**Subject: The Use of Field Methods to Support RFI Streamlining**

**Date: June 20, 1997**



## Introduction

The purpose of this memorandum, which has been prepared by staff participating in the Corrective Action Workgroup Quality Assurance Subcommittee, is to offer Regional guidelines fostering the implementation of appropriately selected field methods for use in RCRA Subtitle C corrective action projects. It is not intended to address field tests associated with health and safety monitoring, or sampling related to other non-corrective action RCRA activities. These strategies are intended to provide in-field data that can be used to achieve specific corrective action objectives in shorter time frames than are usually available through the full fixed laboratory process.

The use of alternative sample collection and on site analytical equipment is encouraged under OSWER Directive 9380.0-25, issued in April, 1996. Region 5's position on this directive is that no tool or technique should be excluded from use for data collection under any portion of the RCRA program, provided site specific quality control parameters are satisfied. It is important to be flexible in allowing efforts to proceed which provide the best possible data for environmental decision making.

The term "field methods" is used in a very broad sense in this memo. It applies to those methods which can be used to obtain samples and/or analyze them more quickly and cheaply than those methods that are normally approved in a standard QAPP. However, there is a trade-off, in that the data obtained may exhibit less precision and/or accuracy than that which would have been obtained using the more stringent methods. The project objectives will determine whether the trade-off is acceptable.

Some examples of situations in which field methods may be constructively used are: to allow the corrective action project manager to make rapid sampling-related decisions in the field, to obtain more samples than could be feasibly done using "standard" procedures under a fixed budget, and to screen for the presence of contamination over a large area. It should be noted that the field method samples are not necessarily analyzed on-site by a field crew; they may be sent to either a mobile laboratory or to a fixed laboratory, which has been approved through the QAPP approval process.

In order to optimize the field method strategy, previous knowledge of the site, including suspected/actual contaminants known on the basis of historical data, should be applied in the selection of specific field methodologies. Knowing which contaminants are likely to have been released at what specific locations can serve as a guide in determining which field methods to employ.

In general, field methods should not be used when concentrations of a wide spectrum of constituents are required. In other words, don't use field methods if you want to analyze for just about everything in Appendix IX. A general rule is that field sampling can be used to analyze for 2 to 10 constituents; however, the exact number is dependent on the specific field methods used. The project manager should determine which constituents are "important", and then discuss with the quality assurance personnel which field methods are appropriate.

**Introducing the Concept of Field Methods During Pre-QAPP Project Phases and QAPP Review**

There are (at least) two points in the corrective action process when a project manager may introduce the possibility of utilizing field methods The first is during the scoping meeting, which is an internal discussion where the project manager can share his/her knowledge of the site with others who will have a vested interest in data quality issues and objectives (e.g. the risk assessor and the QAPP reviewer). During this meeting, issues related to the collection of samples and their analysis are discussed. The meeting provides an opportunity to consider the use of field methods which can be relied on to accomplish specific objectives. At this early project stage, it can sometimes be difficult to identify all of the field objectives that are relevant to the RFI. However, the task must be initiated. Only after the objectives are identified, can analytical methods can be proposed which will fit the project scope.

The second occasion where field methods may be introduced is during the subsequent pre-QAPP meeting with facility representatives If facility representatives suggest that field methods could be utilized, then the discussion can proceed to specific proposals. However, if the project manager proposes them, there may be a hesitance on the part of the facility representative to consider them. This reluctance may stem from a number of concerns, including:

a. Belief that all data used in regulatory decision making must be generated at a confirmatory "CLP-Level IV" or equivalent.

b. Lack of experience with field measurements, other than with relatively unsophisticated field instrumentation, such as photo ionization detectors used to provide a measure of worker health and safety.

c. Belief that use of employing a mobile laboratory or off-site fixed laboratory would not provide adequate cost benefits.

d. Belief that only data generated from an approved fixed laboratory can be used in evaluating site risks.

There may be other reasons as well, but these are typically cited. In promoting the use of field instrumentation the following information can be provided to allay their concerns:

a. Regulatory decisions can be based on data that is generated by the use of any method that has been approved for purposes of meeting site specific objectives. Such approved methods need not always conform to the formerly recognized CLP Level IV criteria, provided appropriate procedures have been used.

b. The hesitancy attributed to lack of experience can be overcome if due attention is paid in the planning stage to the importance of achieving well-stated field objectives and the development of a good SOP.

c. Pre-supposing that use of field methods is not cost effective is not justified. One also has to factor in the potential cost savings associated with other aspects of field methods, including a limited number of constituents for which the samples need to be analyzed, the total number of samples to be analyzed, and the time it takes to receive data back. It is quite possible for the overall costs associated with the RFI to be substantially diminished.

d. Provided that the sampling program is sufficiently comprehensive and representative of site conditions, that field parameters have been selected meaningfully, and that there is an appropriate level of fixed laboratory investigational and quality control data to confirm field analytical data, field method generated data are suitable for human health risk assessment purposes.

If the facility is willing to consider the use of field methods, the focus should move on to defining sampling objectives, and then selecting field methods that will provide the data that is needed. Even if the Project Manager and the facility representatives themselves cannot determine appropriate analytical method(s) capable of fulfilling the data needs, consultation with QA staff may subsequently identify an appropriate procedure that can be included in the work plan.

**Appropriate Field Methods**

Whether or not a particular field method can be regarded as “appropriate” is primarily dependent on the application. A common mistake in deciding appropriateness is made when a method(s) is selected prior to considering the objectives that are relevant to the case. In these circumstances, the data objectives are forced to conform to the field method (instead of being the other way around). As a result, the generated data may not be adequate when assessing the releases or the risk. It is recommended that specific field methods not even be discussed until after the field objectives have been defined.

Although it is not feasible to address all of the various scenarios where field methods could be meaningfully applied, it is possible to provide several typical examples. However, one must bear in mind that there is always an element of "riskiness" in relying on field information. Some field methods are not as robust in their ability to provide information on particular compounds of interest, or on a list of compounds as broad as what could be reported routinely in a normal approved QAPP setting. Also, field methods may not have the ability to identify the constituents with the same degree of confidence as would be the case in a normal approved QAPP setting. In other cases, detection limits associated with certain field techniques may be relatively insensitive compared to the preferred fixed laboratory techniques. Finally, a field laboratory will generally have a limited capability for addressing matrix interference problems.

Example #1: Field Objective- Defining optimal vertical and horizontal locations for placement of groundwater wells monitoring a plume of contamination.

> If the general nature of the release is known on the basis of historical data or phase I RFI data, it may be possible to select meaningful well placement for determining the extent of the plume by making use of field methods. The data obtained should be limited to a few key indicator parameters, selected on the basis of prevalence, migration potential, toxicity to human health, and/or potential for ecological impact. The use of a mobile laboratory will provide near "real time" data, which can be used to locate the optimum positions for the well without having the long waiting period that it takes to receive the sampling results from the normal QAPP-approved laboratory.
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> The QAPP should specify the exact nature of the field parameters as well as the "decision levels" (expressed in concentration units) for each. Once the horizontal locations are selected, then sampling at various depths using "direct push" technology can provide a vertical gradient of contamination through the aquifer(s) of interest. When the decision levels are found not to exceed the criteria at any sampled depth, then the locations can be proposed as candidates for installing permanent monitoring wells. It is implicit that the field instrumentation has been approved for compounds of interest and that the reporting limits are pertinent for making the necessary field decisions. If suitable analytical methods are selected to satisfy pertinent project objectives, then in-field generated data can even be used for risk assessment purposes.

Example #2: Field Objective - Determine the presence of soil contamination with respect to field parameters of special interest.

> Field methods can sometimes be used to determine the "presence" of soil contamination when the reporting limits of the data are below the concentrations of interest, and only a few preselected constituents need to be addressed. (However, it is generally not recommended to use field methods in determining either the "extent" or the "absence" of the release.) Soil samples may be taken at shallow depths using standard augurs, or at deeper levels using Geoprobe and Hydropunch equipment, and then analyzed either in the field, in a mobile laboratory, or at a fixed laboratory.

Special concerns are associated with the collection of soil samples for volatiles organic analysis. It has been demonstrated that VOCs typically are lost to the atmosphere through the very act of sample collection. By not disturbing the sample and analyzing such samples immediately after collection, such losses can be minimized. Therefore, soil collection procedures for this situation must be carefully reviewed. (Note: Typically, field "sniffers" (i.e. HNu and OVA devices) are often used to detect the presence of VOCs in bore holes. These tests are highly qualitative in nature, and are incapable of providing useable data for either risk assessment, or the determination of the "absence" of releases.)

Example #3: Field Objective - Map the location of a groundwater plume or contaminated soil area containing VOCs.

Soil gas probes have been successfully used to map plumes of contamination in the soil or groundwater when there are VOCs involved. A probe is inserted into the soil and a sample of the soil pore gas is obtained. The sample is analyzed in the field or a mobile laboratory, and the concentration of the key constituents is used in determining the proximity of the plume. (Note: Such testing is not able to determine the concentration of contaminants in the plume itself - other types of sampling and analysis are utilized to obtain this data. Also, this technique should not be used to determine the "absence" of such contamination.)

Example #4: Field Objective - Determination of the boundaries of soil contamination during a soil removal operation.

Corrective measures may involve removing contaminated soil in order to meet specific clean-up objectives. A problem for field personnel is knowing when they have excavated enough soil to meet these objectives. Field method sampling and analysis can be used to quickly monitor a suitable set of indicator parameters. Detection of these indicator parameters above the clean-up levels in the undisturbed soil indicates that more soil needs to be removed. When the data does not support further excavation, confirmatory sampling and analysis using the normal QAPP approved methods should be done for the entire group of constituents.

Example #5: Field Objective - Monitor the ongoing progress of an interim measure.

Interim measure requirements often specify remediation or stabilization activities. Field measurements can be used to aid in tracking the progress of the remediation, or in assuring that the stabilization is effective. The levels of concern and monitoring parameters should be specified in the approved QAPP.

**Examples of Commonly Utilized Field Instrumentation**

RCRA Project Managers and QAPP writers should not choose field methods only on the basis of the analytical measurement systems that they happen to be familiar with, or which just happen to be available. Instead, field analytical programs should be designed to fit the data needs of the overall RFI. Analytical methods should be selected on the basis of the appropriateness to the specific project, with input from the QAPP reviewer. One reason for this is that project managers may be unfamiliar with the range of types of field equipment and methods that are applicable to RCRA projects. Another is that new field devices and methods are continually being developed by industry, many of which are not reflected even in draft versions of SW-846, but could be innovatively applied to RCRA corrective action projects.

For RCRA corrective action projects, any method(s) may be used which provides reliable data for the intended use. However, "unconventional" or newer, less road-hardened technology may have to be assessed during the QAPP review and RFI implementation stages to a further degree than will be the case with measurement systems that are used commercially. This may add a little time to the review process.

In this section, typical types of field-appropriate analytical instrumentation will be identified. Of course, other types of field equipment may be employed in corrective action investigation scenarios, as long as they are meaningful for project purposes. Examples of how this instrumentation can be applied to various RCRA corrective action investigations will also be presented. It is important to have an individual familiar with the proposed instrumentation and analytical technique(s) review the SOP prior to approval. When coupled to rapid time frame sampling approaches such as direct push technology, the task of data collection can be greatly accelerated.

<u>X-Ray Fluorescence:</u>

Hazardous constituent metals in soil samples can be readily analyzed in the field using x-ray fluorescence instrumentation (XRF). There are limitations as to its use, however. Facilities typically propose use of XRF for generating risk assessment level data for "all 18 RCRA metals". This is an overly ambitious strategy; Region 5 generally regards the use of portable XRF units alone only as a useful means of site screening. XRF is not intended to be a full site characterization tool.

The technique is most effectively employed in the analysis of 2 to 4 metals, with an overall objective of determining the presence of metals which are present in significant concentrations (usually > 100 ppm). It should be noted that there are also individual limitations for specific metals. For instance, beryllium and cobalt cannot be measured using XRF. If samples are dried above 100 degrees C prior to analysis, mercury data will not be reliable. If high concentrations of lead are present, the quantitation of arsenic will be impaired.

Assuming that the reporting limits of the instrument do not exceed the action or decision levels of concern, then (when supplemented with an appropriate quantity of fixed-laboratory data generated using other analytical methods) the XRF field instrument can be used to generate data acceptable for use in a risk assessment. This is only possible, provided that the instrument is effectively calibrated and tuned using well characterized soils closely representing the matrix to be investigated. (In other words, in-field XRF offers the means of determining the presence of contamination by a handful of metals at some specified level (i.e. < reporting limit, < measured background, or < soil PRG value). However, it may be necessary to establish a statistically high correlation between field results and laboratory results for the metals of interest prior to authorizing use of field data for use in risk assessment evaluations.)

Field Gas Chromatography:

Gas chromatography can prove useful in determining concentrations of organic compounds in many site matrices. However, the use of such instrumentation as a site screening tool is reliable only to the degree that it is appropriately calibrated. Therefore, prior to approving a field GC SOP, it should be determined that the equipment will be calibrated for those compounds of special interest (i.e. the best indicators of contamination).

Different kinds of GC instrumentation are available, although commercially, the services most readily provided are those for field VOCs analysis. In such circumstances the field GC is usually calibrated for only a few specific VOCs. Therefore, it is important that the calibration standards be appropriate for the analytes of concern in the field investigation, and this be documented in the SOP. If an inappropriate SOP has been provided (e.g. a VOCs method when a semivolatiles organic (SVOC) scan is called for), then more appropriate field GC SOP must be substituted.

At the time of the pre-QAPP meeting, the project manager/facility owner/operator should specify which parameters the field GC unit should be capable of analyzing and to what concentrations, for each respective matrix. The field GC unit should be relied on to fulfill only site specific objectives, that are stated in the approved QAPP.

In relatively clean samples, free from matrix interferences, field GC techniques can provide adequate analytical sensitivity. However, the ability to identify GC peaks is directly related to the matrix interference, as well as the nature of the standards used for initial calibration. If matrix interferences are known to be present, it may be difficult to use the technique for the originally intended decision making purposes. It may be difficult to perform some sample extractions and extraction cleanups or derivitizations in the field in the case of SVOCs, which is why some facilities will be reluctant to concur on the need for field GC SVOC scans. Sonication techniques can be employed in the field, however. Due to the fact that in-field extractions may be difficult to perform, GC data generated for SVOC compounds may not be as accurate as fixed laboratory data. (Portable GC/mass spectrometry units are available and may improve compound identity, however this technology is more expensive to employ.)

Colorimetry:

Methods also exist for analyzing samples (or extracts of soil samples) in the field using colorimetric analysis. In the case of organic hazardous constituents, reliable field GC methods have been developed for many of the most frequently encountered volatile organic contaminants (including indicators of contamination, such as gasoline range organics). However, specialized colormetric methods can also be used in situations where a field GC method is not available. For example, colorimetry has been applied to the analysis of explosives constituents in soil matrices, (i.e. RDX, TNT and 2,4-dinitrotoluene in soils). The constituents are typically extracted from the soil matrix and reacted with chemical reagents to form light sensitive compounds known to absorb in a specific region of the spectrum. The absorbance can then be measured quantitatively after calibration of the instrumentation with suitable standards.

There are potential problems when using colorimetry in the field. For instance, there may be other interfering compounds similar in structure to the analytes in question, which contribute to the absorbance reading. Also, in the case of explosive compounds, reporting limits for colorimetric methods are generally never as low as what can be achieved using high performance liquid chromatography (HPLC). Field quality control is typically not as sophisticated as would be the case in the laboratory, resulting in method performance not as reliable as the equivalent standard fixed laboratory method (i.e. HPLC). Therefore, data generated using colorimetric methods may have to be statistically correlated with a limited number of fixed-laboratory measurements, if it is intended to be used in meeting field objectives.

While colorimetry is not a widely used technique in the analysis of site parameters,.it has been utilized at military bases to accomplish a variety of site specific objectives, typically in the determination of the presence of contamination or “hot spots”. If employed in the analysis of soils, it is important to have the soil samples thoroughly homogenized prior to analysis, as described in an important resource document, “EPA Federal Facilities Forum Issue: On-Site Analytical Methods and Field Sampling For Explosives In Soil”, May 28, 1996, draft version 6.

Immunoassay:

Immunoassay techniques are conceptually very similar to colorimetric methods, as reagents are used to develop “color” in a solution. The absorbance of the solution is measured and compared to a standard. Immunoassay methods have been developed for a variety of target parameters, but they are often susceptible to interferences usually from compounds that are structurally similar to the compound of concern. Presently, in SW-846, (including the Update III), there are proposed or finalized methods for the following parameters, TNT, RDX, pentachlorophenol, 2,4-D, Silvex, PCBs, PAHs, TPH, toxaphene, chlordane and DDT. The reporting limits of these techniques are often quite low (subjectively), but the Project Manager must determine whether field objectives can be satisfied through the use of an immunoassay procedure. Some test kits are highly matrix dependent, with specific groundwater or soil/sediment applications.

Immunoassay test kits are most often used in a very qualitative sense, as opposed to colorimetric data which is regarded as quantitative. A sample’s concentration may be reported as above or below some standard, usually being described as within a concentration range. Immunoassay test kits are most applicable if the parameter of interest can be measured in the matrix of concern and reported as above or below the field decision level. Thus the general use of these test kits is in determining whether or not the parameter of concern is "present" in the matrix of concern.

Since the tendency for false negative results may be higher than desired, it would be best not to use such data to determine the absence of contamination at the compared level. Quality control associated with immunoassay test kits is not very sophisticated. However, if needed in certain cases, the level of quality control can be upgraded to accentuate a particular analysis. Immunoassay test kits have a defined shelf life and special preservation techniques must be maintained.

**Sampling Techniques That Can Be Used To Accelerate Field Investigations**

The use of "direct push" methods to obtain groundwater and subsurface soil samples can be quicker and cheaper than the traditional boring methods. Direct push methods involve the driving (e.g. with a pneumatic hammer) of a tube-like device into the soil to a specific depth, and obtaining a soil or groundwater sample for analysis either in the field or the laboratory. Two disadvantages of these methods (compared to utilizing borings) are that the sample volumes are generally small and that samples can be obtained only at a single depth at a time. Some commercial designations of these methods are Hydropunch and Geoprobe technologies.

The prime consideration to be made before a direct push method is allowed is, "Will the combined sampling and analytical strategy meet the specific project objectives?" Examples of questions that need to be answered before direct push methods can be approved are:

a. For what use is the data being generated? Data can be used for "screening" purposes, such as determining the presence or (in some cases) the absence of contamination, the detection of "hot spots", or the delineation of plumes. Data can be also used for "confirmatory" purposes, such as obtaining quantitative concentrations of constituents to be used in risk assessments or in determining when action levels have been exceeded. The project manager, the QAPP review staff, and the risk assessors need to determine if the direct push technology can provide adequate data for their needs.

b. Will the data be analyzed in a fixed laboratory or in the field , and for what constituents? Sample volumes obtained by direct push technologies are usually much smaller than those obtained by boring techniques. This can affect the applicability of push technologies. For example, if VOCs are the constituents of concern and the field analytical instrumentation is a GC, a small sample may be adequate. However, if a full laboratory scan for constituents is needed then only a boring may be able to generate a large enough sample volume. Sometimes, a combination of many direct push, field-analyzed samples, supplemented by a few confirmatory boring, laboratory-analyzed samples (taken at some of the same direct push locations) can give adequate quantitative results.

c. Is the "correct" depth to collect the sample known ahead of the sampling? If borings are utilized, the strata in a vertical direction can be viewed by examining the cores, and a "best" depth chosen to collect a sample for analysis. If direct push methods are used, this option is not available; one just pushes in the sampling rod to some predetermined depth and then takes the sample. You do not get any information about what lies above or below the sampling depth.

d. Has an adequate description of the method and the sampling protocol been provided in the QAPP? Is the method adequately understood and described so that its limitations are understood? Are the soil types and sample depths conducive to the use of direct push methods? Is a SOP included that completely describes the steps and precautions needed to obtain repeatable, representative samples?

As an example of the above identified concerns, consider the retrieval of a groundwater sample which will be analyzed for VOCs. How deep is the aquifer and what type of strata will the probe have to penetrate? If you try to drive a narrow tube through clay to a depth of 20 feet to reach groundwater, you will probably destroy the probe before it ever reaches the depth. Also, considering the narrowness of the probe, how will the groundwater be transferred from the aquifer to the sample vial in a manner that will not volatilize a significant portion of the VOCs in the process?

Conclusions and Recommendations:

Field methods can be used in many situations to accelerate the corrective action process by providing data which meets project objectives much more quickly and cheaply than the normal fixed laboratory methods. While only a few examples were discussed in this memorandum, many additional approaches may be creatively devised for site investigations. The corrective action project manager is encouraged to discuss protocol for field analysis with QA staff prior to approving any work plan where such techniques have been proposed. Use of the concepts outlined in this memo is both endorsed and recommended for RCRA corrective action.