GENERAL FIELD SAMPLING GUIDELINES

CONTENTS

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to describe the general field sampling techniques and guidelines that will assist in planning, choosing sampling strategies and sampling locations, and frequency of Quality Control (QC) samples for proper assessment of site characteristics. The ultimate goal is to ensure data quality during field collection activities.

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The sampler needs to ensure the methods used are adequate to satisfy the data quality objectives (DQOs).

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

2.0 APPLICABILITY

This SOP applies to the collection of aqueous and non-aqueous samples for subsequent laboratory analysis to determine the presence, type, and extent of contamination at a site.

3.0 DESCRIPTION

Representative sampling ensures that a sample or a group of samples accurately reflect the target population from which the sample(s) are intended to draw conclusions about. Depending on the contaminant of concern and matrix, several environmental and logistical variables may contribute to uncertainty in sampling design, which may affect the representativeness of the samples and subsequent measurements. Environmental variability can occur due to non-uniform distribution of the pollutant due to topographic, meteorological and hydrogeological factors, changes in species, and dispersion of contaminants and flow rates. Logistical variables including restricted or limited access to areas for sampling due to health and safety concerns, physical obstructions, or inability to obtain access agreements may affect the spatial representativeness of the sampling design and/or preclude samples from being collected in areas of interest.

Determining the sampling approach depends on what is known about the site from prior sampling (if any) and the site history, variation of the contaminant concentrations throughout a site, potential migration pathways, and human and environmental receptors. The objectives of an investigation determine the appropriate sampling design.

The frequency of sampling and the specific sample locations that are required must be defined in the site-specific QAPP.

3.1 Planning Stage

The objectives of an investigation are established and documented in the site-specific QAPP. The technical approach including the media/matrix to be sampled, sampling equipment to be used, sampling design and rationale, and SOPs or descriptions of the procedure to be implemented are included in the QAPP. Refer to the matrix-specific SOPs for sampling techniques which include the equipment required for sampling.

During the planning stage, the DQOs will be determined. In turn, the project’s DQOs will determine the need for screening data or definitive data. Screening data supports an intermediate or preliminary decision but eventually is supported by definitive data before the project is complete (i.e., placement of monitor wells, estimation of extent of contamination). Definitive data is suitable for final decision making, has defined precision and accuracy requirements and is legally defensible (i.e., risk assessments, site closures).

3.2. Sampling Design

A sample design specifies the number of samples to be collected for each matrix of concern, the measurements which will be conducted on those samples, where the samples will be collected (downstream of the contaminant release, along a grid, etc.) and how the samples will be collected (discrete or composite samples, seasonally, etc.). The DQOs for a Site assist in selecting the appropriate sampling design for the population of concern (e.g., lead concentrations in residential soil, contaminant uptake in plants, polychlorinated biphenyl [PCB] levels in a specific reach of a river). Other factors may include logistical, measurement and budgetary constraints, such as accessibility to the sampling area, analytical instrument sensitivity or manpower availability. EPA QA/G-5S, *Guidance on Choosing a Sampling Design for Environmental Data Collection*, provides detailed guidance on the selection of a representative sampling design.

There are two main categories of environmental sampling designs:

1. Judgmental, also known as biased or targeted sampling; and
2. Probability-based sampling, which includes, but is not limited to, simple random, systematic, ranked set, stratified and cluster sampling.

Judgmental sampling is based on expert/technical knowledge of the site, known contaminant pathways and the chemical/physical processes associated with the contaminants of concern (COCs). It can be less expensive than probability-based sampling as it is typically quicker to implement. It is often used to target sampling in areas where there have been known chemical spills or visible staining of the matrix of concern. Because it is based on professional judgment, the reliability and precision of the results cannot be quantified using statistical assessments. The interpretation of the sampling results is dependent on personal interpretation.

Although probabilistic sampling is often more costly in time and implementation, this type of design allows for the assessment of the uncertainty associated with the sampling results and provides reproducible results, if performed accurately. Probability-based sampling includes a random/unbiased component for locating samples. Inferential statistics can be used to extend the measured results of the sampling efforts to the larger population of concern and statistical limits can be computed assessing the variability of the measurements. Probabilistic sampling is used when DQOs include the need to obtain the mean or median concentration across an area of concern, establish variability of the COC(s), perform trend analyses, determine the probability of exceeding an actionable level, locate hot spot(s) within a designated area, compare reference and on-site COCs, and establish background levels of COCs. There are many more applications of probabilistic-sampling. Simple random, systematic and stratified random sampling are the most commonly applied sampling designs in assessing environmental sites.

3.2.1 Judgmental Sampling

Judgmental sampling is the subjective selection of sampling locations based on the professional judgment of the field team. This method is useful to locate and to identify potential sources of contamination when there is reliable historical and physical knowledge about a relatively small feature or condition. It may not be representative of the full site and is used to document worst case scenarios. For example, groundwater sampling points are typically chosen based on professional judgment, whether permanently installed wells or temporary well points. Judgmental sampling may also be implemented at a site when there are schedule and budget limitations, or to determine if there are contaminant "hotspots" that require further investigation using an extensive probability-based sampling design. For example, judgmental sampling may be used to identify multiple areas of contaminated soil, and a subsequent probability-based sampling design can be used to fully delineate the extent of the contaminated soil in each area within a specified level of uncertainty.

3.2.2 Simple Random Sampling

In simple random sampling, sample locations are selected randomly. For example, random pairs of coordinates could be selected from an area where soil sampling is planned. The simple random sampling approach is applied when there are many sample locations and the concentrations are assumed to be homogeneous across a site with respect to the parameter(s) that are going to be analyzed or monitored for. Simple random sampling can also be used to select an initial sample location in a systematic and stratified sampling design.

3.2.3 Systematic Sampling

Systematic grid sampling involves the collection of samples at fixed intervals when the contamination is assumed to be randomly distributed. A random point is chosen as the origin for the placement of the grid. A grid is constructed over a site and samples are collected from the nodes (where the grid lines intersect). Depending on the number of samples that are required to be collected, the distance between the sampling locations can be adjusted. The representativeness of the sampling may be improved by shortening the distance between sample locations.

Systematic random sampling is used for estimating contaminant concentrations within grid cells. Instead of sampling at each node, a random location is chosen within each grid cell. The systematic grid and random sampling approaches are useful for delineating the extent of contamination, documenting the attainment of clean-up goals, and evaluating and determining treatment and disposal options.

Transect sampling involves one or more transect lines established across the site. Samples are collected at systematic intervals along the transect lines. The number of samples to be collected and the length of the transect line determines the spacing between the sampling points. This type of sampling design is useful for delineating the extent of contamination at a particular site, for documenting the attainment of clean-up goals, and for evaluating and determining treatment and disposal options.

3.2.4 Stratified Sampling

Stratified sampling involves separating a site with heterogenous conditions into multiple homogenous strata. It is useful when a heterogeneous population or area can be broken down into regions with less variability within the boundaries of a stratum then between the strata. Professional judgement, historical information, site observations, exposure to ecological and human receptors, soil type, fate and transport mechanisms, and other site-specific factors can be used to separate a sampling area into multiple strata. Additionally, strata can be defined based on the decisions that will be made. Sampling locations can be selected from each stratum using professional judgment, random sampling, or systematic sampling. Using a systematic sampling design within each stratum, with varying sample densities between different strata, ensures that areas of the site thought to have higher variability in contaminant concentrations and/or thought to be within the boundaries of uncertainty surrounding decision levels are sampled at a higher spatial resolution. This method still maintains a representative and unbiased sample design within each stratum.

3.3 Sampling Techniques

Sampling is the selection of a representative portion of a larger population or body (i.e. target population). The primary objective of all sampling activities is to characterize a site accurately in a way that the impact on human health and the environment can be evaluated appropriately.

3.3.1 Sample Collection Techniques

Sample collection techniques may be either grab or composite. A grab sample is a discrete aliquot representative of a specific location at a given time and collected all at once from one location. The representativeness of such samples is defined by the nature of the materials that are sampled. Samples collected for volatile organic compounds (VOCs) are always grab samples and are never homogenized. Composite samples are non-discrete samples composed of more than one specific aliquot collected at selected sampling locations. Composite samples must be homogenized by mixing prior to putting the sample into containers. Composite samples can, in certain instances, be used as an alternative to analyzing a number of individual grab samples and calculating an average value. Incremental sampling conducted over a grid is a special case of composite sampling and is detailed in U.S. EPA Environmental Response Team (ERT) SOP, *Incremental Soil Sampling.* Choice of collecting discrete or composite samples is based on project's DQOs.

3.3.2 Homogenization

Mixing of soil and sediment samples is critical to obtain a representative sample. An adequate volume/weight of sample is collected and placed in a stainless steel or Teflon® container, and is thoroughly mixed using a spatula or spoon made of an inert material. Once the sample is thoroughly mixed the sample is placed into sample containers specific for an analysis. Avoid the use of equipment made of plastic or polyvinyl chloride (PVC) when sampling for organic compounds when the reporting limit (RL) is in the parts per billion (ppb) or parts per trillion (ppt) ranges. Refer to ERT SOP, *Soil Sampling*, for more details on homogenization.

3.3.3 Filtration

In-line filters are used specifically for collecting groundwater samples for dissolved metals analysis and for filtering large volumes of turbid groundwater. Groundwater samples collected for VOCs are typically not filtered due to potential VOC losses. Filtering groundwater is performed to remove silt particulates from samples to prevent interference with the laboratory analysis. The filters used in groundwater sampling are either cartridge type filters inserted into a reusable housing, or are self-contained and disposable. Filter chambers are usually made of polypropylene housing an inert filtering material that removes particles larger than 0.45 micrometers (µm). Refer to ERT SOP, *Groundwater Well Sampling* and ERT SOP, *Surface Water Sampling*, for more details on filtration techniques.

3.4 Quality Assurance /Quality Control Samples

QA/QC samples provide an evaluation of both the laboratory's and the field sampling team's performance. Including QA/QC samples in a sampling design allows for identifying and measuring sources of error potentially introduced from the time of sample collection through analysis. The most common QA/QC samples collected in the field are collocated field duplicates, field replicates, equipment blanks and field blanks. Trip blanks are typically added for each matrix in each cooler used to ship VOC samples and are prepared prior to going into the field preferably by the laboratory that will be performing the analyses. Extra volume/mass is collected for a matrix spike/matrix spike duplicate (MS/MSD) at a frequency of 5 percent (%; one in 20 samples). Spiking is performed in the laboratory. For additional information or other QA/QC samples pertinent to sample analysis, refer to ERT SOP, *Quality Assurance/Quality Control Samples*.

Collocated field duplicates may be collected based on site objectives and used to measure variability and precision associated with the sampling process including sample heterogeneity, sampling methodology, and analytical procedures. Field replicates are field samples obtained from one location, homogenized, and divided into separate containers. This is useful for determining whether the sample has been homogenized properly. Equipment blanks (also known as rinsate blanks) are typically collected at a rate of one per day. The equipment blank is used to evaluate the relative cleanliness and the decontamination methods of non-dedicated equipment. Refer to ERT SOP, *Sampling Equipment Decontamination,* for more details regarding decontaminating non-dedicated equipment.

3.5 Sample Containers, Preservation, Storage and Holding Times

The amount of sample to be collected, the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix sampled and the analyses to be conducted. This information is provided in ERT SOP, *Sample Storage, Preservation, and Handling*. Field personnel need to be cognizant of any short holding times that warrant immediate shipment/transfer to the laboratory.

3.6 Documentation

Field conditions and site activities must be documented. Scribe will be used to document sample information and generate chain of custody records. Other field measurements not typically entered into Scribe will be documented in a site-specific logbook or in a personal logbook. All sample documentation will be maintained in accordance with ERT SOP, *Sample Documentation* and ERT SOP, *Chain of Custody Procedures.*

4.0 RESPONSIBILITIES

4.1 ERT Work Assignment Manager

The ERT WAM is responsible for providing technical expertise and technical direction to the contractor, preparing task orders/work assignments, reviewing deliverables, interacting with the Regional customers and monitoring the financial and administrative management of the project.

4.2 ERT Quality Control Coordinator

The ERT Quality Coordinator provides quality assurance oversight for all projects and implements/maintains the ERT Quality Assurance Program.

4.3 ERT Contractor Task Leaders

Task Leaders (TLs) are responsible for the overall management of the project. Task Leader responsibilities include ensuring that field personnel are well informed of the sampling requirements for a specific project and that SOP and QA/QC procedures stated in the site-specific QAPP are adhered to, issuing a Field Change Form that documents any changes to sampling activities after the QAPP has been approved and maintaining sample documentation.

4.4 ERT Contractor Field Personnel

Field personnel are responsible for reading the QAPP prior to site activities and performing sample collection activities as written. They are responsible for notifying the TL of deviations from sample collection protocols which occurred during the execution of sampling activities. Field staff will collect samples and prepare documentation in accordance with ERT SOP, *Sample Documentation*. In addition, field personnel are responsible for reading and conforming to the approved site-specific Health and Safety Plan (HASP).

4.5 ERT Contractor QA/QC Officer

The contractor's QA/QC Officer is responsible for reviewing this SOP and ensuring that the information in this SOP is updated on a timely basis. Compliance to this SOP may be monitored by either conducting a field audit or reviewing deliverables prepared by the contractor's TL.

4.6 ERT Contractor Health and Safety Officer

Based on OSHA requirements, a site-specific health and safety plan (HASP) must be prepared for response operations under the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, 29 CFR 1910.120. Field personnel working for EPA's ERT should consult the Emergency Responder Health and Safety Manual currently located at https://response.epa.gov/_HealthSafetyManual/manual-index.htm for the development of the HASP, required personal protective equipment (PPE) and respiratory protection.

The contractor's Health and Safety Officer (HSO) is responsible for ensuring that a HASP has been written and approved prior to field activities. Additionally, the contractor's HSO is responsible for ensuring that the contractor's site personnel H&S training and that their medical monitoring is current.

5.0 REFERENCES

U.S. EPA. 2006. Guidance on Systematic Planning using the Data Quality Objectives Process (QA/G-4), EPA/240/B-06/001, February 2006.

U.S. EPA. 2002. Guidance on Choosing a Sampling Design for Environmental Data Collection (QA/G-5S), EPA/240/R-02/005, December 2002.

6.0 APPENDICES

This section is not applicable to this SOP.