in case of pump failure.

Value of a peristaltic pump for well sampling maybe questionable due to its limited suction capabilities. Generally, it cannot be used to sample wells with a depth to water greater than 25 ft.

NOTE: This pump cannot be used to collect samples for volatile organics or base neutral/acid extractable organics due to the pressure gradients to which the sample is exposed.

### **Sampling Procedures Using Bladder Pumps (Gas Squeeze Pumps)**

A bladder pump consists of a stainless-steel cylindrical housing that encloses a flexible membrane. Below the bladder, a screen is attached to filter any material, which could clog the check valves located above and below the bladder. The pump works as follows: Water enters the membrane through the lower check valve. Compressed gas is injected through a separate line to the space between the bladder and the pump housing. As the bladder is squeezed, the water in it closes the lower check valve and goes out through the upper check valve. As the air pressure is released, the upper check valve closes and water enters the pump through the lower check valve. There is no contact of compressed gas with the sample water.

The bladder pump is utilized much like the portable submersible pumps, except that no electrical lines are lowered down the well. The source of gas for the bladder is either bottled gas or an on-site oil-less air compressor. The preferred material of construction for bladder pumps and any tube, joint or other fixture that remains in contact with the groundwater, is PTFE or stainless steel. All pumps and fixtures must be laboratory cleaned prior to installation or use and dedicated to a particular well.

NOTE: The same bladder pump may be used for well evacuation and sample collection provided that Teflon® tubing is used.

NOTE: Bladder pumps are acceptable to use for the collection of samples for volatile organics and base neutral/acid extractable analysis. Care must be taken to regulate the flow rate during sample collection to avoid surging caused by cycling within the pump.

Disadvantages:

- Large gas volumes needed, especially for lower depths.
- Potential bladder rupture.

**Sampling Procedures Using Packer Pumps.** Packer pumps consist of two expandable bladders that, when inflated, isolate a section of the well bore between them. They deflate for vertical movement within the well. Packer pumps are constructed of rubber and can be

used with submersible, gas lift and suction pumps. Exposures to high-level contamination may deteriorate the rubber with time.

The use of packer pumps to isolate portions of the well for sampling must be specified in the FSP on a case basis as materials of construction may not be appropriate for certain analysis.

Advantages:

- A smaller volume of water is required for evacuation prior to sampling.
- Several zones within a single well can be sampled because the length of the standing water in the column is reduced.

### **Sampling Procedures Using Inertial Pumps**

The inertial pump consists of a single tube or pipe with a foot check valve at one end. The check valve allows water to enter the pipe but stops it from draining out of the pipe. The pump is operated by raising and lowering the tube over a short distance with rapid strokes. This causes the water inside the pump to be moved up a distance due to its inertia. This can be accomplished manually or automatically utilizing a powered unit.

Advantages:

- Ease of operation
- Inexpensive

Disadvantages:

- It is manual operation is labor intensive.
- The pump must be dedicated to a well.

Depending upon the static water level within the well, care must be taken during evacuation and sampling so as not to aerate the water column. Introduction of ambient air may compromise the volatile organic fraction. The use of inertial pumps for sampling must be specified in the FSP on a case basis.

### **Sampling Procedures Using Syringe Samplers**

The sample container is pressurized or evacuated and lowered into the well. Opening the container and or releasing the pressure allows the sample to enter the device. These systems are not widely used or commercially available. Use must be specified in the FSP on a case basis.

### **Filtering Groundwater Samples**

In order to ensure quality of data generated from analysis of groundwater samples, critical sample handling procedures must be addressed. Of chief importance is sample filtration. Because objectives may vary among monitoring programs, it is difficult to establish a filtering standard that applies to all situations.

Regulations require metals analysis to be performed on unfiltered groundwater samples pursuant to the requirements of the Safe Drinking Water Act and the Clean Water Act. The reason for this is to obtain a representative sample as it actually occurs in the aquifer and to maintain consistency between sample handling for inorganic and organic analysis. If a particular case demands consideration of dissolved metals, both filtered and non-filtered sample should be collected for analysis. The regulatory document or approved quality assurance project plan should be consulted for monitoring requirements.

The differences obtained as a result of sample handling (filtered versus non-filtered) are dependent on the type of association between the specific inorganic ion and the particulate matter. Studies show that when an inorganic ion is not closely associated with particulate matter (e.g., sodium), the differences between total and dissolved concentrations are small and random.

Ideally, the sample can be split into two portions, one for filtration and the other for immediate preservation and subsequent analysis for total metals concentration. By analyzing the two fractions separately, differences between dissolved and total metals can be compared.

The decision whether to filter metal(s) samples should be based on the physical quality of the samples, the objective of the monitoring program, and the policy of the Program controlling the specific event. If filtering is allowed and chosen, it is imperative that it be performed in a manner that will preserve the integrity of the sample and allow consistent reproduction of technique.

### **Sampling for Volatile Organics**

1. Remove the cap from a 40-mL septum (Teflon®-faced silicon rubber) vial. Avoid contact with the inner surface.
2. Fill the vial with sample water, then add 1:1 HCl drop by drop and test the pH until it is < 2. Record the amount of HCl added.
3. Add the established amount of HCl to each remaining VOA vial and screw cap on tightly to achieve zero headspace.
4. Inspect the VOA vial for air bubbles. If air bubbles are present, then discard the vial and restart with step 1.
5. Attach a number label and tag to the vial, seal it in a re-sealable bag and place it into a cooler with ice. Place sufficient ice bags in the cooler to completely surround the samples and to maintain a temperature of 4°C until the samples are delivered to the laboratory.
6. Record all appropriate data in Field Logbook/Field Notes.8.5.7

### **Sampling for Extractable Organics**

1. Remove the Teflon®-lined cap from a one-liter amber glass bottle. Avoid contact with the inner surface of the cap.

2. Fill about 80% of the bottle with ground water.
3. Replace the cap tightly, attach the sample label and place the sample bottle in a cooler with sufficient bagged ice to cool to 4°C.
4. Repeat steps 1 through 3 for additional samples.
5. Record appropriate data in a Field Logbook/Field Notes.

### **Sampling for Dissolved Metals and Cyanide**

Filtration of groundwater samples for dissolved metals analysis should be performed with a pre-cleaned filtering apparatus. Sampling devices should be cleaned using ultra-pure nitric acid when low-level contaminants are being measured. Devices such as polyethylene or borosilicate glass should be used when filtering the groundwater samples for inorganic analysis. Filtration must be done immediately upon sample collection, prior to preservation. Samples transported to the lab for filtration and preservation should be documented since sample composition will change during transport. The sample should be collected and filtered with 0.45-micron pore diameter cellulose acetate filter. If the use of a vacuum filter is impractical, pressure filtration must be performed. Care must be taken to strictly follow the manufacture's recommended procedure if vacuum filtration is used. All filter apparatus should be laboratory-cleaned and dedicated. Disposable filters are acceptable. For each sampling event, a new disposable filter must be used to avoid cross-contamination of samples. The following guidelines apply to samples collected for trace metal analysis of groundwater:

- Groundwater samples for metals may be filtered using in-line filtration devices or vacuum filtration in the field. Unfiltered samples should represent "worst case" with respect to metal content. Regulatory or permit requirements will indicate when filtered and unfiltered samples are to be collected.
- If metal concentrations are significantly above groundwater standards, some permits require two samples to be collected from each well: one sample filtered according to the procedures and a second unfiltered sample.

NOTE: the Safe Drinking Water Act program does not allow filtered samples.

1. Fill the bottles for metals analysis to about 90% and preserve with Nitric Acid to a pH < 2.
2. Replace the cap tightly, attach label, seal in re-sealable bag and place the bottle in a cooler with bagged ice sufficient to cool to 4°C.
3. Fill about 90% of the cyanide sample bottle. Preserve to pH > 12 with NaOH = sodium hydroxide. Repeat step 2.
4. Record all appropriate data in Field Log Book/Field Notes.

### **Sampling for Conventional Parameters**

1. Remove caps from sample bottles.
2. Fill containers for BOD, TOC, TSS, TDS, COD, alkalinity, and chloride to about 90%. Add appropriate preservative to the samples per Appendix A or sampling plan.



3. Replace caps tightly, attach labels, seal in re-sealable bags and place sample bottles in a cooler with sufficient bagged ice to cool to 4°C.
4. Record all appropriate data in a Field Log Book/Field Notes.

The VOC samples are collected first. Care must be taken to prevent volatilization of the sample when placing it in the VOC vial. All Chain-of-Custody (COC) procedures should be followed.

Samples are submitted for analysis of VOC's, semi-volatile compounds, pesticides, metals, inorganic compounds, bacteriological species, radiological testing, and other parameters required by the permit or regulatory authority. The pH of some samples must be adjusted to preserve the sample for specific analysis. At the completion of each day's sampling, the containers collected during the day are packed on ice in a cooler and sealed if appropriate.

For detail sampling procedures and preservation of samples refer to Appendix A.

### **Sampling for Light, Non-Aqueous Phase Liquids (LNAPLs).**

LNAPLS are generally considered to be low density, immiscible organics, including gasoline, petrochemicals, and other chemicals which have specific gravities less than water. They are likely to be present in aquifers as a separate phase because of low solubility in water. These chemicals tend to float on the water surface in a water table environment and commonly occupy the capillary fringe zone above the water table. Thus, if product (LNAPL) is suspected to be floating on the water table, all shallow wells installed in the area under investigation must be screened across the water table.

In a confined aquifer, these chemicals are found along the upper surface of the permeable material and also within the overlying confining layer. When immiscible organics with a specific gravity greater than water are the contaminants of concern or if contaminants are suspected in more than one stratified layer in the well column, sampling procedures must be modified. It may be necessary to lower the bailer used for sample collection to a particular depth in the well, or to utilize a double check valve bailer. Sampling procedures for LNAPL differ substantially from those for other pollutants. If more than one distinct LNAPL layer is present in a well, each layer should be sampled. Samples should be analyzed for chemical composition (e.g., for volatile organics and base-neutral extractables, etc.) and physical parameters (e.g., specific gravity, water solubility, vapor pressure of the liquid, and Henry's Law Constant, etc.).

After the well is initially constructed it should be developed and pumped to remove stagnant water, then it should sit idle for at least two weeks to allow the water level to fully stabilize and the floating layer to stabilize.

Measurement of the thickness of the floating layer may be accomplished by using a water indicator paste/gel with a weighted steel tape to determine the depth to the top of the floating layer and to the water surface. The difference between these two readings is the thickness of the floating layer. Measurement of the thickness of the floating layer may also be

accomplished by using an interface probe or clear Teflon® bailer, if the product thickness is less than the length of the bailer. Electric water level sounders will not work properly for these determinations.

Prior to the purging of groundwater from the well, a sample of the floating layer may be obtained using a bailer, which fills from the bottom. Care should be taken to lower the bailer just through the floating layer but not significantly down into the underlying groundwater. Samples should be analyzed to determine the chemical composition of the LNAPL and its physical properties (e.g., specific gravity, water solubility, equilibrium vapor pressure of the liquid and Henry's Law Constant, etc.). After following typical evacuation procedures discussed previously in this section, a sample of formation water may be obtained from the well.

### **Sampling for Dense, Non-Aqueous Phase Liquids (DNAPLs)**

DNAPLs include chlorinated solvents and other chemicals, which have specific gravities greater than water. They are likely to be present in aquifers as a separate phase because of low solubility in water. DNAPL chemicals tend to migrate downward through the unsaturated zone and the saturated zone due to their high density. If the volume of DNAPL chemical introduced into the subsurface is larger than the retention capacity of the vadose and saturated zones, a portion of the DNAPL will spread out as a layer of free liquid on the bottom of the aquifer or on lower permeability beds within the aquifer.

Measurement of the thickness of DNAPLs (and LNAPLs) must be performed prior to purging (evacuating) the well. Measurement of the DNAPL may be accomplished by using a water indicator paste/gel with a weighted steel tape (if no LNAPL is present) to determine the depth of the top of the DNAPL and the bottom of the well. The difference between these two measurements is the thickness of the DNAPL in the well. An interface probe may also be used to measure DNAPL in the well. An interface probe may also be used to aid the measurement of DNAPL thickness.

Prior to purging a monitor well, a sample of the DNAPL may be obtained using a dual check valve bailer or a bladder pump. If both LNAPLs and DNAPLs are present in a well it may be necessary to purge the well of one casing volume of water prior to sampling the DNAPL, provided that efforts are made not to disturb the DNAPL in the bottom of the well. This can be accomplished by setting the pump intake of the submersible or suction-lift pump several feet above the DNAPL.

Samples should be analyzed to determine the chemical composition of the DNAPL and its physical properties (e.g., specific gravity, water solubility, equilibrium vapor pressure of the liquid and Henry's Law Constant, etc.). After the well is purged, a sample of the groundwater may be obtained for laboratory analysis.

### **Sampling Domestic Wells**

An important step in sampling a domestic well is to obtain as much information as possible from the homeowner. This should include: depth of the well, well yield, formation in which the well is completed, screen depth and length, well construction material, diameter of casing and when and by whom the well was installed. This information should be verified if possible by obtaining drilling logs, etc. With this information, determine the number of gallons to be evacuated.

When collecting a sample from an operating domestic well, it is essential to evacuate the plumbing and water storage tank. Running the water for a minimum of fifteen minutes before collection is a good rule of thumb, however, longer is desirable. Listen for the pump or the electric circuit to the pump to come on, indicating that the plumbing is being evacuated. Inquire as to whether any treatment units are installed on the system. Softening, iron removal, turbidity removal, disinfection, pH adjustment may often provide misleading analyses depending on the parameters of interest. Home carbon filters for the removal of organics are also increasingly popular. Basement and outside faucets may by-pass such treated water (Note: sample cold water faucet).

A brief inspection of the system should be performed to locate the well, pump, storage tanks, and any treatment systems. Samples should be taken as close to the pumping well as possible and prior to any storage tanks or treatment systems. If a sample must be taken following a treatment unit, the type, size, and purpose of the unit should be noted on samples sheets and in the Field Log Book/Field Notes.

Home faucets, particularly kitchen faucets, usually have a screen installed on the discharge. The screen should be removed prior to sampling for bacteria or volatile organics, since the screen tends to aerate the water and some organics may be lost. Also, when sampling for bacteria, do not take a sample from a swivel faucet since the joint may harbor a significant bacterial population.

NOTE: Homeowners' plumbing systems should not be tampered with in any way, except for removal of the faucet screen with permission of the homeowner.

For long term monitoring projects utilizing domestic wells, a specific tap or faucet should be designated as the target sample access point for accurate reproducibility of future samples. The removal of the screen should be noted. In some areas, when sampling for drinking water bacteria, the screen should not be removed since removing the screen is not an indication of the drinking water from the tap.

### **Sampling Industrial Wells**

When sampling industrial wells, it is desirable to sample as close to the well source as possible. Samples should be taken directly from the well head whenever possible. This should eliminate treatment interferences, possible changes in quality within the lines, mixing of water from other wells, etc.

Large capacity wells, which are “on-line” during the visit, can be sampled immediately. Wells, which are “off-line,” must be pumped to waste prior to sampling. Fifteen minutes or more is suggested. Access to municipal well systems, well houses, etc. requires the assistance of a water department employee. Prior notification is essential.

### **Quality Assurance/Quality Control (QA/QC)**

Groundwater monitoring and associated laboratory analytical testing demand that sample integrity be maintained during sample collection. Laboratory analysis, no matter how sophisticated, may only be representative if the sample supplied to the analyst has retained its integrity. There are many areas to which specific attention must be paid. Some relate to well drilling and development procedures, well construction materials, or heavy equipment decontamination and are discussed elsewhere in this manual. During on-going groundwater monitoring studies, consistency of sampling is crucial to the interpretation of the data over the year or years. Issues addressed in this section include the decontamination procedure and the construction materials used for sampling equipment.

### **Equipment Cleaning and Decontamination**

For each sampling event, all field measurement and sampling equipment that will enter the well must be cleaned prior to its entry into the well. Field measurement equipment, such as water level indicators, should be cleaned in the following manner:

- Wipe with a paper towel to remove visual debris
- Tap water and laboratory grade glassware detergent wash
- Tap water rinse
- ASTM Type II water rinse

Sampling equipment should be laboratory cleaned using documented cleaning procedures, preferably by the laboratory performing sample analysis. The sampling equipment should then be wrapped in cleaned foil and dedicated to a specific well for the day's sampling. The sampling equipment should remain wrapped in this manner until immediately prior to use. Additionally, bailers and sample bottles must be physically separated from pumps and generators during transport and storage. Pumps and equipment not amenable to laboratory cleaning should be field cleaned using documented cleaning procedures.

### **Composition of Construction Materials for Sampling Equipment**

The composition of materials comprising groundwater sampling equipment is critical to the collection of valid monitoring information, particularly, when volatile organic, pH sensitive, or valence reduced chemical constituents are being evaluated. The construction materials, which come in contact with the sample, are as critical as the composition of the laboratory sample containers. Recommended materials for bailers, pump parts, tubing, other sampling

devices, and associated apparatus in decreasing order of preference are: PTFE(Teflon®), stainless steel 316, stainless steel 304, polypropylene, linear polyethylene, Polyvinyl Chloride (PVC), Viton, conventional polyethylene.

Most regulatory programs require that the bailers be constructed of PTFE or stainless steel. Additionally, any other devices contacting the water to be sampled should be constructed of PTFE or stainless steel. The reader is cautioned that exceptions to this requirement should be confirmed and approved by the regulatory program having project oversight authority.

Tubing utilized in well evacuation may consist of materials other than PTFE, but may not be utilized for sample collection and it is recommended that it should be dedicated for use in each individual well for that particular sampling event.

### **Quality Control Samples**

In an attempt to identify external variables affecting groundwater sample integrity, a program of quality control blanks should be initiated. For volatile parameters, the quality control blank sample program is a two-track approach using both a trip and field blank. The trip blank acts as a check on potential contamination sources in sample container preparation, method blank water including preservative, and sample transport and storage. The field blank serves as a check on the cleanliness of the sampling equipment, potential atmospheric contamination, and the effects of sampling procedures on the analytes of interest. The blank water and same preservation materials used in the samples should be used to assess blank contamination problems. Complete documentation on source of these materials will assist with any problem solving.

Equipment field blanks may be collected at the start and end of the sampling event to determine the cleanliness of the sampling devices used and the evaluation of cleaning techniques used in the field.

Field duplicates or splits are collected in the field by collecting double the number of bottles and sending the samples to the same laboratory (duplicate) or a different laboratory (split). This information will determine field precision (duplicate) or project precision (split).

Field spikes are prepared in a limited number of permit or regulatory requirements. Field spikes determine field accuracy or project accuracy. A known amount of contaminant is placed or spiked into the sample in the field. Samples and spikes are handled in the same manner. Field spikes help to assess method performance and contaminant deterioration or degradation during sample handling, transport, and analysis.