UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

May 1998

REPLY TO THE ATTENTION OF:
D-8J

To the Requestor of the QAPP Policy:

The enclosed QAPP Policy dated May 1998, was developed as a part of the Waste, Pesticides and Toxics Division's (WPTD) management effort to streamline the RCRA Subtitle C corrective action process. The WPTD firmly believes that quality data is the key to an effective corrective action decision making process. The QAPP Policy provides the process which will serve as the foundation for data collection. If the policy is consistently followed, the resulting plan will result in data that meets the corrective action decision needs associated with a facility. The revised QAPP Policy is an update to past Regional QAPP guidance. It also incorporates or references other recent Agency and Division quality assurance (QA) related policies.

I feel that the QAPP Policy will be of assistance as an important tool to ensure environmental protection goals are achieved. The policy will be used at all sites where the Region has lead responsibilities for corrective action. The policy is not intended to supercede or in any way replace State QA procedures which are used at State lead sites. Over the next year we hope to gather input from users which will improve the usability of the policy and we encourage your suggestions which will be considered if a revision is necessary.

I am confident that this QAPP Policy will provide both flexibility and consistency to the QA portions of the RCRA Subtitle C Corrective Action process. If properly applied, the attached QAPP Policy will result in data that is of sufficient quality and quantity to support effective corrective action decision making. If you have any questions or concerns regarding this policy please contact your Corrective Action Project Manager.

Sincerely,

Norman R. Niedergang, Director
Waste, Pesticides and Toxics Division

RCRA QAPP INSTRUCTIONS

U.S. EPA REGION 5

REVISION: APRIL 1998

Acknowledgments

U.S. EPA Region 5 Waste, Pesticides and Toxics Division wishes to thank everyone involved with the development of this project. In particular, technical assistance was provided by Ken Bardo, Prenella Briggs, Lisa Capron, Allen Debus, Robert Egan, Brian Freeman, Gale Hruska, Chris Lambesis, Mario Mangino, Dan Mazur, Margaret McCue, Stephanie Nguyen, Colleen Olsberg, Dave Payne, Gerry Phillips, Vergel Santos, and Linda Sliwa in preparing the document. In addition, editorial assistance was provided by TechLaw, Inc., under EPA Contract Number 68-W4-0006. In addition, the efforts of these people in preparing the associated U.S. EPA Region 5 document, *Example RCRA Quality Assurance Project Plan*, are also appreciated. Thanks to Thomas Matheson for converting this document into an electronic format for publication on the U.S. EPA Region 5 Web Page.

NOTICE: The information and guidance presented in this document is solely intended to assist in the implementation of and the compliance with promulgated regulation. It is not intended and cannot be relied upon to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. The U.S. EPA Region 5 Waste Pesticides and Toxics Division reserves the right to act at variance with this document and to change it at any time with or without public notice.

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APPENDICES

NOTE TO READER
RCRA QUALITY ASSURANCE PROJECT PLAN INSTRUCTIONS
U.S. EPA REGION 5

The following document has been prepared by U.S. EPA Region 5 to facilitate preparation of a RCRA investigation Quality Assurance Project Plan (QAPP) based on U.S. EPA Quality Assurance Management Staff and Region 5 requirements. This instruction document provides the requirements for preparation of QAPPs to be used for RCRA Subtitle C corrective action investigations. In addition, it may also serve as a tool for the production of QAPPs for other RCRA investigations, including but not limited to, Subtitle D activities and underground storage tank (UST) investigations. This RCRA QAPP policy effectively replaces all previous versions created for similar prior purposes (including the may 1993 Region 5 RCRA Model QAPP).

The RCRA QAPP Instructions (Instructions)document describes the preparation of a QAPP in a series of elements. The focus of the Instructions is on the development of appropriate project objectives using a decision process appropriate for a RCRA investigation. In addition, content requirements for each element of a QAPP are provided.

It is critical to realize that these Instructions are not a stand-alone document, but rather must be used in conjunction with the U.S. EPA Region 5 *Example RCRA QAPP* and a pre-QAPP meeting with the appropriate U.S. EPA Project Coordinator/Permit Writer and U.S. EPA RCRA Enforcement/Permitting QA Coordinator. Full participation in a pre-QAPP meeting is likely to reduce the time and effort expended on preparing an acceptable QAPP. In order for this to occur, facility representatives are strongly encouraged to develop preliminary project objectives prior to the pre-QAPP meeting. Sections 3.4 and 3.5 of this Instruction document address development of project objectives.

The Instructions are organized according to the standard 16 Element QAPP structure. While this structure is generally recommended for RCRA project purposes, other organizational formats are acceptable, provided all requirements expressed herein have been substantively addressed. The use of different formats may be helpful if, for example, it is a multi-media investigation where the regulated facility encounters competing guidances. However, under such circumstances, the organizational format should be discussed during the pre-QAPP meeting.

New guidance documents prepared by the U.S. EPA's Quality Assurance Division (QAD) pertaining to Quality Assurance matters (i.e. EPA QA/G-5 and EPA QA/R-5) are reflected herein. In particular, new "elements" unaccounted for in previous versions of this document, have been incorporated into appropriate sections/elements. Each of these new items have been clearly identified. Largely for purposes of continuity, the "16 element format" has been preserved in this RCRA QAPP policy. Guidance contained in the May 1993 RCRA Model QAPP will not address the newly added components stemming from QAD's guidelines. For this reason alone, facility QAPPs prepared in accordance with superseded Region 5 QAPP guidance will be deficient.

Several appendices are also included. These appendices provide additional information on relevant topics and examples of acceptable presentation of information required for a QAPP prepared according to this Instructions document.

ACRONYM LIST

% R	Percent Recovery
AOC	Area of Concern
BOD	Biological Oxygen Demand
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Program
COD	Chemical Oxygen Demand
DCF	Document Control Format
DEFT	Decision Error Feasibility Trials
DNAPL	Denser-than-water Non-aqueous Phase Liquid
DQA	Data Quality Assessment
DQO	Data Quality Objective
EDQL	Ecological Data Quality Level
FID	Flame Ionization Detector
FSP	Field Sampling Plan
GC/EC	Gas Chromatograph/Electron Capture
GC/MS	Gas Chromatograph/Mass Spectrometry
HQ	Hazard Quotient
ICP	Inductively Coupled Plasma Spectrometry
IRIS	Integrated Risk Information System
LNAPL	Lighter-than-water Non-aqueous Phase Liquid
MCL	Maximum Contaminant Level
MS	Mass Spectroscopy
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAPL	Non-aqueous Phase Liquid
NIST	National Institute of Standards and Technology
NPD	Nitrogen-Phosphorus Thermionic Detector
OSWER	Office of Solid Waste and Emergency Response
PERA	Preliminary Ecological Risk Assessment
PID	Photo-ionization Detector
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goal
QA	Quality Assurance
QAD	Quality Assurance Division
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
RBSL	Risk Based Screening Level
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RPD	Relative Percent Difference
SERA	Screening Ecological Risk Assessment
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
TEGD	Technical Enforcement Guidance Document
TIC	Tentatively Identified Compound
TOC	Total Organic Carbon
TOX	Total Organic Halides
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
U.S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound

QAPP ELEMENT 1

SECTION 1.0 - TITLE/SIGNATURE PAGE

The QAPP must contain a Title/Signature Page which documents the following:

1) The complete title of the program and investigation (e.g. RCRA Facility Investigation, etc.) specifying the location (city, state) of the facility and its U.S. EPA identification number;

2) The firm that prepared the plan as well as the organization for whom it was prepared; and

3) The date and revision number.

Functionally, this page ensures that the desired content and level of detail are achieved through the review and approval by the following types of personnel:

- Facility Project Manager;
- QAPP Preparer (usually a contractor);
- U.S. EPA Project Manager/Permit Writer ;
- U.S. EPA RCRA Enforcement/Permitting Quality Assurance (QA) Coordinator; and
- Laboratory Directors.

The titles and names of all individuals appearing on the title page must be consistent with the references to these people elsewhere in the QAPP (e.g. project organization, corrective action, and QA reports to management sections).

QAPP ELEMENT 2

SECTION 2.0 - TABLE OF CONTENTS

The QAPP Table of Contents shall address each of the following items:

1) An "Introduction" to the QAPP shall be referenced in the QAPP's Table of Contents.

2) A serial listing of the QAPP elements shall be presented. The structure indicated in the Example Table of Contents is recommended.

3) A listing of any appendices and subsections which are required to augment the QAPP (i.e., standard operating procedures (SOPs), summaries of past data, etc.) shall be presented.

4) Following the list of appendices, a listing of any tables and figures which are required to augment the QAPP requirements shall be presented.

5) After the list of tables and/or figures will follow a complete listing of QAPP recipients.

All QAPP sections, tables, figures, and appendices and contents of individual appendices, shall be included in a Table of Contents.

Page numbers shall be added to all sections, figures, tables, and the Table of Contents of the submitted QAPP. Furthermore, page numbers will be presented in accordance with the Document Control Format (DCF). A DCF should be used to individually paginate each QAPP element to facilitate revisions as well as ensure that no pages are missing. The DCF is to be placed in the upper right hand corner of each page and shall include the project name; revision number; revision date; section title or number; and page number

The Project Name may be shortened or abridged as necessary. All page numbers will be stated relative to the total number in the section (e.g. Section 4, Page 2 of 8). A new QAPP section will be started at page one. All other documents which are referenced in the QAPP (Work Plan, Field Sampling Plan (FSP), etc.) and have become part of the QAPP by such reference should also include the DCF. The DCF used on this document is one example of an appropriate format.

QAPP ELEMENT 3

SECTION 3.0 - PROJECT DESCRIPTION

All the QAPP elements are significant, in that all can be viewed as integrally defining a process which when implemented can result in generated data of documented quality, and also hopefully of a known reliable nature. However, the Project Description is one of the most critical elements of a QAPP. For it is in this particular element that the purpose for implementing the project in a particular fashion, as well as the ultimate goals, are fully explained.

Programmatic regulatory provisions usually require that environmental chemical measurements be made in order to address certain federal RCRA requirements or other pertinent criteria such as State regulations and water quality criteria. However, because it is often the case that such conditions do not specify sampling and analytical objectives in detail, it is necessary to provide these details in the QAPP. Most often the project objectives are defined programmatically in the form of permit conditions or enforcement requirements. It is then necessary to define site-specific details in this Element of the QAPP to fully flesh out generally stated requirements, such as the need to determine the “horizontal and vertical extent and rate of contamination".

Poorly defined project objectives may be the area most likely to result in unusable data. If the purpose of the project is ill conceived, then the generated data may not be useful for programmatic goals, even if the data have been shown to be of known and documented quality. If the data are found not to address the real objectives that should have been defined before project implementation, then the investigation may have to be repeated!

QAPP preparers must present in this Element of the QAPP human health and ecological target decision levels (screening levels). Any generated data will be compared to these decision levels. The Project Description should also include or reference the items listed below. A technical person unfamiliar with the project must be able to understand what is provided in the QAPP.

- A statement of the decision(s) to be made or the question(s) to be answered.
- A description of the site, facility, process, and/or operating parameters to be studied.
- Specific anticipated uses of the data, including pertinent decision rules.
- A list of all environmental measurements to be performed, supported by appropriate rationale.
- A project schedule, indicating the timing of specific tasks, when samples are expected to be submitted to the laboratory, and the total project duration.
- A tabulated description and itemization of all specific tasks to be performed in the generation of field and laboratory data, linked to every specific objective and decision rule defined for the project.

- A summary table listing, for each sampling location, the total numbers of samples (including investigative, quality control (QC), split and reserve), sample type or matrix, and all measurements to be performed, differentiating where applicable the critical measurements from the noncritical measurements. (Critical measurements are those specifically emphasized in project decision rules. Noncritical measurements are those to be performed in conjunction with the reporting of identified critical measurements. An example of a set of noncritical measurements would be the reporting of tentatively identified compounds (TICs). The facility must specify which measurements are critical.)

The fundamental components of the Project Description are more fully described below. If sections in the RFI Workplan, or Description of Current Conditions Report address any of these items, then specific sections (page or section numbers) of the identified reports may be referenced in the Project Description Element of the QAPP.

SECTION 3.1 - INTRODUCTION

In the Introduction to the QAPP, the overall project objectives should be explained. This should be a succinct description of the project, including a brief statement addressing the phase(s) of the work and intended objectives of the investigation. Typically, the following kinds of objectives may be of concern:

- Determination of the vertical and horizontal extent of contamination and rate of migration of contaminants in soil, sediments, groundwater, surface water, etc...;

- Determination of the presence or absence of "hot spot" zones of contamination in soil, sediments, groundwater, surface water, etc...;

- Evaluation of relative site risks posed to human and ecological receptors by presence of known contaminants;

- Performance of tissue analysis to evaluate contaminant transfer through the food web to ecological receptors;

- Determination that the facility qualifies for the "no further action alternative" provision of a permit or enforcement order.

However, in site-specific cases, such general concepts cannot be meaningfully addressed without first assimilating other relevant factors and details into pertinent decision statements. Therefore, this section should answer the basic questions, "What do we need to learn from this investigation?", "Why do we need to perform this study?", and “What are the main issues that need to be resolved?”. Alternative actions that would result from each resolution should be identified.

SECTION 3.2 - SITE DESCRIPTION

The Site Description should focus on a description of site-specific features, including location, size, borders, important physical features, receiving watershed and airshed information, and topographic, geological and hydrogeological information. Each of these items should be clearly addressed. The QAPP preparer should also consider whether there are any unique or special site-specific features of any kind which may have some later bearing on the way in which data are obtained or interpreted.

SECTION 3.3 - SITE HISTORY AND BACKGROUND

Under the Site History and Background section of this Element, the chronological history of the site leading to its current status under RCRA should be outlined emphasizing the nature and operation of Solid Waste Management Units (SWMUs) and Area of Concern (AOC). Background information relevant to the resolution of each decision statement should be provided. Documentation of waste streams managed and releases known to have occurred on-site should be included. Also, provide a summary of any previous sampling and analysis efforts, with an overview of the results or copies of previous reports appended to the QAPP. Proper use, consideration and presentation of historical data is outlined in a guidance memorandum provided in Appendix A of this document. Site histories are unique and sometimes contain large historical gaps. Often, much of the known information has already been gathered in a report prior to the stage where an RFI is being conducted. Therefore, only summaries of this information may be required, provided that the facility can identify previously generated reports precisely by title, date, and author.

If the objectives of prior investigations which generated historical data are vague or unstated (e.g. “It was done to get a feel for site conditions”), the U.S. EPA Project Manager/Permit Writer may have to infer what the objectives actually were. Once the historical project objectives are determined, they need to be compared to the subject investigation objectives to determine whether or not they are compatible, and whether or not to continue the review of the historical data. Any of three outcomes are likely:

- If the objectives are similar, the historical data are likely to be of use. (Example: If the objective of both sampling events is/was to delineate a groundwater plume, historical data could provide useful information on the temporal history of the release. It would be worthwhile to continue the effort to evaluate the historical date.)

- If the data collection objectives are incompatible, then the historical data review may be immediately terminated. (Example: If the investigation objective is to determine the risk to humans from a known groundwater plume, and the objective of the historical data was to satisfy a regulatory agency that a particular tank was clean-closed, then the historical data may be of little use, and any further review will probably not be productive.)

- If the historical project objective is vague or unknown, the U.S. EPA Project Manager/Permit Writer must use his/her judgement to determine whether it is worth the effort to continue the review.

Prior to submitting historical data to U.S. EPA, the facility owner/operator or his designee must submit a signed certification indicating that to the best of his knowledge, no releases of hazardous wastes or hazardous constituents have occurred to environmental media of concern since the (respective) date(s) of historical data sampling. Further details pertaining to the certification process are presented in Appendix A. If the certification can't be made, then the historical data must be rejected. Under certain circumstances, it may also be necessary to verify the nature of historical data. Appendix A should be consulted for instructions on how to perform verification of a sampling event.

SECTION 3.4 - PROJECT OBJECTIVES

The Project Objectives and Intended Data Usages, and associated decision rules, must be clearly outlined. Any QAPP must include a statement of the overall project objectives and project specific objectives. This section presents an outline of the specific usages for all data to be obtained, including any data generated from field screening and/or field measurements. The intended data usages should be presented in tabular format.

The facility must present a strategy for accomplishing the overall objectives. However, this strategy must be expressed in terms of specific field and laboratory measurements that will be performed. The strategy must define an analytical scheme that is conceptually consistent with the overall objectives and decision statements. This information can sometimes be tabulated meaningfully by citing the overall objectives which will be satisfied by performing each measurement.

Specific project objectives, or decision rules, including human health and ecological objectives founded in RCRA Permit or Enforcement Order requirements, entail hypotheses that are to be proved or disproved and will prescribe data quality necessary to support or defend the results obtained. While overall project objectives may be proposed in narrative form, specific objectives must be expressed quantitatively, or in the form of "if...then" decision rules.

Development of decision rules is associated with the data quality objectives (DQOs) process, outlined in Element 5 of this document. Specific objectives and associated tasks identified with overall project objectives for any measurement work to be conducted should be summarized in the form of decision rules. The underlying rationale and, to the extent necessary, statistical foundation supporting these decision rules should be presented in Element 5, the Data Quality Objectives section of a QAPP. Therefore, Elements 3 and 5 must be developed together in order to ensure that they are in agreement.

Tabulation of such information will facilitate review. Without such tables, it is difficult to determine whether the proposed analytical methods are sufficiently sensitive or precise, or whether a sufficient number of samples are being collected, or whether decisions to be made on the basis of generated data will be of sufficient reliability and quality.

In order to adequately express the specific project objectives, the following information should be tabulated in this portion of a QAPP.

- Target compounds, measurement parameters and sample matrices.

- Action levels or regulatory standards (screening levels) required for the project, with respect to each intended measurement parameter by matrix, in order to achieve the overall human health and ecological objectives.

- Laboratory-specific analytical reporting limits for proposed field and fixed laboratory methods that will achieve the required action levels and analytical goals targeted for the investigation.

- Summary statistic(s), e.g. mean, maximum, range, etc., which specify the form the data will be in when compared to action levels or standards expressed in decision rules.

- Acceptable level of confidence in the data needed for the stated purposes, or the acceptable amount of uncertainty.

Appropriate decision rules cannot be developed until due consideration has been given to the project's intended data usages. Sometimes project objectives must be stated somewhat less quantitatively, particularly in situations where the use of a rigorously statistical DQO process cannot be employed.

In special cases, such as when volatile organic compounds (VOCs) data are required for a soil matrix sample, special consideration must be give to the sampling and preservation techniques. (See Appendix B.)

SECTION 3.5 - TARGET PARAMETER LIST

For the purposes of the RCRA program, the site specific Target Parameter List may be derived from any of a number of lists such as the Hazardous Substance List, the 40 CFR Part 261 Appendix VIII or IX lists, State regulations, the toxicity characteristic list, the "Skinner List", method specific lists (where the methods have been validated for sets of constituents regulated under RCRA or by the U.S. EPA, such as the most recently drafted SW-846 methods or the CLP methods), or other parameters such as those of possible use to hydrologists in assessing general groundwater quality. Most importantly, however, the proposed target parameter list must reflect the requirements of the investigation, and address the specific project objectives. The tabulated list should specify which of all the parameters to be reported are the critical measurement parameters.

SECTION 3.6 - RISK-RELATED ISSUES

Section 3.6.1 - Ecological Data Quality Levels

Appendix C describes ecological data quality levels (EDQLs) developed by Region 5 to focus project objectives and data requirements during the planning and implementation of field investigations. These EDQL values represent the most conservative criteria (i.e. based on indicator species). Following a SERA the selection of indicator species (a conceptual model) may result in the use of less conservative EDQL values. A table for the EDQLs is provided in Appendix C.

Based on existing information and a rapid field assessment (if required), a completed screening ecological risk assessment (SERA) and a draft preliminary ecological risk assessment (PERA) outline may be provided. Alternatively, it may be possible to perform SERAs and PERAs concurrently with the RFI.

Section 3.6.2 - Human Health Risk-Related Issues

Consideration of Human Health Risk-Related Issues, which may impact field activities, should be addressed at the initial stages of QAPP preparation. Consideration of these issues at an early stage will: 1) ensure that data collected in the initial phases of the investigation will be of sufficient quality and quantity to support a baseline risk assessment; and 2) help streamline the Corrective Action process by preventing iterations of field activities (i.e., resampling). Risk-related issues to be considered during QAPP preparation are Land Use Planning and Assumptions, Selection of Detection Limits/Reporting Limits, Risk-Based Screening Options, Background Sampling, and Data Quality for Assessing Human Health Risk. These points are addressed below.

Section 3.6.2.1 - Land Use Planning and Assumptions

Current and future land use planning and assumptions should be developed as part of the conceptual site model (e.g., Field Investigation Work Plan) in the early phases of QAPP preparation. Resolution of the land use issue early in the process will allow the selection of appropriate exposure scenarios for evaluation in the risk assessment. This selection will also influence the choice of media-specific screening levels (i.e., "action levels") and the required detection limits that will drive RFI sampling (see Section 3.6.2.2 below). The OSWER directive on land use (*Land Use in the CERCLA Remedy Selection Process*; OSWER 9355.7-04, May 25, 1995) should be used to determine the types of information needed to support and justify assumptions regarding future land use. It should be noted that the consideration of non-residential future land uses during an RFI (or as part of a presumptive remedy) may require the implementation of institutional controls and land use restrictions for part or all of a particular facility.

Section 3.6.2.2 - Selection of Detection Limits/Reporting Limits

During the development of the QAPP, the selection of detection limits/reporting limits is critical to obtaining high quality data. Detection limits/reporting limits should be selected to yield data with a suitable sensitivity for use in calculating risk levels in the baseline risk assessment. In addition, the choice of sufficiently sensitive reporting limits is critical in situations where justification is necessary for elimination of chemicals never detected in any medium, based on minimal risk (see Section 3.6.2.3). Therefore, the Region 5 Risk Based Screening Levels (RBSLs) (see Appendix D) should be used as the starting point for developing sensitive detection limits for chemicals targeted in the investigation. The purpose of the RBSLs is to provide conservative human health risk-based media concentrations (soil, groundwater) which establish analytical sensitivities for method reporting limits.

Section 3.6.2.3 - Risk-Based Screening Options

Individual chemical constituents may be eliminated from further consideration by comparison of

each site-specific constituent concentration to a pre-determined risk-based screening level. Risk-based screening of chemical constituents in soil may be conducted using the "generic" soil screening levels (SSLs) listed in Appendix D. These values are taken from the *EPA Soil Screening Guidance: Technical Background Document* (OSWER Publication 9355.4-17A; EPA/540/R-95/128, May 1996). They apply specifically to the residential land use scenario. If the use of a generic SSL value is not appropriate or if no value is available for a given chemical, the following two options should be considered.

- Development of site-specific screening levels for soil contaminants using the methodology given in the *EPA Soil Screening Guidance.*

- Use of the Region 9 Preliminary Remediation Goals (PRGs) (EPA-Region 9; August 1996).

Screening levels will be evaluated for appropriateness on a site-specific basis according to the following criteria.

- The analytical detection limit/reporting limit for a constituent must be sufficient to demonstrate that the proposed screening level can be achieved through field sampling and laboratory analysis.

- Risk-based screening procedures should consider additive (cumulative) cancer and noncancer health impacts.

As stated in the U.S. EPA *Soil Screening Guidance*, this is accomplished by setting a "one-in-a-million" (1×10^{-6}) individual excess target risk for each carcinogenic chemical and a target hazard quotient (HQ) of 1.0 for each noncarcinogenic chemical. These target levels are based on the following rationale.

- Since the carcinogenic risk of multiple chemicals is additive, the 1×10^{-6} risk screening level for individual chemicals and pathways will lead to a cumulative cancer risk within the 1×10^{-6} to 1×10^{-4} range for the combination of chemicals usually found at Superfund or RCRA sites.

- An HQ of 1.0 corresponds to a threshold dose below which adverse health effects are not expected to occur.

In general, HQs should only be added for chemicals which exhibit the same toxic endpoint and/or mechanism of action. Consequently, if multiple chemicals are present which act by the same endpoint/mechanism, the combined HQ may be a value greater than 1.0. Therefore, if the results of a screening procedure indicate that significant levels of cumulative risk or cumulative toxic potential exist, the U.S. EPA may require further investigation of specific chemicals and locations at a given site. Risk-based screening of chemical constituents in ground water may be conducted by comparison of site data to Maximum Contaminant Levels (MCLs), based upon the common use of MCLs as cleanup levels (see Appendix D). Chemical constituents which do not have listed MCLs should be screened against the Region 9 PRG values for drinking water. In some situations, State groundwater remediation criteria may be more stringent than the MCLs. For

these cases, the State remedial levels may be more appropriate screening levels for groundwater. The following guidance documents may be of utility in developing this portion of the QAPP.

RISK ASSESSMENT - REFERENCE LIST

Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual, Part A (EPA/540/1-89/00; December 1989).

Human Health Evaluation Manual, Supplemental Guidance; Standard Default Exposure Factors (OSWER Directive 9285.6-30; March 25, 1991).

Supplemental Guidance to RAGS: Calculating the Concentration Term (U.S. EPA Publication 9285.7-081; OSWER; Washington, D.C.; May 1992).

Soil Screening Guidance: Users Guide (OSWER Publication 9355.4-23; April 1996).

Soil Screening Guidance: Technical Background Document (EPA/54/OR-95/128; May 1996).

Land Use in the CERCLA Remedy Selection Process (OSWER Directive 9355.7-04; May 25, 1995).

Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive 9355.4-12; July 1994).

U.S. EPA Region 5 Waste Management Branch RCRA Data Quality Levels (December 1995).

Drinking Water Regulations and Health Advisories (EPA 822-B-96-002; Office of Water; October 1996)

Exposure Factors Handbook; Volume I: General Factors (EPA/600/P-95/002Ba; August 1996).

Exposure Factors Handbook; Volume II: Food Ingestion Factors (EPA/600/P-95/002Bb; August 1996).

Exposure Factors Handbook; Volume III: Activity Factors (EPA/600/P-95/002Bc; August 1996)

Dermal Exposure Assessment: Principles and Applications (EPA/600/8-91/011B; January 1992).

Integrated Risk Information System (IRIS); (U.S. EPA on-line database located at http;//www.epa.gov/iris)

Health Effects Assessment Summary Tables; FY-1997 Update (EPA-540-R-97-036; July 1997).

Framework For Ecological Risk Assessment (EPA/630/R-92/001: February 1992).

Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA/540/R-97/006; June 1997).

Ecological Assessment of Hazardous Waste Sites; A Field and Laboratory Reference Document (EPA 600/3-89/013; March 1989).

Ecological Risk Assessment Guidance For RCRA Corrective Action - Region 5 (Interim Draft; October 1994).

Ecological Data Quality Levels, RCRA Appendix IX Hazardous Constituents (U.S. EPA - Region 5; Draft Report, August 1997).

Section 3.6.2.4 - Background Sampling

Background sampling should be conducted on natural media which has not been impacted by facility operations. Background samples should be collected from each particular environmental medium of concern. A suitable number of samples should be collected from all horizons and matrices in order to represent background conditions in a statistically meaningful way. Site-related samples for a particular environmental medium should only be compared to background samples taken from the same environmental medium, and comparable depth to that of investigative samples.

For risk assessment application, evaluation of data with respect to background concentrations of chemicals is only relevant for inorganic chemicals which occur naturally in the environment. Organic and inorganic chemical constituents normally associated with industrial or anthropogenic activities should not be compared to background concentrations.

If "surrogate background" values (e.g., local background, local clean soil) are proposed *in lieu* of actual background sampling performed during the investigation, the use of these values must be justified in the QAPP on a site-specific basis.

Section 3.6.2.5 - Data Quality for Assessing Human Health Risk

Analysis of data quality for assessing human health risk should be conducted only on high quality sampling data associated with fully approved quality assurance/quality control (QA/QC) procedures and review. High quality data will meet the following criteria:

- Consistency with the data objectives for the current investigation;
- Existence of laboratory data packages to support constituent calibration and data reporting procedures;
- Adherence to proper sample holding times and "chain-of-custody"; and
- Application of constituent detection limits/reporting limits that exhibit appropriate sensitivity for current risk assessment needs.

QAPP ELEMENT 4

SECTION 4.0 - PROJECT ORGANIZATION AND RESPONSIBILITY

SECTION 4.1 - MANAGEMENT RESPONSIBILITIES

All managers who will have any responsibility in this project will be identified, by name and position, affiliation/organization and their responsibilities will be specifically defined. This includes the facility, their contractors, U.S. EPA, and State management (if applicable), and any other entity having a substantive management responsibility for the project.

SECTION 4.2 - QA RESPONSIBILITIES

The responsibilities of all QA personnel involved in this project will be stated by position, affiliation/organization and their responsibilities will be delineated. The section shall clearly specify the QA personnel responsible for the following:

1) data validation;

2) data assessment; and

3) internal performance and system audits.

SECTION 4.3 - FIELD RESPONSIBILITIES

The responsibility of the field personnel will be outlined in this section. Included in this section shall be the person responsible for identifying and documenting nonconformances through corrective action.

SECTION 4.4 - LABORATORY RESPONSIBILITIES

Laboratory responsibilities will be outlined in this section. This includes stating the location of all project laboratories (city and state) and listing the analytes and matrices to be tested at each laboratory. Any laboratory staff with responsibility during this project will have those duties stated (e.g., lab sample custodian, etc.).

SECTION 4.5 - PROJECT ORGANIZATION DIAGRAM

This diagram will include ALL personnel (no more, no less) discussed in the text and will show the lines of authority and communication. Titles and names used in the text and organization chart in this section shall be consistent with those used elsewhere in the QAPP.

SECTION 4.6 - SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

Special training requirements and certification for nonroutine field sampling techniques, field analyses, laboratory analyses or data validation must be presented. The nature of special training needed and the assigned individuals' certification or training schedule should be indicated.

QAPP ELEMENT 5

SECTION 5.0 - QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The purpose of this section is to describe project-specific objectives in terms of accuracy, precision, completeness, representativeness, and comparability. It is also intended to define project-specific decision rules which will establish the extent to which data will be both useable and reliable for project purposes. This element of the QAPP must be developed in conjunction with Element 3, Project Description, to ensure that the QA objectives properly support the project objectives and address the entire Target Parameter List. See Sections 3.4 and 3.5 for further discussion.

SECTION 5.1 - CHOICE OF DECISION RULES

Project-specific QA objectives stated in this Element will rely on a systematic planning approach for data collection in accordance with the guidance manual *Guidance for the Data Quality Objectives Process*[1]. This document was designed to help facilities plan, implement, and evaluate the DQO process, with a focus on environmental decision-making for regulatory and enforcement actions. This process will be used to ensure that the sampling and analytical objectives are well defined. Decision rules must reflect project goals. In special cases involving certain measurement parameters, it is possible to use a more statistically-based approach to the development of site-specific DQOs. In such cases, the referenced guidance document may assist QAPP writers.

SECTION 5.2 - THE DQO PROCESS

As explained in the referenced guidance document, the DQO process is iterative by nature. Some RCRA Corrective Action projects involve data collection activities which may be regarded as preliminary at the outset, because the site under investigation is not well characterized. Therefore, early phases of work focus on detection-limit and accuracy-based DQOs, involving a broad list of critical measurement parameters. In these stages, it is most critical to obtain data that are accurate, reliable and of adequate sensitivity for a complex target parameter list. However, in later phases of the investigation, or in cases where sites are well characterized and risk assessments have been completed, investigators should instead focus on the key indicator parameter(s) which will drive final cleanup decisions.

The statistical concepts outlined in the referenced manual ensure that site-specific DQOs are rigorously developed, specifically defining the goals of the sampling plan and guiding the activities of data collection. The DQO process will establish specific decision rules and numerically-founded goals by which the data collection activity will be defined. If generated data are statistically valid and reliable, then the data should directly apply to established decision rules. Decision rules should be conclusive in nature. There should be no need for additional sampling in order to meet the project objectives, unless the data are invalid. Therefore, early in the process, practicable and applicable questions pertaining to current and future Land Use should be addressed (See also Section 3.6.2.1).

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[1]For additional information, contact the U.S. EPA Quality Assurance Division (QAD) at (202)564-6830. Request EPA QA/G4 - *Guidance for the Data Quality Objective Process*, and EPA QA-4D - *Data Quality Objective Decision Errors Feasibility Trials (DEFT) Software*.

In cases where defining project-specific objectives using the full statistical rigor of the DQO process is not applicable, or when using a non-statistical based approach or "best judgement" strategy, sufficient field information and analytical data will need to be collected to compensate for the lack of statistically based assumptions supporting the decision rule(s).

SECTION 5.3 - DQO DISCUSSION CONTENT REQUIREMENTS

This Element of the QAPP shall address each of the following areas.

Section 5.3.1 - Project-Specific QA Objectives

The discussion of project-specific QA objectives shall include:

1) A table indicating the anticipated method reporting limits (Practical Quantitation Limits, PQLs) that will permit specific project objectives to be met. If this table is presented in the Project Description section, then a reference to that section should be given.

2) Completeness - The definition of completeness along with the percent of completeness to be obtained for the project will be stated for both field and laboratory analyses.

3) Decision Rule - The measures to be employed to ensure the application of the decision rule for field and laboratory measurements will be stated.

4) Representativeness - The definition of representativeness along with the measure to be employed to ensure representativeness for field and laboratory measurements will be stated.

5) Comparability - The definition of comparability along with the measures to be employed to ensure comparability for field and laboratory measurements will be stated.

Section 5.3.2 - Analytical QA Objectives

The discussion of analytical QA objectives shall address:

1) A table of control limits will be supplied. The control limits for all QC samples/audits (e.g., matrix spikes/matrix spike duplicates (MS/MSDs), surrogates, blanks, etc.) for all analytes to be quantitated will be stated.

2) Precision - The definition for precision and a description of how precision will be assessed for field and laboratory measurements will be presented. Sample duplicates are preferred versus MS/MSDs for inorganic analyses. MS/MSDs are commonly done for organic analyses.

3) Accuracy - The definition for accuracy and a description of how accuracy will be assessed for field and laboratory measurements will be presented.

4) Frequency of QC Audits - In the case of MSs, MS/MSDs, and sample duplicates, collection frequency should incorporate at least one sample/sample duplicate or MS/MSD pair for each SWMU type when unique SWMUs are encountered.

Method Specific Concerns:

It is pertinent to establish rationale for the matrix spiking compounds selected for the study. In Method 3500B (Update III of SW-846, *Test Methods for Evaluating Solid Wastes Physical/Chemistry Methods*, 1996, 3rd edition), Sections 5.5.4 and 8.3.1 recommend the selection of appropriate compounds for organic MS/MSDs corresponding to project DQOs. At the same time, a core list of six pesticide MS compounds exists for Method 8081, five volatile MS compounds are used for Method 8260 and 11 MS semivolatile acid or neutral compounds are used for Method 8270. Therefore, matrix spiking compounds and laboratory control solutions should be proposed which reflect the compounds of concern, in addition to the core compounds used to assess overall method performance. Special concerns for organic matrix spikes are:

a) Selection of pesticides and/or Aroclors for Methods 8081/8082.

b) Selection of specialized volatiles or water miscible volatiles (acetone, acetonitrile, acrylonitrile, etc.) whose performance cannot be assessed by the five core MS compounds or three surrogates.

c) When Appendix IX is to be used, representative basic compounds (aniline, pyridine, 2-picoline, etc.) should be added to the Method 8270 core MS list. Appendix IX requires a basic extraction for water.

d) Selection of matrix spikes for inorganic analyses are usually not a concern since inorganic test procedures usually use all target analytes for matrix spikes. However, the oxidation state or compound form of an inorganic analyte (chromium, mercury, cyanide, Kjeldahl nitrogen, etc.) can be of concern for certain inorganic analyses.

e) The matrix spike concentration to use should be reviewed, especially for inorganic analyses. Too small an MS concentration will be overwhelmed by site contaminant levels. For contaminants such as chromium or lead, a contaminants' action level (such as 500 mg/kg lead in soil) can be the best MS concentration to use. When appropriate, analogous considerations can be given for spiking organic compounds at target action levels.

QAPP ELEMENT 6

SECTION 6.0 - SAMPLING PROCEDURES

This section will provide detailed, stepwise sampling procedures for all environmental media to be investigated and evaluated. An environmental medium is a unique sample matrix which may be a solid, liquid, gas, animal, or vegetable (e.g., soil, sediment, rock, waste, non-aqueous phase liquids (NAPLs), surface water, groundwater, seeps, soil gas, air, fish, macroinvertebrates, vegetation, etc.). Solid environmental media (e.g., soil and sediment) or liquid environmental media (e.g., groundwater from monitoring wells and residential wells) may be similar but are considered separate and unique matrices for sampling purposes.

The sampling strategy should include a sufficient number of samples for each target parameter, by matrix, to be collected at each SWMU or AOC such that critical decisions can ultimately be made at an appropriate level of confidence. The rationale for sample numbers should be founded on an understanding of how the project objectives will ultimately be assessed.

SECTION 6.1 - CONTENT REQUIREMENTS

This section will specify the following.

1) All necessary equipment for sampling the matrices to be investigated.

2) Detailed "cookbook" procedures to collect investigative samples, including the use of any field-screening procedures (such as PID screening of soils, immunoassay test kits, soil-gas survey, or X-ray fluorescence), field-filtering (if warranted), and the determination of "background" for total metals (See Appendix M, Guidelines for the Preparation of Standard Operating Procedures (SOPs) for Field and Laboratory Measurements and Appendix R, Example Field Standard Operating Procedure.)

3) All sample locations (diagram or site map) for each matrix and the rationale for their selection. A table (see Appendix H, Example Summary of Sampling and Analysis Program) should be included that summarizes the matrices, field and laboratory parameters, and their frequency of collection. Whenever soil and sediment samples are collected for purposes of “hot spot” screening or site characterization, it is highly recommended that a grid system be applied so as to delimit presumed extent of contamination (provided a sufficient number of samples are collected).

4) Any pertinent installation procedures required in order to obtain investigative samples, such as monitoring well construction or direct-push probes.

5) Any supplementary field measurements such as pH, specific conductance, turbidity, temperature, water levels, stream gaging, surveying, hydraulic conductivity testing, geophysical survey and logging, or seismic survey.

6) Explicit instructions for collecting each applicable type of QC sample for each matrix and associated analytical parameter. These QC samples will include field duplicates,

field blanks, trip blanks (for aqueous VOC samples), matrix spike, matrix spike duplicates, etc.

7) The order of analytical parameter sample fraction collection (i.e. "VOCs first, followed by extractable organics...") for each matrix.

8) Sample containers for each analytical fraction, matrix type, and concentration level. Specifically, the following will be addressed:

   a) The type of container.

   b) The container volume.

   c) The number of containers required for each analysis.

   d) Specific chemical/temperature preservations required.

   e) Recommended holding times before analysis, including before and after extraction for organics.

9) The procedure to be used for obtaining contaminant-free sample containers. Specifically, the following will be addressed:

   a) Detailed procedures used to prepare contaminant-free sample containers for each container/analytical fraction type.

   b) The criteria all containers must meet (i.e., "benzene < 1 ppb," etc.).

   c) How the criteria are verified and the frequency of the verification (i.e. "{Laboratory} will conduct a GC/MS analysis using CLP OLM01.8 at a frequency of one VOC and SVOC container per lot of 100 sample containers.").

   d) Who will prepare the containers (i.e. "Containers will be prepared by [Sample Container Company].").

   e) How the criteria are documented (i.e., "[Sample Container Company] will provide a certified analysis for each sample container lot.").

10) Decontamination procedures for field equipment, including management practices for investigation-derived wastes.

11) An appropriately detailed system for labeling and numbering all samples collected such that their traceability to field locations and collection circumstances can be ensured.

12) Sample packaging and shipping procedures to be used as part of the field chain-of-custody procedures (See also Appendix N, Example Chain-of-Custody Sequence, and Appendix O, Sample Tag Instructions.).

The information to be supplied in the QAPP can be referenced to the FSP. However, the QAPP, including FSP sections included by reference shall 1) address ALL requirements stated in this section, 2) provide very detailed information, and 3) provide the specific reference to the FSP where the requested information is located. If these criteria cannot be met by the FSP, then the required information must be presented in the QAPP.

SECTION 6.2 - REFERENCES

The following list identifies guidance documents, by subject, which may be useful in preparing and implementing sampling procedures. This list does not necessarily include every guidance document available for performing field work under Corrective Action.

GENERAL

Interim Final RCRA Facility Investigation (RFI) Guidance, Volumes I-IV, EPA/530/SW-89-031, May 1989.

GROUND WATER

RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD), OSWER Directive 9950.1, September 1986.

Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells, EPA/600/4-89/034, April 1989.

RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530/R-93/001, November 1992.

Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, EPA/540/S-95/504, April 1996.

SOILS

Soil Sampling Quality Assurance User's Guide, EPA/600/8-89/046, March 1989.

Soil Screening Guidance: Users Guide, OSWER 9355.4-23, April 1996.

Soil Screening Guidance: Technical Background Document, OSWER 9355.4-17A, May 1996.

FIELD SCREENING METHODS

Initiatives to Promote Innovative Technology in Waste Management, OSWER 9380.0-25, April 29, 1996.

The Use of Field Methods to Support RFI Streamlining, U.S. EPA, Region 5 Memorandum, June 20, 1997 (included as Appendix P of this document).

WASTE SAMPLING

Characterizing Heterogeneous Wastes: Methods and Recommendations, EPA/600/R-92/033, February 1992.

Guide to Management of Investigation-Derived Wastes, OSWER 9345.3-03FS, April 1, 1992.

Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes: A Guidance Manual, OSWER 9938.4-03, April 1994.

BACKGROUND SAMPLING

Engineering Forum Issue: Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites, EPA/540/5-96/500, December 1995.

NON-AQUEOUS PHASE LIQUIDS

Considerations in Ground-Water Remediation at Superfund Sites and RCRA Facilities--Update, OSWER 9283.1-06, May 27, 1992.

QAPP ELEMENT 7

SECTION 7.0 - CUSTODY PROCEDURES

Chain-of-custody is defined as the sequence of persons who have the item in custody. Chain-of-custody will be demonstrated by documenting that the item in question was always in a state of custody. This will be accomplished through a combination of field and laboratory records that demonstrate possession and transfer of custody.

This element will provide detailed procedures for chain-of-custody for field activities, laboratory activities, and final evidence files as discussed below.

SECTION 7.1 - FIELD CUSTODY PROCEDURES

Detailed custody procedures will be stated for evidence collected in the field. All documents, logbooks, photographs, measurements, analyses, samples collected, etc. must be addressed in the field custody procedures. Detailed explanations will include:

1) Procedures for transfer of custody between individuals.

2) A sample numbering system (if not presented in another QAPP section).

3) Sample packaging and shipment procedures to an off site laboratory.

4) Chronological sequences and instructions for completing all field custody documents as well as copies of each document (as applicable):

   a) The field logbook entry shall provide all information pertinent to the collection of field samples including locations, number/types of samples, measurements, sampling/atmospheric conditions, observations, etc. The field logbook will be a bound volume assigned to an individual field team member. All entries will be completed with a permanent ink pen with no erasures or whiteout used. All entries will be signed/dated. Any entry which is to be deleted shall use a single crossout which is signed/dated.

   b) A sample tag is attached to each individual sample aliquot for each investigative or QC sample. An example sample tag with instructions for completion is found in Appendix O, Sample Tag Instructions. At a minimum, the tag will include the field sample number, location (if not already encoded in the sample number), date/time of collection and type of analysis. A space for the laboratory sample number (provided by the laboratory upon log-in) is also required.

      A sample tag may be attached to the sample container with a wire around the container neck through a reinforced hole in the tag. All tag entries are made with a waterproof, permanent ink pen.

While sample labels (described below) may be used in addition to tags, tags must always be used whenever chain-of-custody is required! The sample tag is the only physical evidence of the sample aliquot as carried through the entire custody process outside of keeping all sample containers. Sample labels cannot usually be removed intact and often do not include enough space for information on smaller containers. Sample tags allow for disposal of sample containers once the samples have exceeded their holding times.

c) As noted above, sample labels are optional when chain-of-custody is required. Sample labels may repeat some of the information provided on tags but usually cannot be removed intact.

d) A chain-of custody record form is used to record information pertinent to all samples being shipped in the same cooler. In general, the form will record sample aliqouts shipped together (i.e. extractable organics or metals) to the same laboratory. The form will also include spaces for transfers of custody by the field team as well as for log-in by the lab sample custodian. See also Appendix N, Example Chain-of-Custody Sequence.

e) Shipping cooler custody seals are placed on the edges of the cooler between the lid and sides to determine whether coolers may have been tampered with. The custody record form, along with all associated samples with tags, preservative (i.e., ice) and packing material are placed in the cooler prior to sealing with one or more seals. Custody seals should be signed and dated by the field team leader.

f) Airbills used by the shipping company are often overlooked in the custody chain. Airbills are the only means to document and ensure continuity in custody between the shipment of samples from the field until arrival at the laboratory. Copies of all completed airbills must be included as part of the final custody documentation.

SECTION 7.2 - LABORATORY CUSTODY PROCEDURES

Detailed laboratory custody procedures specific to each laboratory associated with the project will be stated. The facility and its field contractor must ensure continuity between field and laboratory custody procedures. Laboratory custody procedures will:

1) Begin when samples are received by the laboratory.

2) Maintain the chain-of-custody initiated in the field.

3) Provide the chronological sequence from sample log-in through sample analysis and disposal.

4) Provide detailed log-in procedures.

5) Detail the internal sample tracking and numbering systems.

6) Identify the sample custodian.

7) Detail transfers of custody within the laboratory.

8) Provide examples of internal custody documents (with instructions for completion).

9) Specify how and where samples are stored.

10) Specify how and when samples, extracts, and digestates are disposed.

11) Specify how custody of analytical data is maintained.

12) Specify how analytical data and custody records are "purged" from the custody of the lab to the final evidence file.

SECTION 7.3 - FINAL EVIDENCE FILES

This section will specify:

1) The contents of the final evidence file.

2) The identification of the file custodian.

3) The location where the file will be maintained in a secure, limited access area.

4) The length of time (as mandated by U.S. EPA) that the file will be maintained. This may be specified in an order, and will be six (6) years after termination of the order at a minimum. The file must be offered to U.S. EPA prior to disposal.

QAPP ELEMENT 8

SECTION 8.0 - CALIBRATION PROCEDURES AND FREQUENCY

This section will include a description of the calibration procedures and the frequency with which these procedures will be performed for both field and laboratory instruments. Each calibration procedure will also include the acceptance criteria and the conditions that will require recalibration. The accuracy and traceability of the calibration standards used must be properly documented.

Note, all SOPs will include a section on instrument calibration if the format described in Appendix M, *Guidelines For The Preparation of Standard Operating Procedures (SOPs) For Field and Laboratory Measurements*, is followed. For additional discussion, refer to Section 9.0 and Appendix R of this document.

Any deviation from an SOP must be explained and justified in this element, even if the deviation is only temporary for the purpose of the subject investigation. If the deviation is permanent, the SOP must be revised and resubmitted to the U.S. EPA.

It is recommended that the specific calibration procedures, frequencies and acceptance criteria be tabulated, along with specific references to SOP sections from which this information has been derived. Narrative summaries of the procedures are unacceptable.

SECTION 8.1 - FIELD CALIBRATIONS

This element shall address initial and continuing calibrations, as applicable, for all field instruments. Frequency and QC criteria for each type of calibration for each analytical method shall be described in addition to the actual calibration procedures.

SECTION 8.2 - LABORATORY CALIBRATIONS

All calibrations associated with each laboratory method shall be addressed. For each method, the procedure, frequency and QC criteria for each applicable type of calibration should be presented, as discussed below.

1) The initial calibration for each instrument, generally a three or five point calibration. (Note, the ICP only requires a two point initial calibration.)

2) The initial calibration verification, where applicable.

3) All continuing calibrations.

QAPP ELEMENT 9

SECTION 9.0 - ANALYTICAL PROCEDURES

This section should describe the field and laboratory analytical procedures to be used for the site investigation. Field analytical procedures are those procedures which generate analytical data to be used in a decision-making process involved with sample selection or site screening (e.g., field screening with a GC to determine particular constituent concentrations). Laboratory analytical procedures include organic and inorganic constituents as well as characteristic matrix concentrations (e.g., BOD, COD, TOC, TOX, TPH, etc.). These procedures will provide information for the purpose of meeting defined project objectives. Additionally, Regional guidance, policies and examples are expressed in Appendices E, F, G, I, and J. These documents must be consulted before attempting to write this portion of a QAPP.

Note, the SOPs, method validation studies, and sample data packages discussed below should be submitted along with the QAPP and be referenced as attachments in the document. The types of information which must be included in this Element are described below.

SECTION 9.1 - ANALYTICAL PARAMETERS

The analytical parameters and matrices to be tested for each laboratory involved in the project must be provided. A tabular presentation is recommended. Each laboratory address will be stated in this section of the QAPP. A reference to the specific subsection in QAPP Section 2 is acceptable to satisfy this requirement.

SECTION 9.2 - SAMPLE PREPARATION METHODS

SOPs for sample preparation (i.e., extraction, concentration, etc., for organics; digestion, dilutions, etc., for inorganics) and cleanup methods, for all types of matrices, if not included in the determinative SOPs will be cited in this section of the QAPP. Determinative SOPs are those that describe the qualitative/quantitative analysis of specific analyte groups which may or may not include the sample preparation and cleanup of the extracts. For example, in *The Test Methods for Evaluating Solid Waste (SW-846)*, the sample preparation and cleanup methods are cited independent of the determinative instrumental methods.

In certain cases, where it is important to address specific objectives, standard analytical approaches may not suffice. Alternatively, certain strategies may be adapted as outlined in Appendix I of this document. Preferably, only promulgated methods should be utilized, but other methods superseded by regulation or “non-EPA” methods may be proposed and approved if adequate objectives-based performance can be demonstrated.

SECTION 9.3 - ANALYTICAL METHODS

SOPs for all analyses that will be performed, either in the field or laboratory, on the samples collected from the site under investigation will be stated. The SOPs may be based on SW-846, or other U.S. EPA methods, such as those promulgated under the Clean Water Act (e.g. U.S. EPA

600 Series Organic Methods) and Safe Drinking Water Act (e.g., U.S. EPA 500 Series Methods) provided that the methods are sufficient to meet project objectives. Some SOPs for inorganic analysis will be based on EPA-600/4-79-020 *"Method for Chemical Analysis of Water and Wastes."* The SOPs must be detailed and specify analytes and matrices of interest for this RCRA investigation. Pertinent sections of the equivalent SW-846 method may be referenced in the SOP, but need not be included if these sections are followed without modification.

If any referenced sections offer several options, the option selected must be clearly stated. To the extent possible, all SOPs should follow a definite format as described in the attached U.S. EPA Region 5 document *Guidelines For the Preparation of Standard Operating Procedures (SOPs) For Field And Laboratory Measurements* which is included in Appendix M.

SECTION 9.4 - CONFIRMATORY ANALYSIS METHODS

SOPs to be used for confirmatory analysis of detected compounds, if applicable, will be stated in this section. The basis for these SOPs will be the U.S. EPA SW-846, 600 or 500 Series Methods, as stated earlier. For example, if a compound determined by GC/EC will be confirmed using a different detector system (such as FID, NPD, MS, etc.), then the SOP will have to be included in the QAPP.

SECTION 9.5 - METHOD VALIDATION STUDIES

An explanation of how any method validation study (including detection limit study) was conducted for a "nonstandard" method must be included. This should be based on the field or laboratory SOPs and include the criteria for acceptance, rejection or qualification of data. A method validation study is required any time a method is modified, is used to determine "nonstandard" analytes, or is used to report detection levels lower than standard levels for human health or ecological risk purposes.

SECTION 9.6 - SUMMARY TABLES

Summary tables of analyte groups of interest (e.g., VOCs, acid/base/neutrals, metals, nutrients, etc.), including the appropriate field and laboratory SOP numbers and U.S. EPA method references shall be included in this section. For each analyte group on a matrix-specific basis, all the applicable sample preparation, cleanup and analysis SOPs will be included in a table format. In addition, list each of the project target compounds in each analyte group that will be measured and reported.

SECTION 9.7 - SOIL VOC ISSUES

As of January 1, 1998, no RCRA projects will be approved in which a low VOCs in soil method has been selected that is not consistent with the intent of FR Vol. 62, no. 114, June 13, 1997, pp. 32452-463, and promulgated Update III to SW-846. U.S. EPA Region 5 is requiring appropriate alternatives for this application. See Appendix B for additional information on this issue.

SECTION 9.8 - METALS ANALYSIS ISSUES

In all cases where the project-specific target parameter list includes metals, the specific metals to be analyzed, as well as the group name (e.g., RCRA metals, Appendix IX metals, TCLP metals, etc.) should be identified. The rationale for the selected target list shall be discussed under Element 3, Project Description, of the QAPP. The analytical method to be used for each metal must be specified. The parameter list, analytical methods and method detection limits must all be consistent with and supportive of the project objectives.

In cases where filtered groundwater samples are to be analyzed for metals, the QAPP must provide the filtering procedure (or reference to an SOP appended to the QAPP). Note, the analysis of filtered samples for groundwater without also including the analysis of unfiltered (totals) samples is rarely considered acceptable. In any case where groundwater samples are to be filtered, (such as highly turbid samples where a total suspended solids (TSS) analysis is also included), the rationale must be provided, regardless of whether totals groundwater samples will also be analyzed. As with the metals target parameter list, the rationale provided to justify any decisions concerning filtered and unfiltered metals analysis of groundwater samples must be shown to be appropriate based on the project objectives presented in the Project Description (QAPP Element 3).

SECTION 9.9 - QC SAMPLES

The quantities and types of QC samples to be taken for each analyte group, on a matrix-specific basis will be included in this section. This list will reflect the specific QA objectives presented in Element 5 of the QAPP. The laboratory SOPs will have a QC section which addresses minimum QC requirements. However, any additional project requirements will need to be addressed. Other sections of the QAPP, such as those in which Element 3 requirements are met, may be referenced.

It may be necessary to modify the QC protocol outlined in certain SOPs in order to meet site specific objectives and implement relevant decision rules. (Most often, adjustments may be made to the calibration and spiking procedures of submitted SOPs).

QAPP ELEMENT 10

SECTION 10.0 - INTERNAL QUALITY CONTROL CHECKS

This element describes all of the QC checks for both field and laboratory analysis in order to meet the project objectives as presented in the Project Description, Element 3.

SECTION 10.1 - FIELD QUALITY CONTROL CHECKS

Each of the topics listed below applicable to a given investigation, must be addressed for each field procedure in this element.

1) Replicate measurements per sample (if applicable).

2) Duplicate samples.

3) Reference standards used to calibrate field instruments such as pH meters, specific conductance or conductivity meters, potentiometer for Eh measurements, HNU GC for organics, etc.

4) For temperature measurements, thermometer is compared with NIST traceable thermometer.

5) Reference standards for turbidity measurements. (Nephelometric method, etc.)

6) Munsell color chart for color checks.

SECTION 10.2 - LABORATORY QUALITY CONTROL CHECKS

The topics listed below must be addressed for each applicable analytical parameter and matrix. In addition, if more than one laboratory is to be used, laboratory-specific information must be provided.

1) Method blanks

2) Reagent/preparation blanks (applicable to inorganic analysis)

3) Instrument blanks

4) Matrix spikes/matrix spike duplicates (to be selected, reported and assessed in accordance with Section 5.3.2 of these RCRA QAPP Instructions).

5) Surrogate compounds (applicable to organic analysis)

6) Analytical spikes (Graphite furnace)

7) Laboratory duplicates (applicable to inorganic analysis)

8) Laboratory control standards

9) Internal standard area control limits (applicable to GC/MS analysis)

10) Mass Spec tuning (applicable to GC/MS analysis)

11) Endrin/DDT degradation checks (applicable to GC/EC analysis of pesticides)

12) Second, dissimilar column confirmation (applicable to GC/EC analysis)

Specific references to the laboratory SOPs are acceptable if a QC section which describes the specific QC requirements for the method is present in each SOP. Note, all SOPs will include a section on QC requirements if the format described in Appendix M, *Guidelines For The Preparation of Standard Operating Procedures (SOPs) For Field and Laboratory Measurements,* is followed. For additional discussion, refer to Section 9.0 of this document.

QAPP ELEMENT 11

SECTION 11.0 - DATA REDUCTION, VALIDATION, AND REPORTING

The project-specific plans for reducing, validating, and reporting data, for both field and laboratory activities will be explained in this element of the QAPP. Data reduction is the process of converting raw analytical data to final results in proper reporting units. In most cases, data reduction will be primarily concerned with the equation used to calibrate results. Data validation is the process of qualifying measurement data based on the performance of the field and laboratory QC measures incorporated into the sampling and analysis procedures. Data reporting is the detailed description of the data deliverables used to completely document the analysis, calibration, QC measures and calculations.

Individuals responsible for implementing data reduction, validation and reporting for the project will be identified in this section of the QAPP and must be consistent with the information provided in Element 4, Project Organization.

SECTION 11.1 - FIELD DATA

For field activities, data reduction, validation, and reporting must be tailored to the nature of the instrumentation being utilized. For direct reading instruments, (e.g., pH meters, thermometers), where no calculations are involved, there will ordinarily be no data reduction. Therefore, the QAPP may simply state that there is no calculation involved.

In order to address data validation for direct reading instruments, it must be ensured that transcription errors have not occurred as data are copied from log books to results forms. Also, there should be review of field logs to ensure that calibration was done as defined in the SOP. Field data are usually reported through report summary sheets tabulating results and field logbooks which document calibrations.

However, for field analytical instruments where data reduction may be necessary, such as in the case of a field gas chromatograph, the level of information concerning data reduction, validation, and reporting must be comparable to that required for laboratory instrumentation, as discussed below.

SECTION 11.2 - LABORATORY DATA

For laboratory activities, the following items must be addressed in this section:

Section 11.2.1 - Data Reduction

1) Analytical procedures will contain the equation(s) used to calculate results. It may be acceptable to reference applicable section(s) of analytical SOPs where equations may be found.

2) Reduction procedures (as well as analytical procedures) must include the equations applicable for each matrix to be analyzed.

Section 11.2.2 - Data Validation

1) Design of the sampling and analysis procedures for this investigation must be completed in order to prepare and review a validation procedure.

2) Validation procedures must specify the verification process of every QC measure used in the field and laboratory.

3) An appropriate level of laboratory data validation must be performed by an entity independent of the laboratory, (i.e., engineering firm or laboratory's corporate QA officer). This should normally entail 100% of all critical measurement parameters, including QC data.

4) A validation procedure should be prepared for each analytical procedure.

5) The U.S. EPA Functional Guidelines are only directly applicable to Contract Laboratory Program Statements of Work (CLP-SOWs), low/medium analyses. For SW-846 and other analytical methods, the Functional Guidelines can be used to construct the validation procedures for these methods.

6) All qualifiers used in the validation report as well as the contents of the validation report must be defined in this element of the QAPP.

7) As outlined below, a "CLP-like" data deliverables package documenting analyses is necessary for a complete validation.

8) This element of the QAPP must clearly state that 100% of the analytical data will be validated, unless a strong rationale, consistent with the project objectives presented in Element 3, Project Description, can be provided.

Section 11.2.3 - Data Reporting

1) Data deliverables should completely document the analysis (i.e., recreate the analysis on paper).

2) Data deliverables should be based upon the method.

3) The QAPP should provide a listing of data deliverables and examples of forms that will be used to tabulate the information. An example of a data deliverables package is found in the CLP-SOWs, Exhibits B and C.

4) CLP-SOW deliverables are only directly applicable to CLP-SOW analyses. All other analyses require listing or examples in the QAPP.

5) Thorough data deliverables are necessary for complete data validation.

6) Hardcopy data deliverables should be generated at the time of analysis and not "available upon request." At a minimum, one complete "CLP-like" data package (for all samples) must be delivered to the facility, to be made available to the U.S. EPA immediately upon request.

7) Typical data deliverables include, (but are not necessarily limited to):

   i. case narrative
   ii. calibration (initial/continuing) summary and raw data
   iii. mass spectrometer tuning data
   iv. gas chromatograms
   v. mass spectra
   vi. QC summary forms and raw data
   vii. ICP, AA and graphite furnace data outputs
   viii. interelement correction data
   ix. blank data results
   x. method and instrumental detection limit results

Section 11.2.4 - Data Acquisition Requirements

The objective of this section is to identify the type of data acquired from non-measurement sources, such as computer databases, spreadsheets, and programs, and literature files, with acceptance criteria. This element of the QAPP should clearly identify the intended sources of previously collected data and other information that will be used in this project. Information that is nonrepresentative and possibly biased, and is used uncritically may lead to decision errors. The care and skepticism applied to the generation of new data is also appropriate to the use of previously compiled data (for example, data sources such as handbooks and computerized databases.) Issues to be considered are presented below.

1) Are the data evaluated in a manner that permits logical decisions concerning whether or not the data are applicable to the current project? Is the system of qualifying or flagging data adequately documented to allow the combination of data sets?

2) Is the plan for summarizing data clear and sufficiently consistent with the goals of this project? Ideally, observation and transformation equations are available so that their assumptions can be evaluated against the objectives of the current project. This Element should also include a discussion of limitations on the use of the data and the nature of data uncertainty.

Section 11.2.5 - Data Management

An outline of the project data management scheme tracing the path of the data, beginning with receipt from the field or laboratory to the use or storage of the final reported form should be presented. Any internal checks (including verification and validation checks) that will be used to ensure data quality during data encoding in the data entry process should be identified together

with the mechanism for detailing and correcting recording errors. Examples of data entry forms and checklists should be included. Additional issues to be considered are presented below.

1) Data analysis sometimes involves comparing suitably reduced data with a conceptual model (e.g., a dispersion model). It frequently includes computation of summary statistics, standard errors, confidence intervals, tests of hypotheses relative to model parameters, and goodness-of-fit tests. This element should briefly outline the proposed methodology for data analysis and a more detailed discussion should be included in the final report.

2) Data management includes tracking the status of data as collected, transmitted, and processed. The QAPP should describe the established procedures for tracking the flow of data through the data processing system.

3) The QAPP should discuss data storage and retrieval including security and time of retention, and it should document the complete control system. The QAPP should also discuss the performance requirements of the data processing system, including provisions for the batch processing schedule and the data storage facilities.

QAPP ELEMENT 12

SECTION 12.0 - PERFORMANCE AND SYSTEM AUDITS

The purpose of performance and system audits is to verify that QA and QC programs are strictly followed by the appropriate personnel during field activities (e.g., sample collection, preservation and transportation) and laboratory activities (e.g., sample preparation, instrument calibration, sample analysis, data validation, and final evidentiary documentation).

Internal audits will be performed by the organization primarily responsible for performing the task. External audits will be performed by U.S. EPA.

Performance audits are an independent check to evaluate the quality of data being generated. System audits are an on-site review and evaluation of the facilities, instrumentation, QC practices, data validation, and documentation practices.

SECTION 12.1 - FIELD PERFORMANCE AND SYSTEM AUDITS

This element will address the following:

1) Internal and external performance and system audits to be performed for the subject investigation.

2) Staff responsible for performing these audits will be identified. In addition, the information provided in this element will be consistent with that in Element 4, Project Organization.

3) The frequency of the audit will be stated.

4) The audit procedures (including a checklist) and the documentation of audit procedures will be provided.

SECTION 12.2 - LABORATORY PERFORMANCE AND SYSTEM AUDITS

The following will be addressed:

1) Internal and external performance and system audits to be performed for each laboratory to be used in the subject investigation.

2) Staff responsible for performing these audits will be identified. In addition, the information provided in this element will be consistent with that in Element 4, Project Organization.

3) The frequency of the audit will be stated.

4) The audit procedures (including a checklist) and the documentation of audit procedures will be provided.

5) Results/outcome of recent laboratory audits performed by U.S. EPA or other Agencies that are relevant to the site specific nature of the project.

QAPP ELEMENT 13

SECTION 13.0 - PREVENTATIVE MAINTENANCE

Field and laboratory preventative maintenance procedures must be specified for the instrumentation to be used to acquire measurement data during the investigation.

SECTION 13.1 - FIELD INSTRUMENT PREVENTATIVE MAINTENANCE

Maintenance procedures for equipment such as thermometers, and pH and conductivity meters will be addressed. Procedures for HNu detectors and organic vapor analyzer systems will be addressed in this element of the QAPP unless used only for health and safety purposes. It should be indicated how frequently such instruments are checked (possibly as part of daily calibration), and where and how frequently such checks will be documented. Lists of critical spare parts such as tape, pH probes and batteries should be presented in the QAPP, in tabular format (this table can be included in an appendix). Any other means for ensuring that equipment to be used in the field is routinely serviced, maintained or repaired should be stated. See also Appendix L, Example Preventative Maintenance for Field Instrumentation.

SECTION 13.2 - LABORATORY INSTRUMENT PREVENTATIVE MAINTENANCE

These procedures are designed to minimize the occurrence of instrument failure and other system malfunctions and should be included in this element of the QAPP. The laboratory schedule for maintenance of each instrument to be used during implementation of the project will be presented in tabular format. A list of critical spare parts necessary for maintaining this equipment will also need to be presented in tabular format.

Although it is understood that laboratory instruments are usually maintained in accordance with manufacturer's specifications, it is not acceptable to submit copies of instrument manuals to satisfy the intent of this element. If preventative maintenance is performed through a vendor contract, then it should be so stated. See also Appendix K, Example Preventative Maintenance for Laboratories.

SECTION 13.3 - INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

The purpose of this discussion is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the project or task. If these requirements have been included under another section of the QAPP, it is sufficient to provide a reference only. All supplies and consumables that may directly or indirectly affect the quality of the project or task should be clearly identified. For each item identified, the inspection or acceptance testing requirements or specifications should be identified in addition to any requirements for certificates of purity or analysis.

QAPP ELEMENT 14

SECTION 14.0 - SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

In order to address this Element of the QAPP, the procedures and equations used to assess the accuracy and precision of analytical data, and completeness of data collection shall be clearly documented. The equations to be used for calculation of percent recovery (%R), relative percent difference (RPD) and percent valid data will be indicated. In some cases, as addressed below, statistical assessment of data may be required. Data completeness, precision, and accuracy must be addressed in the QAPP, with respect to both field and laboratory samples.

SECTION 14.1 - ACCURACY

Accuracy of laboratory results will be assessed for compliance with the established QC criteria in accordance with site specific DQOs that are cited in Section 3 of the QAPP using the analytical results of surrogate compounds, laboratory control samples, duplicate samples, and matrix spike/matrix spike duplicate samples. The percent recovery of matrix spike samples will be calculated as indicated below.

$$\%\ R = \frac{A - B}{C} \times 100$$

Where: A = **The analyte concentration determined experimentally from the spiked sample;**

B = **The background level determined by a separate analysis of the unspiked sample;**

C = **The amount of the spike added.**

SECTION 14.2 - PRECISION

Precision of laboratory analysis will be assessed in accordance with site specific DQOs by comparing the analytical results between matrix spike duplicate for organic analysis, and laboratory duplicate analyses for inorganic analysis. The relative percent difference will be calculated for each pair of duplicate analyses as indicated below.

$$RPD = \frac{S - D}{(S + D)/2} \times 100$$

Where: S = First sample value (original or matrix spike value)

D = Second sample value (duplicate or matrix spike duplicate value)

SECTION 14.3 - COMPLETENESS

Data completeness will be assessed for compliance with the amount of data required for decision making. The completeness is calculated as indicated below:

$$Completeness = \frac{\text{(number of valid measurements)}}{\text{(number of measurements planned)}} \times 100$$

"Valid Data" refers to numbers of investigational samples obtained or to be obtained for a specific purpose, or in order to satisfy a particular project objective that are not qualified as to use or invalid. Note that unless project objectives and decision rules have been appropriately designed, it is possible to generate valid data that are not useable for project purposes.

SECTION 14.4 - ASSESSMENT OF DATA

This section must include an appropriately detailed discussion of how data will be assessed as to whether the originally defined objectives were satisfied. All project data should be assessed by capable facility representatives in accordance with the Region 5 Data Quality Assessment (DQA) Policy.

For projects involving large numbers of samples, or to evaluate sample matrix interference and its effect on final data, statistical analysis and/or hypothesis testing may be required. Guidance on procedures, methods, rationale and equations for evaluating data of this type is offered in *Guidance for Data Quality Assessment - Practical Methods for Data Analysis* (EPA-2A-G9; QA 96 Version, July 1996).

QAPP ELEMENT 15

SECTION 15.0 - CORRECTIVE ACTION

Information included in this QAPP element will address the entire project, not just the laboratory operation. More specifically, corrective action will focus on three general areas. These areas are 1) Field Corrective Action; 2) Laboratory Corrective Action; and 3) Corrective Action during Data Validation and Data Assessment. For each of the three areas, certain procedures and mechanisms must be stated. These include:

1) The mechanism of triggering the initiation of corrective actions;

2) The proper procedures to be used for initiating, developing, approving, and implementing the corrective actions;

3) Identification of the project personnel responsible for initiating, developing, approving, and implementing the corrective actions, consistent with the information provided in Element 4, Project Organization;

4) Alternate corrective actions to be taken; and

5) The documentation process for a corrective action.

Corrective actions may be required for two classes of problems: 1) analytical and field equipment problems; and 2) noncompliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review.

Note, any corrective action issue which directly impacts project DQOs should be reported immediately to the project manager and the U.S. EPA RCRA Project Coordinator/RCRA Permit Writer and/or the U.S. EPA Enforcement/Permitting RCRA QA Coordinator.

QAPP ELEMENT 16

SECTION 16.0 - QUALITY ASSURANCE REPORTS TO MANAGEMENT

QA reports must be submitted on a periodic basis to management during the course of the project. This is done to ensure that problems arising during the sampling and analysis phases of the project are investigated and corrected. This report will be submitted monthly (at a minimum) and can be part of the monthly progress report. This report at a minimum, will contain:

1) Data validation and assessment results since the last report.

2) Field and laboratory audit results performed since the last report.

3) Significant QA/QC problems, recommended solutions, and results of corrective actions.

4) Assessment of data generated since the last report, including consideration as to whether originally targeted objectives are being met through the implemented sampling plan.

The contents and nature of all QA reports to be generated should be indicated in this section of the QAPP. For instance, the type of report, be it written or oral, interim versus final, should be specified in the QAPP. Furthermore, the contents of the QA reports should be specified. Some examples of relevant topics which may appear in QA reports, as appropriate, are given below:

1) Minor changes in QAPP (NOTE: Major changes to procedures or responsibilities requires approval from the Region 5 RCRA Permit Writer/RCRA Project Manager);

2) Summary of QA/QC programs, training and other miscellaneous accomplishments;

3) Results of technical systems and performance evaluation audits;

4) Data quality assessment in terms of project-specific QA objectives which include the following; precision, accuracy, representativeness, completeness, comparability, and detection limits;

5) Indication of whether the QA objectives were met; and

6) Limitations on use of the measurement data.

United States Environmental Protection Agency
Region 5

Date: May 8, 1998

Subject: Region 5 Policy and Guidance Regarding Historical Data Usage in the RCRA Facility Investigation

From: Norman R. Niedergang, Director
Waste, Pesticides and Toxics Division

To: All Staff Managing Corrective Action Projects

A RCRA facility investigation (RFI) is a process where data is generated and evaluated in order to determine the nature and extent of releases of hazardous constituents at a facility subject to RCRA corrective action. Facilities often propose utilization of sampling data which was obtained prior to the RFI work plan being finalized to meet some (or all) of the RFI objectives. It is Region 5's policy to utilize such "historical data" in meeting RFI objectives to the extent the quality of the data permits its use.

The purpose of this memo is to provide a policy on the acceptability and use of historical data relative to corrective action decision making. [For purposes of this memo, historical data is defined as any analytical data obtained and/or analyzed under conditions other than specified in an approved RFI quality assurance project plan (QAPP).] The attached guidance must be given to the facility, and it must be utilized by the U.S. EPA corrective action project manager in evaluating historical data.

If you have any questions regarding this policy and/or guidance, please contact:

Gale Hruska	886-0989	(Permitting)
Allen Debus	886-6186	(Permitting)
Brian Freeman	353-2720	(Enforcement)

Guidance Regarding Historical Data Usage in RCRA Facility Investigations in Region 5

Introduction

Both the Region and the facility can benefit from the decreased costs that result when historical data is used to provided some (or all) of the required RFI data. The corrective action process will also be expedited because less sampling will be required. In many situations, the utilization of historical data may result in either a move directly to a corrective measures study, the direct implementation of corrective measures, or the determination that no further action is needed.

If a facility wants to incorporate historical data into the RFI, it must first be discussed with the project manager and the QAPP reviewer, and be approved before submission of the RFI work plan. This discussion can also incorporate a pre-assessment of the data package. The submission of "unapproved" data at any later point in the RFI process (e.g. at the time of an initial QAPP submission or in a final report) could trigger additional sampling to replace any "unapproved" data. This would result in significant time delays and added costs.

Historical Analytical Data as a Continuum

Historical data cannot be catagorized simply as either clearly acceptable or clearly unacceptable. Much historical data will fall somewhere in between the two extremes. "Clearly acceptable historical data" is defined to be data which has been adequately documented to be of known and acceptable quality, and for which the sampling plan, data objectives, and analytical requirements are known to be compatible with the RFI data needs. "Clearly unacceptable historical data" could be seriously deficient in one or in all of the elements identified above. Intermediate quality data will demonstrate some of the required qualities, and be deficient in others. The following guidance is intended to assist the project manager in evaluating the usefulness and acceptability of such data.

Project Objectives

The RFI data objectives need to be initially well-defined. Only when they are known will the quality assurance (QA) staff be able, during the pre-QAPP meeting, to identify the criteria which must be met before the historical data can be determined to be acceptable for use in the RFI. Then the facility needs to apply these criteria to determine whether or not its historical data actually satisfies the RFI data objectives and whether the data should be submitted. This process will simplify and speed up the Agency's subsequent review of the QAPP, since the QA staff will only have to review historical data which matches the RFI data needs.

Requirements to Be Met Prior to Facility Submission of the Historical Data Package

Prior to the facility submitting a historical data package, the facility must submit the following information:

+ A detailed description of what information the facility intends to submit.

+ A rationale as to what purpose(s) the data is intended to serve, and why the facility believes the data can meet these objectives.

+ A detailed discussion of all activities, releases, and/or other changes at the facility that have (or could have) affected the location, nature, and/or concentration of hazardous constituents at the SWMU(s) under consideration, from the date the historical data was generated until the present. If the facility does not know of any changes in facility conditions that could have altered the release situation, a statement to this effect must be included.

+ A certification, as specified in 40 CFR 270.11(d) must be submitted.

The purpose of the above information is to prevent the submission of obviously unusable data and/or data that is not relevant because of changes in the facility condition that have resulted in the historical data being no longer applicable. The project manager must make a decision as to whether or not the Agency will accept the data for review.

Review of the Historical Data Package

An initial review of the historical data package should be done by the facility or its consultant before the package is submitted to the Agency to ensure that it meets Regional requirements. After the historical data is submitted, the QA staff and the project manager should work together on the Agency review. There are many components to address in a data package review. Some of the more important ones are:

+ Identification of specific dates, locations, and depths of samples in all media.
+ Sampling techniques utilized, including well construction information.
+ Sample collection, preservation, and transportation practices.
+ Identification of all constituents for which the samples were analyzed.
+ QC samples and results.
+ Laboratory acceptability (including any audits, certifications, etc.).
+ Analytical method documentation.
+ Original analytical laboratory-submitted data package.

+ Data package quality control report.
+ Data reporting (including reporting limits, treatment of non-detects, etc.)

After the data package is reviewed, the QA reviewer and the project manager will make a decision as to the next step. Three basic options exist: (1) Accept all (or some) of the data and incorporate it into the RFI; (2) Require confirmatory sampling prior to making the decision to reject or accept the data; or (3) Reject the data and continue on with the full RFI. (It should be noted that the age of the historical data may or may not be a factor in assessing data acceptability. There is no automatic cut-off as to when historical data lose relevance. Specific site factors and project objectives must be used in making this determination.)

There are no absolute criteria for the acceptance or rejection of a data package, or for the imposition of confirmatory sampling. The choice of which of the three options is appropriate is dependent on the intended use of the historical data. Some examples of situations where the intended use of the historical data determines whether the data is acceptable or not are:

+ In choosing locations for RFI sampling, even relatively poor quality data can be of use. Such data will not be acceptable in determining the absence of contamination or in eliminating locations to be sampled, but if the historical data did detect releases, some (or all) of those locations should be chosen for required sampling in the RFI.

+ If historical data are to be important factors in making critical decisions, such as playing a significant role in the determination of human risk, then only trustworthy data should be used.

+ If there is an acceptable historical data package, but there are reasons to believe that it may possibly not reflect present conditions (for example, because of possible new releases subsequent to the original sampling, chemical reactions with the matrix, migration of a plume, etc;), then confirmatory sampling could be used to determine whether the historical package may be accepted as defining the present situation.

Confirmatory Sampling

The first consideration to be addressed before proposing confirmatory sampling is whether the quality of the historical data is sufficient to warrant confirmatory sampling. If the sampling methodology or the analytical procedures are unknown, or are known to be clearly unacceptable, confirmatory sampling is not an option. Unacceptable historical data cannot be legitimized by re-sampling, even if the confirmatory and historical sampling results turn out to be consistent with each other.

If the RFI work plan reviewers determine that confirmatory sampling is needed before making a

decision on the acceptability of the historical data, then care must be taken to assure that the confirmatory data is of sufficient quality to act as a standard for comparison with the historical data. In particular:

+ The confirmatory sampling plan must contain data objectives that are coordinated with the full RFI project objectives.

+ Sampling and analytical methods appropriate to the site specific circumstances must be used.

+ Confirmatory sampling and analysis must be performed under an approved work plan and QAPP. However, it may also be acceptable to perform a field investigation under an approved mini-QAPP. Guidance on the use of field methods can be found in the July 20, 1997 memo The Use of Field Methods to Support RFI Streamlining (from Norman R. Niedergang to all staff managing corrective action projects).

A number of decisions must be made in specifying the confirmatory sampling parameters. In particular:

+ Location of Samples. Confirmatory samples must be taken at the same location as the historical data samples. The actual locations to be sampled should be specified prior to sampling, together with the justification for choosing those particular locations. If new locations also need to be sampled, these should be addressed in the full RFI work plan, and not as confirmatory sampling.

+ Number of Samples. The number of confirmatory samples to be taken will be dependent on a number of parameters, such as the homogeneity of the SWMU geology, the stability of the hazardous constituents in the SWMU matrix, the number of historical data samples submitted, and the uniformity of the historical data. A reasonable rule of thumb for most situations would be to sample 25% of the historical data locations, with a minimum of 3 confirmatory samples. This number is not carved in stone, but could be revised either upward or downward, if warranted by site-specific considerations.

+ Constituents for Analysis. Confirmatory sample analysis must be done for all constituents identified in the full RFI. Sometimes historical data contain analyses for constituents that have not been identified as being constituents of concern in the RFI. Since such data will not be used for decision making purposes, they do not have to be confirmed.

Analysis of Confirmatory Data

After the results of the confirmatory sampling event are received, the Region will make a decision

as to whether the historical data has been confirmed or rejected. While there are no standard or Agency approved methods applicable to the determination of whether or not confirmatory sampling supports historical data, Region 5 has developed a simple empirical method which provides a reasonable measure of the degree of confirmation. This method is presented in the appendix to this memo. The utilization of this method is Regional guidance; however, the use of other methods is not precluded where adequate justification is provided.

If it can be assumed that the analytical variability between the historical data and the confirmatory data caused by differences in laboratories, sampling plans, and laboratories is small (i.e. there are no significant quality assurance problems), there are three scenarios which can be expected to result from the evaluation of the sample data. The scenarios and the response to them are as follows:

+ Historical data and confirmatory data correlate well. In this situation, both sets of data will either indicate the presence of contamination, or both will fail to detect contamination. If contamination is detected in both sets of data, and the concentrations of constituents are similar, the historical data should be utilized in decision making. If no significant contamination is detected in either set of data, then the consideration of eliminating the SWMU from further corrective action would normally be appropriate.

+ Historical data identifies significant releases, but the confirmatory data do not. This would be a puzzling situation. Further investigation may be needed to address the discrepancy. Potential explanations are: natural remediation corrected the situation during the time between sampling events; the original contamination was caused by a one-time release which subsequently degraded or migrated out of the area; or, the choice of confirmatory sampling locations was inadequate.

+ Historical data identifies no significant releases, but the confirmatory data do. This situation brings into question the use of the historical data for purposes of making corrective action decisions. The historical data could be reevaluated by the facility to resolve the discrepancy. However, it is unlikely that anything but a full RFI will be appropriate.

Data Generated Under Voluntary Corrective Action Activities or Under Other Governmental Authority Activities

Sometimes analytical data may be generated during the course of voluntary corrective action activities, preliminary site assessments, or as the result of sampling activities required and approved by other governmental authorities. This data meets the definition of "historical data" regardless of the reason why it was generated. The quality of this data must be evaluated in accordance with this policy before it can be used in a Region 5 RCRA RFI. There are presently no defined criteria as to what would make this type of data automatically acceptable to the Region. If it is determined that this data is unacceptable for RFI purposes, then the sampling must be repeated under the full RFI. If the data has been determined to be acceptable, then data packages can be selected for use in the RFI.

The Reporting of Historical Data and Its Use in Making Corrective Action Decisions

Historical data can be reported as a stand-alone submission, as part of the RFI final report, or both ways. If it is a stand-alone report, it must be complete, formatted in a clear and concise manner, and clearly demonstrate that it satisfies the RFI project objectives.

If the historical data has been determined to be acceptable, the project manager must utilize the data in making corrective action decisions; it should not be ignored. (For example, if the data is sufficient, it can be used to eliminate locations from full RFI sampling, or it can be used trigger a SWMU into a corrective measures study without further sampling under a full RFI.)

Appendix: A Method for Comparing Historical Data and Confirmatory Sampling Data

This is a simple empirical method for comparing confirmatory data with historical data, and drawing conclusions about the degree of confirmation observed. It assumes that the confirmatory data were taken in the same locations, depths, etc: as was the historical data, so as to rule out any site variability. Its purpose is to determine if there is significant variability in the laboratory data reporting limits and in the sample concentrations. The variability in the laboratory data reporting limits are first addressed, and if determined to be acceptable, then the variability in the data itself is addressed.

Laboratory Method Reporting Limits Comparability

This test is designed to compare the laboratory method reporting limits (MRLs) of historical and confirmatory data. (It is assumed that both sets of data provide this information on an individual sampling location basis.) It compares the ratio of the MRLs of the historical data with that of the confirmatory data. If the historical data MRLs are significantly higher than the confirmatory

MRLs, then the quality of the historical data needs to be reassessed.

Step 1. For each hazardous constituent of concern at a sample location, calculate the ratio:

R = (MRL for historical data) / (MRL for confirmatory data)

Step 2. If R>2 then assign the index "0" to the location/constituent.
If R≤2 then assign the index "1" to the location/constituent

Step 3. Compare the number of locations/constituents having an index of 1 to those having an index of 0. If there are 80% (or more) of the 1 values, then conclude that both sets of data have basically the same method detection limits. If there are less than 80% of 1 values, then the historical data has a trend of higher MDLs than the confirmatory data, and the data quality either needs to be reassessed, or the data must be rejected.

[Note: This test is not a replacement for the historical data package review. It is only designed to flag the historical data quality and alert the project manager to situations where high reporting limits could mask significant releases identified by the confirmatory sampling. In other words, a lot of non-detects in the historical data could indicate that there were no releases, but it could also indicate that the historical data quality was insufficient to be able to confidently compare it to the confirmatory data. Also, if the targeted action levels are much greater than both the historical and confirmatory MRLs, then this test will not be relevant, and can be ignored, i.e., differences in reporting limits are not significant if the levels that trigger corrective action decisions are significantly higher.]

Data Comparability and Confirmation

This test is designed to compare the reported hazardous constituent concentrations obtained in the historical data to those in the confirmatory data. (It assumes that the MRLs for the historical data and confirmatory data addressed in the preceding test are acceptable.) It specifically compares the ratio of the concentration of a hazardous constituent reported in the historical data with that reported in the confirmatory data. If too many of the constituent concentrations are more than an order of magnitude different than the confirmatory concentrations, then the data is determined not to be confirmed.

Step 1. For each hazardous constituent of concern and each sampling depth at the sampling location, calculate the ratio:

R = (Concentration from historical data) / (Concentration from confirmatory data)

[Note: Use the reporting limit if the constituent is not detected.]

Step 2. If $0.1 \leq R \leq 10$, then assign the index "1" to the location.
If either $R > 10$ or $R < 0.1$, then assign the index "0" to the location.

Step 3. Compare the number of location/constituents having an index of 1 to those having an index of 0. If less than 75% of the points have an index of 0, then conclude that the data have not been confirmed.

Step 4. On a map of the sampling locations, plot each index number. By doing this it may be possible to observe whether the non-confirmed data exhibit any patterns which could segregate out the non-confirming locations from conforming ones.

[Note: This test assumes that there is a sufficient number of data points. If there are only a few, the comparisons in Step 3 may not make sense.]

MEMORANDUM

SUBJECT: Determination of Volatiles in Soil - Directive for Change

FROM: Norman R. Niedergang, Director
Waste, Pesticides and Toxics Division

TO: Corrective Action Project Managers
QA Staff

DATE: December 22, 1997

I. INTRODUCTION/SUMMARY

Soils/Solids traditionally have been collected for volatile organic determinations using "low concentration volatiles in soil" techniques described in Update II to SW-846, or earlier editions. Update III to SW-846, published June 13, 1997, deleted the "low concentration volatiles in soil" sample collection/laboratory procedure. Update III mandates that analysis aliquots (field or off-site lab) be collected in the VOA vial (with TFE lined septa cap) used for laboratory analysis. Either a methanol extraction reagent or a matrix modifying reagent are to be added to a soil aliquot at time of sample collection. Separate soil samples are collected for percent moisture determinations for reporting volatile results on a dry weight basis.

Technical and QA staff of our Waste, Pesticides and Toxics Division (WPTD) have reviewed and disseminated published experimental data comparing Update II and Update III soil sample collection techniques for volatile organics. Our Division has supported some of this work through the UST program in Wisconsin. Update III sample collection techniques are more complicated and tedious for volatiles than those of Update II; however, the accuracy of the modern Update III soil collection techniques warrant their immediate use versus traditional methods. Previous methodology has been shown to significantly under-report the presence of volatiles in soil.

II. DIRECTIVE

1. Starting January 1, 1998, all RCRA Corrective Actions and Underground Storage Tank (UST) activities under the direct control of the Waste, Pesticides and Toxics Division will determine volatiles in soil using sample collection procedures consistent with Methods 5021 or 5035 of Update III to SW-846, "Test Methods for Evaluating Solid Waste" as published in Federal Register of June 13, 1997, Vol. 62, No. 114, pp. 32452-463.

2. If Work Plan/Quality Assurance Project Plans (QAPPs) were approved prior to January 1, 1998 using the traditional "low-concentration volatiles in soil" procedures of Update II to SW-846, these documents are to be modified for future sampling, done after January 1, 1998 to reflect use of Update III techniques for soil/solids. Significant numbers of corrective action soil surveys are not expected to occur during first quarter of calendar year 1998. Time should be available to update sample collection/laboratory test procedures for soil volatiles. Updating these documents will be a high priority of the QA staff. Any exceptional circumstances that suggest use of the old procedure must be brought to the attention of the Corrective Action Process Manager and QA staff no later than January 15, 1998.

3. Although Update III to SW-846 was effective June 13, 1997, EPA's Office of Solid Waste, in a policy memorandum, recommended Update III changes be cautiously implemented to allow laboratory and sampling organizations time to purchase new instrumentation/ equipment. A six (6) month delay in implementing Update III was suggested, and this is equivalent to the above January 1, 1998 date.

4. Update III to SW-846 provides three (3) options for volatile determinations of soil, either at on-site field labs, or for off-site analytical support laboratories.

   a. Soils will be collected and tested using only the methanol extract option of Method 5035.

   b. Soils will be collected and tested using both the methanol extract option of Method 5035 for large volatile concentrations and either one of the low concentration procedures of Method 5021/5035.

   c. Alternatively, soils can be collected using the En-Core (or equivalent) sampler for subsequent sample preparation by Methods 5021 or 5035 in a field or off-site laboratory.

   The need and use of a low concentration option from Method 5021 or Method 5035 will be determined for each Corrective Action or UST activity based on Data Quality Objectives, risk, project needs, intended data use, etc. This directive does not apply to in-situ field determinations of volatiles in soil. Attached to this Directive is a table identifying EPA Region 9 Soil Preliminary Remedial Goals and Superfund Soil Screening Levels whose values for volatiles are less than 200 ppb. The table identifies critical volatile compounds that may dictate use of low concentration options. The 200 ppb cutoff is taken from SW-846 guidance. This criteria may vary for specific lab instrumentation.

5. It is relatively easy to implement the methanol extraction for sample collection/laboratory analysis. Volatile soil determinations, using methanol, are done using the same instrumentation currently in place for waters. Many or most laboratories are now purchasing sample preparation instrumentation necessary for the low concentration option of Method 5035, or for Method 5021, hence the 6-month delay in implementation. Consistent use of Update III will provide a level playing field for sampling/lab organizations.

6. U.S. EPA contractor support (e.g.,-oversight activities) for RCRA Corrective Action or UST activities, will determine volatiles in soil/solids using Update III procedures.

7. Soils/samples tested at the Region 5 Central Region Laboratory for the WPTD will determine soil volatiles consistent with Update III.

III. DETAILED BACKGROUND

The analysis of volatile organic compounds, or volatiles in soil commonly has utilized collection of a soil in a 40-60 ml VOA vial with TFE lined septa, refrigerated transport to a laboratory (field or off-site), and soil subaliquots (2-5) selected by the laboratory for heated purge and trap GC or GC/MS analysis. This process has been known as the "low concentration volatiles in soil" test procedure. For medium or high level volatile concentrations in soil, the laboratory could alternatively extract the soil with water-misible methanol extraction solvent and then test the methanol extract (after dilution) as they would for water. Methanol extraction values were traditionally a very minor part of all volatile soil data reported.

A large body of state, federal, and private research, independent from operational EPA staff and programs, has demonstrated the above "low concentration volatiles in soil" methodology to be inaccurate and biased low versus sample collection in the specific VOA containers used for laboratory analysis (field or lab). Negative errors are commonly observed for the traditional technique and are caused by a variety of field/transport/lab volatile concentration losses.

Update III to SW-846, published in the June 13, 1997 Federal Register, deleted the "low concentration volatiles in soil" protocol from the manual and replaced it with the following three (3) alternatives:

1. Method 5021 - Heated Head Space. This is applicable to volatile concentration below 200 ppb.

2. Method 5035 - Heated Purge and Trap (Low Concentration Option in range of 5 to 200 ppb). Five (5) mls of a matrix modifying solution is added to 2-5g of soil at time of sample collection.

3. Method 5035 - Methanol Extract (High Concentration Option for volatiles exceeding 200 ppb). Methanol is added to 2-5g of soil at time of collection, then subsequently diluted with water and tested for volatiles by Method 5030.

All of the three alternatives require a tared VOA vial with matrix modifying solution or methanol, addition of 2-5g soil at time of collection to the vial, and then a final vial weight to determine soil aliquot weight by difference. Separate vials are used for the collection and determination of soil moisture content.

The above options can be implemented in several ways depending on field or off-site lab capability or based on Data Quality Objectives.

1. A separate VOA vial is always collected for a percent moisture value.

2. A single methanol extract VOA vial is collected for each soil site to provide for volatile concentrations exceeding 200 ppb. Analyses can be repeated, since the methanol extract is easily rediluted.

3. Two or more low concentration option VOA vials (Methods 5021 or 5035) are collected for each soil site. One is necessary for concentration measurements below 200 ppb - the other serves as backup for any reanalyses. The heated headspace analysis (Method 5021) can be repeated using a different or smaller air volume.

4. The methanol extract VOA vial alone may suffice for many soil surveys. The low level options of Methods 5021 and 5035 may be unnecessary, depending on DQOs or risk assessment values. A unique aspect of methanol extracts is that soils can be composited for volatiles via their methanol extracts.

5. Method 5035 specified/approves the use of the En-Core proprietary/patented soil sampler, as an alternative to use of methanol reagent in the field. This sampler can collect 5g soil cores with no loss in sample integrity if transported to a lab within two days of sample collection. Sample preparation can then be done by any of the above techniques.

The above procedures and alternatives are more complicated and tedious than the traditional "low-concentration volatiles in soil," however, their accuracy warrants and justifies their use versus the traditional techniques. The new procedures require careful coordination between field and lab personnel and use of VOA vials that are compatible with specific laboratory instrumentation. For more information, or assistance in choosing the new option best suited to project objectives, please consult with QA staff members.

Attachment

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ATTACHMENT

Volatile Contaminants, whose EPA Region 9 Soil Preliminary Remedial Goals (PRGs) or Superfund Soil Screening Levels:

1. Are less than 200 ppb (ug/kg) threshold/detection of methanol extraction for method 8260; or

2. Between 200 and 1,000 ppb (0.2 - 1.0 ppm), where quantitation is uncertain for method 8260 after methanol extraction of soil.

Tap Water PRGs which are less than 1 ug/L (ppb) (threshold of Method 8260) are listed for comparison.
(If Soil PRG is greater than 1,000 ppb or 1.0 ppm, it is not listed and methanol extraction should be successful for risk assessment.)

Volatile Contaminant Group	**Soil Residential PRG (ug/kg or ppb) (<200) (200-1000)**	**Soil Industrial PRG (ug/kg or ppb)(<200) (200-1000)**	**Superfund Soil Screening Level 1-DAF 20 (ug/kg or ppb) (<200)(200-1000)**	**Tap Water PRG (ug/L) (<1)**
Appendix IX Hydrocarbon:				
benzene(ca)	630		30	0.39
Non Appendix IX Hydrocarbon:				
1,3 butadiene(ca)	6.5	14	Not Available	0.011
Common Appendix IX Halogenated Hydrocarbons:				
bromomethane(nc)			800	
carbon tetrachloride(ca)	230	500	70	0.17
1,2-dichloroethane(ca)	250	550	20	0.12
1,1-dichloroethene(ce)	37	80	60	0.046
cis-1,2-dichloroethene(nc)			400	
trans-1,2-dichloroethene(nc)			700	
1,2-dichloropropane(ca)	310	680	30	0.16
1,3-dichloropropane(ca)	250	550	4	0.081
methylene chloride(ca)			20	4.3 (lab cont.)
1,1,2,2-tetrachloroethane (ca)	450		3	0.055

Volatile Contaminant Group	Soil Residential PRG (ug/kg or ppb) (<200) (200-1000)	Soil Industrial PRG (ug/kg or ppb)(<200) (200-1000)	Superfund Soil Screening Level 1-DAF 20 (ug/kg or ppb) (<200)(200-1000)	Tap Water PRG (ug/L) (<1)
1,1,1,2-tetrachloroethane (ca)				0.43
tetrachloroethene (PCE)(ca)			60	1.1
1,1,2-trichloroethene(ca)	650		20	0.20
Vinyl chloride	16	35	10	0.02
1,4-dichlorobenzene(ca)				0.47
Non Appendix IX Halogenated Hydrocarbons:				
vinyl bromide(ca)	190		410	0.10
Appendix IX Trihalomethanes:				
chloroform(ca)	250	530	600	0.16
bromodichloromethane(ca)	630		600	0.18
Dibromochloromethane(ca)			400	1.0
Bromoform(ca)			800	
Specialized Appendix IX Halogenated Hydrocarbons:				
1,2-dibromo-3-chloropropane (DBCP)(ca)	320		Not Available	0.048
1,2-dibromoethane (EDB)(ca)	4.9	20	Not Available	0.00076
1,4-dichloro-2-butene(ca)	7.5	100	Not Available	0.0012
1,2,3-trichloropropane (ca)	1.4	3.1	Not Available	0.0016
Appendix IX Water - Miscible Volatile:				
acrolein(nc)	100	340*	Not Available	0.042
acrylonitrile	190	470*	Not Available	3.7*
1,4-dioxane			Not Available	1.0*
methacrylonitrile (nc)	2,000*		Not Available	
acetonitrile(nc)			Not Available	71*
non Appendix IX Water Miscible Volatiles:				

Volatile Contaminant Group	Soil Residential PRG (ug/kg or ppb) (<200) (200-1000)	Soil Industrial PRG (ug/kg or ppb)(<200) (200-1000)	Superfund Soil Screening Level 1-DAF 20 (ug/kg or ppb) (<200)(200-1000)	Tap Water PRG (ug/L) (<1)
acrylamide(ca)	980		Not Available	0.015
ethyl acrylate(ca)	210	450	Not Available	0.23
ethylene oxide (ca)	130	320	Not Available	0.024
malonitrile(nc)	1,300*		Not Available	0.73
propylene oxide(ca)	Not Available	Not Available	Not Available	0.22

(Ca) - Cancer PRG **(Nca) - noncancer PRG**

*****All water miscible volatiles have poor purging efficiencies by method 8260. Detection limits are elevated for method 8260 for these types of volatiles. Asterisked volatile criteria are adjusted for purging efficiency. 1,4-dioxane has less than 1% purging efficiency at room temperature.

EDQL, MRL VALUES FOR ALL MEDIA

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Acenaphthene 83-32-9	- - mg/m3	9.90 ug/L	10	6.71 ug/kg	660	6.82E+05 ug/kg	660
Acenaphthylene 208-96-8	- - mg/m3	4.84E+03 ug/L	10	5.87 ug/kg	660	6.82E+05 ug/kg	660
Acetone 67-64-1	959.40 mg/m3	7.80E+04 ug/L	100	453.37 ug/kg	100	2.50E+03 ug/kg	100
Acetonitrile 75-05-8	17.10 mg/m3	3.00E+04 ug/L	10	139.05 ug/kg	100	1.37E+03 ug/kg	100
Acetophenone 98-86-2	- - mg/m3	687.89 ug/L	10	246.00 ug/kg	- -	3.00E+05 ug/kg	- -
Acetylaminofluorene[2-] 53-96-3	- - mg/m3	534.97 ug/L	20	15.32 ug/kg	- -	596.34 ug/kg	- -
Acrolein 107-02-8	5.78E-01 mg/m3	2.05E-01 ug/L	11	1.44E-02 ug/kg	7	5.27E+03 ug/kg	7
Acrylonitrile 107-13-1	7.97E-01 mg/m3	8.90E-01 ug/L	5	1.57E-02 ug/kg	5	23.93 ug/kg	5
Aldrin 309-00-2	- - mg/m3	3.09E-02 ug/L	0.34	2 ug/kg	22.8	3.32 ug/kg	22.8
Allyl chloride 107-05-1	1.22 mg/m3	- - ug/L	100	2.66E-01 ug/kg	5	13.38 ug/kg	5

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Aminobiphenyl[4-] 92-67-1	- - mg/m3	- - ug/L	20	5.66 ug/kg	- -	3.05 ug/kg	- -
Aniline 62-53-3	- - mg/m3	4.40E-01 ug/L	10	3.38E-02 ug/kg	- -	56.78 ug/kg	- -
Anthracene 120-12-7	- - mg/m3	2.90E-02 ug/L	10	46.9 ug/kg	660	1.48E+06 ug/kg	660
Antimony (Total) 7440-36-0	- - mg/m3	31.00 ug/L	30	- - ug/kg	300	142.30 ug/kg	300
Aramite 140-57-8	- - mg/m3	3.09 ug/L	10	1.11E-03 ug/kg	- -	1.66E+05 ug/kg	- -
Arsenic (Total) 7440-38-2	- - mg/m3	53.00 ug/L	10	5900 ug/kg	100	5.70E+03 ug/kg	100
Azobenzene[p-(dimethylamino)] 60-11-7	- - mg/m3	1.65 ug/L	10	317.99 ug/kg	- -	39.76 ug/kg	- -
Barium (Total) 7440-39-3	- - mg/m3	5.00E+03 ug/L	20	- - ug/kg	200	1.04E+03 ug/kg	200
Benzene 71-43-2	9.76 mg/m3	114.00 ug/L	0.09	141.57 ug/kg	0.09	254.62 ug/kg	0.09
Benzo[a]anthracene 56-55-3	- - mg/m3	8.39E-01 ug/L	0.13	31.7 ug/kg	8.7	5.21E+03 ug/kg	8.7

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Benzo[a]pyrene 50-32-8	- - mg/m3	1.40E-02 ug/L	0.23	31.9 ug/kg	15.4	1.52E+03 ug/kg	15.4
Benzo[b]fluoranthene 205-99-2	- - mg/m3	9.07 ug/L	0.18	1.04E+04 ug/kg	12.1	5.98E+04 ug/kg	12.1
Benzo[ghi]perylene 191-24-2	- - mg/m3	7.64 ug/L	0.76	170 ug/kg	51	1.19E+05 ug/kg	51
Benzo[k]fluoranthene 207-08-9	- - mg/m3	5.60E-03 ug/L	0.17	240 ug/kg	11.4	1.48E+05 ug/kg	11.4
Benzyl alcohol 100-51-6	- - mg/m3	281.24 ug/L	20	33.94 ug/kg	1300	6.58E+04 ug/kg	1300
Beryllium (Total) 7440-41-7	- - mg/m3	7.60 ug/L	2	- - ug/kg	20	1.06E+03 ug/kg	20
BHC[alpha-] 319-84-6	- - mg/m3	12.38 ug/L	0.35	6 ug/kg	23.4	99.39 ug/kg	23.4
BHC[beta-] 319-85-7	- - mg/m3	4.95E-01 ug/L	0.23	5 ug/kg	15.4	3.98 ug/kg	15.4
BHC[delta-] 319-86-8	- - mg/m3	666.67 ug/L	0.24	7.15E+04 ug/kg	16.1	9.94E+03 ug/kg	16.1
BHC[gamma-] 58-89-9	- - mg/m3	1.00E-02 ug/L	0.25	0.94 ug/kg	16.8	5.00 ug/kg	16.8

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Bromodichloromethane 75-27-4	- - mg/m3	- - ug/L	0.2	1.13 ug/kg	5	539.78 ug/kg	5
Bromoform 75-25-2	9.11 mg/m3	466.00 ug/L	2	996.27 ug/kg	5	1.59E+04 ug/kg	5
Bromophenyl phenyl ether[4-] 101-55-3	- - mg/m3	1.50 ug/L	10	1.55E+03 ug/kg	660	- - ug/kg	660
Butylamine[N-Nitrosodi-n-] 924-16-3	- - mg/m3	1000.00 ug/L	10	772.04 ug/kg	- -	267.07 ug/kg	- -
Butylbenzyl phthalate 85-68-7	- - mg/m3	49.00 ug/L	0.42	4.19E+03 ug/kg	660	238.89 ug/kg	660
Cadmium (Total) 7440-43-9	- - mg/m3	6.60E-01 ug/L	1	596 ug/kg	10	2.22 ug/kg	10
Carbon disulfide 75-15-0	3.67 mg/m3	84.10 ug/L	1	133.97 ug/kg	5	94.12 ug/kg	5
Carbon tetrachloride 56-23-5	1.41 mg/m3	5.90 ug/L	1	35.73 ug/kg	5	2.98E+03 ug/kg	5
Chlordane 57-74-9	- - mg/m3	2.90E-04 ug/L	0.37	4.5 ug/kg	24.8	224.00 ug/kg	24.8
Chlorethyl ether[bis(2-] 111-44-4	- - mg/m3	1.14E+03 ug/L	10	211.96 ug/kg	660	2.37E+04 ug/kg	660

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Chloro-1-methylethyl)ether[Bis(2-] 108-60-1	- - mg/m3	20.00 ug/L	10	68.78 ug/kg	660	1.99E+04 ug/kg	660
Chloroaniline[p-] 106-47-8	- - mg/m3	231.97 ug/L	20	146.08 ug/kg	1300	1.10E+03 ug/kg	1300
Chlorobenzene 108-90-7	119.68 mg/m3	10.00 ug/L	0.03	61.94 ug/kg	0.3	1.31E+04 ug/kg	0.3
Chlorobenzilate 510-15-6	- - mg/m3	7.16 ug/L	10	860.29 ug/kg	- -	5.05E+03 ug/kg	- -
Chloroethane 75-00-3	20.00 mg/m3	2.30E+05 ug/L	1	5.86E+04 ug/kg	5.2	- - ug/kg	5.2
Chloroform 67-66-3	1.34 mg/m3	79.00 ug/L	0.2	27 ug/kg	0.2	1.19E+03 ug/kg	0.2
Chloronaphthalene[2-] 91-58-7	- - mg/m3	3.96E-01 ug/L	10	417.23 ug/kg	630	12.18 ug/kg	630
Chlorophenol[2-] 95-57-8	- - mg/m3	8.80 ug/L	5	11.70 ug/kg	660	242.66 ug/kg	660
Chlorophenyl phenyl ether[4-] 7005-72-3	- - mg/m3	- - ug/L	10	656.12 ug/kg	660	- - ug/kg	660
Chloroprene 126-99-8	4.16E-02 mg/m3	- - ug/L	5	1.06 ug/kg	5	2.90 ug/kg	5

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Chromium (Total) 7440-47-3	- - mg/m3	42.00 ug/L	10	26000 ug/kg	100	400.00 ug/kg	100
Chrysene 218-01-9	- - mg/m3	3.30E-02 ug/L	1.5	57.1 ug/kg	100	4.73E+03 ug/kg	100
Cobalt (Total) 7440-48-4	- - mg/m3	5.00 ug/L	10	50000 ug/kg	100	140.33 ug/kg	100
Copper (Total) 7440-50-8	- - mg/m3	5.00 ug/L	60	16000 ug/kg	600	313.20 ug/kg	600
Cresol[4,6-dinitro-o-] 534-52-1	- - mg/m3	2.30 ug/L	50	10.38 ug/kg	3300	144.08 ug/kg	3300
Cresol[m-] 108-39-4	- - mg/m3	- - ug/L	10	8.45E-01 ug/kg	- -	3.49E+03 ug/kg	- -
Cresol[o-] 95-48-7	- - mg/m3	- - ug/L	10	8.26E-01 ug/kg	660	4.04E+04 ug/kg	660
Cresol[p-chloro-m-] 59-50-7	- - mg/m3	34.79 ug/L	5	388.18 ug/kg	240	7.95E+03 ug/kg	240
Cresol[p-] 106-44-5	- - mg/m3	- - ug/L	10	8.08E-01 ug/kg	660	1.63E+05 ug/kg	660
Cyanide 57-12-5	- - mg/m3	5.20 ug/L	40	0.1 ug/kg	- -	1.33E+03 ug/kg	- -

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
DDD[4,4'-] 72-54-8	- - mg/m3	1.10E-03 ug/L	0.5	5.53 ug/kg	33.5	758.15 ug/kg	33.5
DDE[4,4'-] 72-55-9	- - mg/m3	4.51E-09 ug/L	0.6	1.42 ug/kg	38.9	595.87 ug/kg	38.9
DDT[4,4'-] 50-29-3	- - mg/m3	1.00E-03 ug/L	0.8	1.19 ug/kg	54.3	17.50 ug/kg	54.3
Di-n-butyl phthalate 84-74-2	- - mg/m3	3.00 ug/L	3.3	110.50 ug/kg	221	149.79 ug/kg	221
Di-n-octyl phthalate 117-84-0	- - mg/m3	30.00 ug/L	0.5	4.06E+04 ug/kg	32.8	7.09E+05 ug/kg	32.8
Diallate 2303-16-4	- - mg/m3	29.00 ug/L	10	1.51 ug/kg	- -	452.14 ug/kg	- -
Dibenzofuran 132-64-9	- - mg/m3	20.00 ug/L	10	1.52E+03 ug/kg	660	- - ug/kg	660
Dibenz[a,h]anthracene 53-70-3	- - mg/m3	1.60E-03 ug/L	0.3	6.22 ug/kg	20.1	1.84E+04 ug/kg	20.1
Dibromo-3-chloropropane[1,2-] 96-12-8	3.20E-01 mg/m3	11.20 ug/L	1	19.98 ug/kg	5	35.18 ug/kg	5
Dibromochloromethane 124-48-1	- - mg/m3	6.40E+03 ug/L	0.3	267.61 ug/kg	0.3	2.05E+03 ug/kg	0.3

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Dibromoethane[1,2-] 106-93-4	176.40 mg/m3	22.50 ug/L	1	12.37 ug/kg	5	1.23E+03 ug/kg	5
Dichloro-2-butene[trans-1,4-] 110-57-6	4.03 mg/m3	- - ug/L	1	1.82 ug/kg	5	- - ug/kg	5
Dichlorobenzene[m-] 541-73-1	272.70 mg/m3	87.00 ug/L	0.2	3.01E+03 ug/kg	0.2	3.77E+04 ug/kg	0.2
Dichlorobenzene[o-] 95-50-1	270.00 mg/m3	11.00 ug/L	0.5	231.32 ug/kg	0.5	2.96E+03 ug/kg	0.5
Dichlorobenzene[p-] 106-46-7	275.40 mg/m3	43.00 ug/L	0.07	1.45E+03 ug/kg	0.07	545.59 ug/kg	0.07
Dichlorobenzidine[3,3'-] 91-94-1	- - mg/m3	99.75 ug/L	20	28.22 ug/kg	1300	646.36 ug/kg	1300
Dichlorodifluoromethane 75-71-8	1.55E+03 mg/m3	- - ug/L	1	1.33 ug/kg	5	3.95E+04 ug/kg	5
Dichloroethane[1,1-] 75-34-3	1.24E+03 mg/m3	47.00 ug/L	1	5.75E-01 ug/kg	5	2.01E+04 ug/kg	5
Dichloroethane[1,2-] 107-06-2	29.70 mg/m3	190.00 ug/L	1	54.18 ug/kg	5	2.12E+04 ug/kg	5
Dichloroethene[1,1-] 75-35-4	3.03E-01 mg/m3	78.00 ug/L	0.7	23.27 ug/kg	0.7	8.28E+03 ug/kg	0.7

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Dichloroethylene[trans-1,2-] 156-60-5	29.09 mg/m3	310.00 ug/L	1	208.94 ug/kg	5	783.73 ug/kg	5
Dichlorophenol[2,4-] 120-83-2	- - mg/m3	18.00 ug/L	5	133.63 ug/kg	260	8.75E+04 ug/kg	260
Dichlorophenol[2,6-] 87-65-0	- - mg/m3	- - ug/L	10	3.94 ug/kg	- -	1.17E+03 ug/kg	- -
Dichloropropane[1,2-] 78-87-5	70.60 mg/m3	380.00 ug/L	0.06	351.61 ug/kg	5	3.27E+04 ug/kg	5
Dichloropropene[cis-1,3-] 10061-01-5	5.89 mg/m3	7.90 ug/L	1	2.96 ug/kg	5	397.86 ug/kg	5
Dichloropropene[trans-1,3-] 10061-02-6	5.89 mg/m3	7.90 ug/L	1	2.96 ug/kg	5	397.86 ug/kg	5
Dieldrin 60-57-1	- - mg/m3	2.60E-05 ug/L	0.44	2 ug/kg	29.5	2.38 ug/kg	29.5
Diethyl O-2-pyrazinyl phosphorothioate[O,O-] 297-97-2	- - mg/m3	- - ug/L	20	4.88E-02 ug/kg	- -	799.49 ug/kg	- -
Diethyl phthalate 84-66-2	- - mg/m3	3.00 ug/L	2.5	8.04 ug/kg	168	2.48E+04 ug/kg	168
Dimethoate 60-51-5	- - mg/m3	41.20 ug/L	2.6	190.15 ug/kg	130	218.02 ug/kg	130

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Dimethyl phthalate 131-11-3	- - mg/m3	73.00 ug/L	6.4	24.95 ug/kg	429	7.34E+05 ug/kg	429
Dimethylbenzidine[3,3'-] 119-93-7	- - mg/m3	- - ug/L	10	2.00 ug/kg	- -	104.20 ug/kg	- -
Dimethylbenz[a]anthracene[7,12-] 57-97-6	- - mg/m3	5.48E-01 ug/L	10	6.64E+04 ug/kg	- -	1.63E+04 ug/kg	- -
Dimethylphenethylamine[alpha,alpha-] 122-09-8	- - mg/m3	- - ug/L	10	8.90 ug/kg	- -	300.16 ug/kg	- -
Dimethylphenol[2,4-] 105-67-9	- - mg/m3	100.17 ug/L	5	304.53 ug/kg	660	10.00 ug/kg	660
Dinitrobenzene[m-] 99-65-0	- - mg/m3	2.36 ug/L	0.11	9.24E-01 ug/kg	0.25	654.70 ug/kg	0.25
Dinitrophenol[2,4-] 51-28-5	- - mg/m3	4.07 ug/L	50	1.33 ug/kg	3300	60.86 ug/kg	3300
Dinitrotoluene[2,4-] 121-14-2	- - mg/m3	230.00 ug/L	0.02	75.13 ug/kg	0.25	1.28E+03 ug/kg	0.25
Dinitrotoluene[2,6-] 606-20-2	- - mg/m3	42.00 ug/L	0.1	20.62 ug/kg	0.26	32.83 ug/kg	0.26
Dinoseb 88-85-7	- - mg/m3	3.90E-01 ug/L	1	11.78 ug/kg	47	21.80 ug/kg	47

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Dioxane[1,4-] 123-91-1	367.20 mg/m3	- - ug/L	12	5.43E-03 ug/kg	- -	2.05E+03 ug/kg	- -
Diphenylamine 122-39-4	- - mg/m3	412.51 ug/L	10	34.60 ug/kg	- -	1.01E+03 ug/kg	- -
Disulfoton 298-04-4	- - mg/m3	4.02E-02 ug/L	0.7	324.08 ug/kg	35	19.88 ug/kg	35
D[2,4-] 94-75-7	- - mg/m3	- - ug/L	0.2	5.79 ug/kg	1.2	27.25 ug/kg	1.2
Endosulfan I 959-98-8	- - mg/m3	3.00E-03 ug/L	0.3	1.75E-01 ug/kg	20.1	119.27 ug/kg	20.1
Endosulfan II 33213-65-9	- - mg/m3	3.00E-03 ug/L	0.4	1.04E-01 ug/kg	26.8	119.27 ug/kg	26.8
Endosulfan sulfate 1031-07-8	- - mg/m3	2.22 ug/L	0.35	34.60 ug/kg	23.4	35.78 ug/kg	23.4
Endrin 72-20-8	- - mg/m3	2.00E-03 ug/L	0.39	2.67 ug/kg	26.1	10.10 ug/kg	26.1
Endrin aldehyde 7421-93-4	- - mg/m3	1.50E-01 ug/L	0.5	3.20E+03 ug/kg	33.5	10.50 ug/kg	33.5
Ethyl methacrylate 97-63-2	355.50 mg/m3	- - ug/L	5	6.02E-01 ug/kg	5	3.00E+04 ug/kg	5

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Ethyl methane sulfonate 62-50-0	- - mg/m3	- - ug/L	20	1.61E-02 ug/kg	- -	- - ug/kg	- -
Ethylbenzene 100-41-4	304.20 mg/m3	17.20 ug/L	0.05	0.1 ug/kg	0.05	5.16E+03 ug/kg	0.05
Famphur 52-85-7	- - mg/m3	- - ug/L	20	1.78 ug/kg	- -	49.70 ug/kg	- -
Fluoranthene 206-44-0	- - mg/m3	8.10 ug/L	2.1	111.3 ug/kg	660	1.22E+05 ug/kg	660
Fluorene 86-73-7	- - mg/m3	3.90 ug/L	2.1	21.2 ug/kg	660	1.22E+05 ug/kg	660
Heptachlor 76-44-8	- - mg/m3	3.90E-04 ug/L	0.4	0.6 ug/kg	26.8	5.98 ug/kg	26.8
Heptachlor epoxide 1024-57-3	- - mg/m3	4.80E-04 ug/L	0.32	0.6 ug/kg	21.4	151.88 ug/kg	21.4
Hexachlorobenzene 118-74-1	- - mg/m3	2.40E-04 ug/L	0.056	20 ug/kg	3.8	198.78 ug/kg	3.8
Hexachlorobutadiene 87-68-3	- - mg/m3	2.23E-01 ug/L	0.014	1.38E+03 ug/kg	0.9	39.76 ug/kg	0.9
Hexachlorocyclopentadiene 77-47-4	- - mg/m3	77.04 ug/L	2.4	900.74 ug/kg	161	755.37 ug/kg	161

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Hexachloroethane 67-72-1	- - mg/m3	30.50 ug/L	0.016	2.23E+03 ug/kg	1.1	596.34 ug/kg	1.1
Hexachlorophene 70-30-4	- - mg/m3	2.28E-01 ug/L	50	2.31E+05 ug/kg	- -	198.78 ug/kg	- -
Hexachloropropene 1888-71-7	- - mg/m3	20.00 ug/L	50	2.00E-01 ug/kg	- -	- - ug/kg	- -
Hexanone[2-] 591-78-6	105.23 mg/m3	1.71E+03 ug/L	50	1.01E+03 ug/kg	50	1.26E+04 ug/kg	50
Indeno(1,2,3-cd)pyrene 193-39-5	- - mg/m3	4.31 ug/L	0.43	200 ug/kg	29	1.09E+05 ug/kg	29
Isobutyl alcohol 78-83-1	32.81 mg/m3	3.48E+04 ug/L	50	3.35E+03 ug/kg	7	2.08E+04 ug/kg	7
Isodrin 465-73-6	- - mg/m3	3.09E-02 ug/L	20	55.16 ug/kg	- -	3.32 ug/kg	- -
Isophorone 78-59-1	- - mg/m3	900.00 ug/L	10	422.30 ug/kg	3800	1.39E+05 ug/kg	3800
Isosafrole 120-58-1	- - mg/m3	- - ug/L	10	4.12 ug/kg	- -	9.94E+03 ug/kg	- -
Kepone 143-50-0	- - mg/m3	1.32E-01 ug/L	20	3.31 ug/kg	- -	32.72 ug/kg	- -

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Lead (Total) 7439-92-1	- - mg/m3	1.30 ug/L	10	31000 ug/kg	100	53.73 ug/kg	100
Mercury (Total) 7439-97-6	- - mg/m3	1.30E-03 ug/L	2	174 ug/kg	100	100.00 ug/kg	100
Methacrylonitrile 126-98-7	3.38 mg/m3	- - ug/L	5	2.97E-02 ug/kg	100	57.05 ug/kg	100
Methane[bis(2-chloroethoxy)] 111-91-1	- - mg/m3	6.40E+03 ug/L	10	349.71 ug/kg	660	302.09 ug/kg	660
Methapyrilene 91-80-5	- - mg/m3	- - ug/L	100	1.44E-02 ug/kg	- -	2.78E+03 ug/kg	- -
Methoxychlor 72-43-5	- - mg/m3	5.00E-03 ug/L	0.86	3.59 ug/kg	57.6	19.88 ug/kg	57.6
Methyl bromide 74-83-9	26.52 mg/m3	- - ug/L	1	1.48E-01 ug/kg	10	235.16 ug/kg	10
Methyl chloride 74-87-3	2.63 mg/m3	- - ug/L	1	7.85E-02 ug/kg	0.8	1.04E+04 ug/kg	0.8
Methyl ethyl ketone 78-93-3	641.70 mg/m3	7.10E+03 ug/L	10	136.96 ug/kg	100	8.96E+04 ug/kg	100
Methyl iodide 74-88-4	11.70 mg/m3	- - ug/L	5	3.05E-01 ug/kg	5	1.23E+03 ug/kg	5

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Methyl mercury 22967-92-6	- - mg/m3	2.46E-03 ug/L	Variable	1.00E-02 ug/kg	Variable	1.58 ug/kg	Variable
Methyl methacrylate 80-62-6	87.12 mg/m3	2.80E+03 ug/L	2	167.56 ug/kg	50	9.84E+05 ug/kg	50
Methyl methanesulfanate 66-27-3	- - mg/m3	- - ug/L	10	4.74E-03 ug/kg	- -	315.49 ug/kg	- -
Methyl parathion 298-00-0	- - mg/m3	- - ug/L	0.5	7.55E-01 ug/kg	20	2.92E-01 ug/kg	20
Methyl-2-pentanone[4-] 108-10-1	45.90 mg/m3	3.68E+03 ug/L	5	544.37 ug/kg	50	4.43E+05 ug/kg	50
Methylcholanthrene[3-] 56-49-5	- - mg/m3	8.91E-02 ug/L	10	8.19E+06 ug/kg	- -	77.94 ug/kg	- -
Methylene bromide 74-95-3	343.90 mg/m3	- - ug/L	1	8.59E-02 ug/kg	5	6.50E+04 ug/kg	5
Methylene chloride 75-09-2	4.78E+03 mg/m3	430.00 ug/L	1	1260 ug/kg	5	4.05E+03 ug/kg	5
Methylnaphthalene[2-] 91-57-6	- - mg/m3	329.55 ug/L	10	20.2 ug/kg	660	3.24E+03 ug/kg	660
Naphthalene 91-20-3	80.13 mg/m3	44.00 ug/L	10	34.6 ug/kg	660	99.39 ug/kg	660

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Naphthoquinone[1,4-] 130-15-4	- - mg/m3	4.40E-02 ug/L	10	2.11E-02 ug/kg	- -	1.67E+03 ug/kg	- -
Naphthylamine[1-] 134-32-7	- - mg/m3	6.70E-01 ug/L	10	1.09 ug/kg	- -	9.34E+03 ug/kg	- -
Naphthylamine[2-] 91-59-8	- - mg/m3	- - ug/L	10	1.74 ug/kg	- -	3.03E+03 ug/kg	- -
Nickel (Total) 7440-02-0	- - mg/m3	29.00 ug/L	50	16000 ug/kg	1500	1.36E+04 ug/kg	1500
Nitroaniline[m-] 99-09-2	- - mg/m3	- - ug/L	33	2.22E-01 ug/kg	2211	3.16E+03 ug/kg	2211
Nitroaniline[o-] 88-74-4	- - mg/m3	- - ug/L	10	2.22E-01 ug/kg	670	7.41E+04 ug/kg	670
Nitroaniline[p-] 100-01-6	- - mg/m3	- - ug/L	20	2.22E-01 ug/kg	7370	2.19E+04 ug/kg	7370
Nitrobenzene 98-95-3	- - mg/m3	740.00 ug/L	6.4	487.60 ug/kg	0.26	1.31E+03 ug/kg	0.26
Nitrophenol[o-] 88-75-5	- - mg/m3	13.50 ug/L	5	7.77 ug/kg	300	1.60E+03 ug/kg	300
Nitrophenol[p-] 100-02-7	- - mg/m3	35.00 ug/L	10	7.78 ug/kg	470	5.12E+03 ug/kg	470

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Nitroquinoline-1-oxide[4-] 56-57-5	- - mg/m3	- - ug/L	40	1.24 ug/kg	- -	122.22 ug/kg	- -
Nitrosodiethylamine[N-] 55-18-5	- - mg/m3	767.94 ug/L	20	22.77 ug/kg	- -	69.33 ug/kg	- -
Nitrosodimethylamine[N-] 62-75-9	- - mg/m3	- - ug/L	1.5	2.75E-03 ug/kg	- -	3.21E-02 ug/kg	- -
Nitrosodiphenylamine[N-] 86-30-6	- - mg/m3	13.00 ug/L	8.1	155.24 ug/kg	660	545.14 ug/kg	660
Nitrosomethylethylamine[N-] 10595-95-6	- - mg/m3	- - ug/L	10	4.85E-03 ug/kg	- -	1.66 ug/kg	- -
Nitrosomorpholine[N-] 59-89-2	- - mg/m3	- - ug/L	10	3.70E-03 ug/kg	- -	70.57 ug/kg	- -
Nitrosopiperidine[N-] 100-75-4	- - mg/m3	- - ug/L	20	2.26E-02 ug/kg	- -	6.65 ug/kg	- -
Nitrosopyrrolidine[N-] 930-55-2	- - mg/m3	- - ug/L	40	9.08E-04 ug/kg	- -	12.56 ug/kg	- -
Parathion 56-38-2	- - mg/m3	8.00E-03 ug/L	10	3.40E-01 ug/kg	- -	3.40E-01 ug/kg	- -
Pentachlorobenzene 608-93-5	- - mg/m3	4.70E-01 ug/L	10	1.26E+03 ug/kg	- -	496.95 ug/kg	- -

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Pentachloroethane 76-01-7	6.80E-01 mg/m3	56.42 ug/L	5	689.18 ug/kg	10	1.07E+04 ug/kg	10
Pentachloronitrobenzene 82-68-8	- - mg/m3	50.00 ug/L	20	1.82E+04 ug/kg	- -	7.09E+03 ug/kg	- -
Pentachlorophenol 87-86-5	- - mg/m3	5.23 ug/L	0.076	3.01E+04 ug/kg	400	119.27 ug/kg	400
Phenacetin 62-44-2	- - mg/m3	6.30 ug/L	20	2.25 ug/kg	- -	1.17E+04 ug/kg	- -
Phenanthrene 85-01-8	- - mg/m3	2.10 ug/L	10	41.9 ug/kg	660	4.57E+04 ug/kg	660
Phenol 108-95-2	4.31 mg/m3	100.00 ug/L	1	27.26 ug/kg	94	1.20E+05 ug/kg	94
Phenylenediamine[p-] 106-50-3	- - mg/m3	- - ug/L	10	5.68E-03 ug/kg	- -	6.16E+03 ug/kg	- -
Phorate 298-02-2	- - mg/m3	3.62 ug/L	0.4	8.61E-01 ug/kg	20	4.96E-01 ug/kg	20
Phthalate[bis(2-ethylhexyl)] 117-81-7	- - mg/m3	2.10 ug/L	2.7	182 ug/kg	181	925.94 ug/kg	181
Picoline[2-] 109-06-8	139.68 mg/m3	3.79E+03 ug/L	5	753.05 ug/kg	- -	9.90E+03 ug/kg	- -

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Polychlorinated biphenyls 1336-36-3	- - mg/m3	2.90E-05 ug/L	5.4	34.1 ug/kg	36.2	3.32E-01 ug/kg	36.2
Polychlorinated dibenzo-p-dioxins PCDD-S	- - mg/m3	2.78E-07 ug/L	0.01	0.0033 ug/kg	- -	1.99E-04 ug/kg	- -
Polychlorinated dibenzofurans 51207-31-9	- - mg/m3	1.29E-03 ug/L	0.01	1.29E-05 ug/kg	- -	3.86E-02 ug/kg	- -
Pronamide 23950-58-5	- - mg/m3	160.00 ug/L	10	1.60 ug/kg	- -	13.60 ug/kg	- -
Propionitrile 107-12-0	1.87 mg/m3	6.08E+03 ug/L	5	114.66 ug/kg	100	49.83 ug/kg	100
Propylamine[N-nitrosodi-n-] 621-64-7	- - mg/m3	- - ug/L	4.6	2.17E-01 ug/kg	660	543.68 ug/kg	660
Pyrene 129-00-0	- - mg/m3	3.00E-01 ug/L	2.7	53 ug/kg	660	7.85E+04 ug/kg	660
Pyridine 110-86-1	13.68 mg/m3	2.38E+03 ug/L	5	106.17 ug/kg	- -	1.03E+03 ug/kg	- -
Safrole 94-59-7	- - mg/m3	40.00 ug/L	10	164.86 ug/kg	- -	403.98 ug/kg	- -
Selenium (Total) 7782-49-2	- - mg/m3	5.00 ug/L	20	- - ug/kg	200	27.65 ug/kg	200

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Silver (Total) 7440-22-4	- - mg/m3	1.00E+00 ug/L	70	500 ug/kg	700	4.04E+03 ug/kg	700
Silvex 93-72-1	- - mg/m3	326.64 ug/L	0.75	7.35E+03 ug/kg	0.28	108.80 ug/kg	0.28
Styrene 100-42-5	9.46E-01 mg/m3	56.00 ug/L	1	444.96 ug/kg	5	4.69E+03 ug/kg	5
Sulfide 18496-25-8	- - mg/m3	- - ug/L	10000	- - ug/kg	- -	3.58 ug/kg	- -
Tetrachlorobenzene[1,2,4,5-] 95-94-3	- - mg/m3	26.24 ug/L	10	2.09E+04 ug/kg	- -	2.02E+03 ug/kg	- -
Tetrachlorodibenzo-p-dioxin[2,3,7,8-] 1746-01-6	- - mg/m3	3.00E-07 ug/L	0.01	0.0033 ug/kg	0.8	1.99E-04 ug/kg	0.8
Tetrachloroethane[1,1,1,2-] 630-20-6	22.50 mg/m3	90.25 ug/L	1	10.89 ug/kg	5	2.25E+05 ug/kg	5
Tetrachloroethane[1,1,2,2-] 79-34-5	352.80 mg/m3	13.00 ug/L	1	29.08 ug/kg	5	127.22 ug/kg	5
Tetrachloroethene 127-18-4	69.00 mg/m3	8.90 ug/L	0.4	195.83 ug/kg	0.4	9.92E+03 ug/kg	0.4
Tetrachlorophenol[2,3,4,6-] 58-90-2	- - mg/m3	14.06 ug/L	10	1.51E+03 ug/kg	- -	198.78 ug/kg	- -

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Tetraethyl dithiopyrophosphate 3689-24-5	- - mg/m3	13.90 ug/L	0.7	559.98 ug/kg	35	596.34 ug/kg	35
Thallium (Total) 7440-28-0	- - mg/m3	5.60E-01 ug/L	10	- - ug/kg	100	56.92 ug/kg	100
Tin (Total) 7440-31-5	- - mg/m3	73.00 ug/L	8000	- - ug/kg	2000	7.62E+03 ug/kg	2000
Toluene 108-88-3	1.04E+03 mg/m3	253.00 ug/L	1	52500 ug/kg	2	5.45E+03 ug/kg	2
Toluidine[5-nitro-o-] 99-55-8	- - mg/m3	- - ug/L	10	8.45E-01 ug/kg	- -	8.73E+03 ug/kg	- -
Toluidine[o-] 95-53-4	- - mg/m3	- - ug/L	10	1.99E-01 ug/kg	- -	2.97E+03 ug/kg	- -
Toxaphene 8001-35-2	- - mg/m3	2.00E-04 ug/L	0.86	1.09E-01 ug/kg	57.6	119.27 ug/kg	57.6
Trichlorobenzene[1,2,4-] 120-82-1	- - mg/m3	69.20 ug/L	1	1.17E+04 ug/kg	34	1.11E+04 ug/kg	34
Trichloroethane[1,1,1-] 71-55-6	4.17E+03 mg/m3	88.00 ug/L	1	246.85 ug/kg	5	2.98E+04 ug/kg	5
Trichloroethane[1,1,2-] 79-00-5	11.56 mg/m3	650.00 ug/L	1	673.51 ug/kg	0.2	2.86E+04 ug/kg	0.2

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Trichloroethylene 79-01-6	1.22E+03 mg/m3	75.00 ug/L	0.1	179.56 ug/kg	0.1	1.24E+04 ug/kg	0.1
Trichlorofluoromethane 75-69-4	5.15E+03 mg/m3	- - ug/L	0.3	3.07 ug/kg	0.3	1.64E+04 ug/kg	0.3
Trichlorophenol[2,4,5-] 95-95-4	- - mg/m3	- - ug/L	10	85.56 ug/kg	660	1.41E+04 ug/kg	660
Trichlorophenol[2,4,6-] 88-06-2	- - mg/m3	2.00 ug/L	5	84.84 ug/kg	390	9.94E+03 ug/kg	390
Trichloropropane[1,2,3-] 96-18-4	3.32 mg/m3	12.11 ug/L	1	8.35 ug/kg	4	3.36E+03 ug/kg	4
Trichlorphenoxyacetic acid[2,4,5-] 93-76-5	- - mg/m3	686.33 ug/L	0.8	5.87E+04 ug/kg	130	596.34 ug/kg	130
Triethyl phosphorothioate[O,O,O-] 126-68-1	- - mg/m3	58.25 ug/L	10	188.94 ug/kg	- -	817.57 ug/kg	- -
Trinitrobenzene[Sym-] 99-35-4	- - mg/m3	- - ug/L	0.26	1.21E-01 ug/kg	250	376.15 ug/kg	250
Vanadium (Total) 7440-62-2	- - mg/m3	19.00 ug/L	40	- - ug/kg	- -	1.59E+03 ug/kg	- -
Vinyl acetate 108-05-4	359.00 mg/m3	248.03 ug/L	5	12.95 ug/kg	50	1.27E+04 ug/kg	50

Chemical Name / CAS Number	Air EDQL	Surface Water EDQL	Surface Water MRL	Sediment EDQL	Sediment MRL	Soil EDQL	Soil MRL
Vinyl chloride 75-01-4	2.21E-01 mg/m3	9.20 ug/L	0.2	2.00 ug/kg	0.2	646.14 ug/kg	0.2
Xylenes (total) 1330-20-7	134.80 mg/m3	117.00 ug/L	0.1	1.88E+03 ug/kg	0.1	1.00E+04 ug/kg	0.1
Zinc (Total) 7440-66-6	- - mg/m3	58.90 ug/L	20	120000 ug/kg	200	6.62E+03 ug/kg	200

Appendix D

Risk-Based Screening Levels

A. INTRODUCTION

The Human Health Risk-Based Screening Levels (RBSLs) contained in this Appendix are intended to support QAPP ELEMENT 3: PROJECT DESCRIPTION. As explained in QAPP ELEMENT 3, the RBSLs have two essential purposes: 1) to assist in the selection of chemical constituent detection limits/reporting limits that will result in analytical data with appropriate sensitivity for entry into a risk assessment; and 2) to provide generic constituent screening concentrations (i.e., for soil and groundwater samples) which may be compared to the site-specific constituent concentration data obtained during the RFI. The purpose of the comparison is to support decisions for "no further action" or "no further investigation" for individual chemical constituents at a particular Solid Waste Management Unit (SWMU) or Area of Concern (AOC).

The rationale for the risk-based screening approach is explained in detail in the following U.S. EPA documents: 1) *Soil Screening Guidance: User's Guide* (OSWER Publication 9355.4-23; April 1996); 2) *Soil Screening Guidance: Technical Background Document* (OSWER Publication 9355.4-17A; EPA/540/R-95/128; May 1996); and *Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities: Advanced Notice of Proposed Rulemaking* (Federal Register 61: 19432-19464, 1996).

These guidance documents explain EPA's intention to implement the risk-based screening approach for the Agency's major site remediation and corrective action programs (i.e., Superfund and RCRA). According to this approach, individual chemical constituents present at a facility undergoing corrective action may be eliminated from further investigation/action by comparison of each site-specific constituent concentration to a pre-determined screening concentration level. Please note that effective site characterization of chemical constituents (i.e., identity, concentration, media type, migration potential, etc.) is the key factor which ensures that comparison of site-specific analytical data with pre-determined screening levels will result in accurate and protective decisions.

The *Technical Background Document* includes tables of generic soil screening levels (SSLs) which were developed for the chemicals detected most frequently at Superfund sites. The calculated generic screening levels rely on specific risk-based assumptions and parameters that result in the following limitations:

A. The SSLs were calculated for approximately 110 chemicals. However, RCRA corrective

action can include a much larger list of potential chemicals of concern. Therefore, many potential RCRA constituents are not included in the SSL guidance.

B. The SSLs were calculated using parameters that are based on residential land use. If non-residential land uses (e.g., industrial, agricultural, recreational) are proposed and appropriate, then screening levels based on the proposed non-residential uses must be developed.

C. The SSLs are based on default exposure pathways (direct soil ingestion and inhalation of contaminants or particulate matter) as well as modeled pathways (migration of chemicals from soil to ground water). If other exposure pathways (e.g., dermal exposure, food chain exposure) apply to a facility because of location, the type of chemicals of concern, or the potential receptors, then these additional pathways must be included in the development of the screening levels.

B. CONTENTS OF TABLE

In order to address the limitations described above and provide generic risk-based screening levels for a wide range of potential target constituents, the Region 5 RCRA program has adopted the following approaches in developing the attached **TABLE of RBSLs**:

1. For constituents which have generic SSLs established and listed in Appendix A of the *Technical Background Document*, the Table of RBSLs displays the same values. The generic SSLs are presented in separate columns based on the major pathways of potential exposure, which are: direct **ingestion** of soil, **inhalation** of volatiles for organic constituents and mercury, and **inhalation** of fugitive particles for inorganic constituents. A third column displays the generic SSL values for **Protection of Ground Water** in order to account for migration of soil contaminants to ground water. The value displayed is based on the use of a default dilution-attenuation factor (DAF) of 20 to account for natural processes which reduce contaminant concentrations in the subsurface.

   NOTE: The following general criteria should be employed to select the appropriate RBSL for a specific chemical constituent: if more than one exposure pathway to soil contaminants is possible at a particular SWMU or AOC, then the pathway with the lowest SSL should be used as the RBSL.

2. For additional chemical constituents (i.e., RCRA constituents) which do not have generic SSL values established in the *Technical Background Document*, the soil RBSLs displayed in the Table of RBSLs were adopted from the EPA *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA Region 9; August 1996). In the Region 9 approach, the soil PRGs were established based on exposure of the same receptor to a combination of soil ingestion, inhalation of volatiles or fugitive particles, and dermal exposure.

3. The RBSLs discussed in items #1 and #2 above apply only to the current and/or future residential land use scenario. At many RCRA corrective action sites, it may also be appropriate to assume that a current and/or future industrial land use scenario should apply. For this situation, the "Industrial Soil" RBSL values displayed in the Table of RBSLs were also adopted from the EPA Region 9 PRGs.

4. For chemical constituents in groundwater, EPA has a throughout-the-plume/unit boundary point of compliance policy for ground water, and expects all usable ground waters to be returned to their maximum beneficial uses wherever practicable. Consequently, for screening purposes, the ground water RBSLs should always account for the potential residential use of ground water. Therefore, for risk-based screening of chemical constituents in ground water, Maximum Contaminant Levels (MCLs) have been adopted as ground water RBSLs. Chemical constituents which possess final MCLs are listed in a separate column in the Table of RBSLs. However, MCLs exist for less than 100 chemicals (*Drinking Water Regulations and Health Advisories; EPA 822-B-96-002; October 1996*). For chemical constituents which do not have a final MCL, the EPA Region 9 PRG value for drinking water should be used as the ground water RBSL. These values are listed in the final column in the Table of RBSLs. **NOTE:** As stated earlier in QAPP ELEMENT 3, some States have ground water remediation criteria that are more stringent than Federal MCL values for certain chemical constituents. It is suggested that QAPP writers and RCRA project managers should review the appropriate State ground water remediation standards before deciding on final ground water RBSLs for a given site.

TABLE OF RISK-BASED SCREENING LEVELS May, 1998

CAS No.	Constituent	Soil Screening Level (mg/kg)					GW Screening Level (ug/L)	
					Region 9 PRG			
		Ingestion	Inhalation	Protection of GW [a]	Residential	Industrial	MCL	R9 PRG [b]
83-32-9	Acenaphthene	4700	---	570	NA	1.1E+02	---	3.7E+02
208-96-8	Acenaphthylene	---	---	---	---	---	---	---
67-64-1	Acetone	7800	100000	16	NA	8.8E+03	---	6.1E+02
75-05-8	Acetonitrile; Methyl cyanide	---	---	---	2.2E+02	1.2E+03	---	7.1E+01
98-86-2	Acetophenone	---	---	---	4.9E-01	1.6E+00	---	4.2E-02
53-96-3	2-Acetylaminofluorene; 2-AAF	---	---	---	---	---	---	---
107-02-8	Acrolein	---	---	---	1.0E-01	3.4E-01	---	4.2E-02
107-13-1	Acrylonitrile	---	---	---	1.9E-01	4.7E-01	---	3.7E+00
309-00-2	Aldrin	0.04	3	0.5	NA	1.1E-01	---	4.0E-03
107-05-1	Allyl chloride	---	---	---	3.2E+03	3.3E+04	---	1.8E+03
92-67-1	4-Aminobiphenyl	---	---	---	---	---	---	---
62-53-3	Aniline	---	---	---	1.9E+01	2.0E+02	---	1.1E+01
120-12-7	Anthracene	23000	---	12000	NA	5.7E+00	---	1.8E+03
7440-36-0	Antimony	31	---	5	NA	6.8E+02	---	1.5E+01
140-57-8	Aramite	---	---	---	1.8E+01	7.6E+01	---	2.7E+00
7440-38-2	Arsenic	0.4	750	29	NA	2.4E+00	---	4.5E-02
7440-39-3	Barium	5500	690000	1600	NA	1.0E+05	---	2.6E+03
71-43-2	Benzene	22	0.8	0.03	NA	1.4E+00	5	3.9E-01
56-55-3	Benzo[a]anthracene; Benzanthracene	0.9	---	2	NA	2.6E+00	---	9.2E-02
205-99-2	Benzo[b]fluoranthene	0.9	---	5	NA	2.6E+00	---	9.2E-02
207-08-9	Benzo[k]fluoranthene	9	---	49	NA	2.6E+01	---	9.2E-01
191-24-2	Benzo[g,h,i]perylene	---	---	---	---	---	---	---
50-32-8	Benzo[a]pyrene	0.09	---	8	NA	2.6E-01	0.2	9.2E-03
100-51-6	Benzyl alcohol	---	---	---	2.0E+04	1.0E+05	---	1.1E+04
7440-41-7	Beryllium	0.1	1300	63	NA	1.1E+00	---	1.6E-02
319-84-6	alpha-BHC	0.1	0.8	0.0005	NA	3.0E-01	---	1.1E-02
319-85-7	beta-BHC	0.4	---	0.003	NA	1.1E+00	---	3.7E-02
319-86-8	delta-BHC	---	---	---	---	---	---	---
58-89-9	gamma-BHC; Lindane	0.5	---	0.009	NA	1.5E+00	0.2	5.2E-02
111-91-1	Bis(2-chloroethoxy)methane	---	---	---	---	---	---	---
111-44-4	Bis(2-chloroethyl)ether	0.6	0.2	0.0004	NA	9.7E-02	---	9.8E-03

See text for source references. "---" = value is not currently available. "NA" = value is not applicable for this constituent: refer to the SSL values given in the columns labeled "Ingestion", "Inhalation" and "Protection of GW."

CAS No.	Constituent	Soil Screening Level (mg/kg)					GW Screening Level (ug/L)	
					Region 9 PRG			
		Ingestion	Inhalation	Protection of GW [a]	Residential	Industrial	MCL	R9 PRG [b]
	Bis(2-chloro-1-methylethyl) ether; 2,2-							
108-60-1	Dichlorodiisopropyl ether	---	---	---	6.3E+00	2.7E+01	---	9.6E-01
117-81-7	Bis(2-ethylhexyl) phthalate	46	31000	3600	NA	1.4E+02	---	4.8E+00
75-27-4	Bromodichloromethane	10	3000	0.6	NA	1.4E+00	---	1.8E-01
75-25-2	Bromoform; Tribromomethane	81	53	0.8	NA	2.4E+02	---	8.5E+00
101-55-3	4-Bromophenyl phenyl ether	---	---	---	---	---	---	---
85-68-7	Butyl benzyl phthalate; Benzyl butyl phthalate	16000	930	930	NA	9.3E+02	---	7.3E+03
7440-43-9	Cadmium	78	1800	8	NA	8.5E+02	---	1.8E+01
75-15-0	Carbon disulfide	7800	720	32	NA	2.4E+01	---	2.1E+01
56-23-5	Carbon tetrachloride	5	0.3	0.07	NA	5.0E-01	---	1.7E-01
57-74-9	Chlordane	0.5	20	10	NA	1.5E+00	---	5.2E-02
106-47-8	p-Chloroaniline	310	---	0.7	NA	2.7E+03	---	1.5E+02
108-90-7	Chlorobenzene	1600	130	1	NA	2.2E+02	---	3.9E+01
510-15-6	Chlorobenzilate	---	---	---	1.6E+00	7.1E+00	---	2.5E-01
59-50-7	p-Chloro-m-cresol	---	---	---	---	---	---	---
75-00-3	Chloroethane; Ethyl chloride	---	---	---	1.1E+03	1.6E+03	---	7.1E+02
67-66-3	Chloroform	100	0.3	0.6	NA	5.3E-01	---	1.6E-01
91-58-7	2-Chloronaphthalene	---	---	---	1.1E+02	1.1E+02	---	4.9E+02
95-57-8	2-Chlorophenol	390	53000	4	NA	3.7E+02	---	3.8E+01
7005-72-3	4-Chlorophenyl phenyl ether	---	---	---	---	---	---	---
126-99-8	Chloroprene	---	---	---	3.6E+00	1.2E+01	---	1.4E+01
7440-47-3	Chromium (total)	390	270	38	NA	4.5E+02	---	---
218-01-9	Chrysene	88	---	160	NA	7.2E+00	---	9.2E+00
7440-48-4	Cobalt	---	---	---	4.6E+03	9.7E+04	---	2.2E+03
7440-50-8	Copper	---	---	---	2.8E+03	6.3E+04	---	1.4E+03
108-39-4	m-Cresol	---	---	---	3.3E+03	3.4E+04	---	1.8E+03
95-48-7	o-Cresol	3900	---	15	NA	3.4E+04	---	1.8E+03
106-44-5	p-Cresol	---	---	---	3.3E+02	3.4E+03	---	1.8E+02
57-12-5	Cyanide	1600	---	40	NA	1.4E+04	---	7.3E+02
94-75-7	2,4-D; 2,4-Dichlorophenoxyacetic acid	---	---	---	6.5E+02	6.8E+03	70	3.7E+02
72-54-8	4,4'-DDD	3	---	16	NA	7.9E+00	---	2.8E-01

See text for source references. "---" = value is not currently available. "NA" = value is not applicable for this constituent: refer to the SSL values given in the columns labeled "Ingestion", "Inhalation" and "Protection of GW."

CAS No.	Constituent	Soil Screening Level (mg/kg)					GW Screening Level (ug/L)	
					Region 9 PRG			
		Ingestion	Inhalation	Protection of GW [a]	Residential	Industrial	MCL	R9 PRG [b]
72-55-9	4,4'-DDE	2	---	54	NA	5.6E+00	---	2.0E-01
50-29-3	4,4'-DDT	2	---	32	NA	5.6E+00	---	2.0E-01
2303-16-4	Diallate	---	---	---	7.3E+00	3.1E+01	---	1.1E+00
53-70-3	Dibenz[a,h]anthracene	0.09	---	2	NA	2.6E-01	---	9.2E-03
132-64-9	Dibenzofuran	---	---	---	1.4E+02	1.4E+02	---	2.4E+01
124-48-1	Dibromochloromethane; Chlorodibromomethane	8	1300	0.4	NA	2.3E+01	---	1.0E+00
96-12-8	1,2-Dibromo-3-chloropropane; DBCP	---	---	---	3.2E-01	1.4E+00	0.2	4.8E-02
106-93-4	1,2-Dibromoethane; Ethylene	---	---	---	4.9E-03	2.0E-02	---	7.6E-04
84-74-2	Di-n-butyl phthalate	7800	2300	2300	NA	6.8E+04	---	3.7E+03
95-50-1	o-Dichlorobenzene	7000	560	17	NA	7.0E+02	600	3.7E+02
541-73-1	m-Dichlorobenzene	---	---	---	5.0E+02	8.6E+02	---	1.8E+02
106-46-7	p-Dichlorobenzene	27	---	2	NA	8.5E+00	75	4.7E-01
91-94-1	3,3-Dichlorobenzidine	1	---	0.007	NA	4.2E+00	---	1.5E-01
110-57-6	trans-1,4-Dichloro-2-butene	---	---	---	---	---	---	---
75-71-8	Dichlorodifluoromethane	---	---	---	9.4E+01	3.1E+02	---	3.9E+02
75-34-3	1,1-Dichloroethane	7800	1300	23	NA	1.7E+03	---	8.1E+02
107-06-2	1,2-Dichloroethane	7	0.4	0.02	NA	5.5E-01	5	1.2E-01
75-35-4	1,1-Dichloroethylene	1	0.07	0.06	NA	8.0E-02	7	4.6E-02
156-60-5	trans-1,2-Dichloroethylene	1600	3100	0.7	NA	2.7E+02	100	1.2E+02
120-83-2	2,4-Dichlorophenol	230	---	1	NA	2.0E+03	---	1.1E+02
87-65-0	2,6-Dichlorophenol	---	---	---	---	---	---	---
78-87-5	1,2-Dichloropropane	9	15	0.03	NA	6.8E-01	5	1.6E-01
542-75-6	1,3-Dichloropropene (mixture)	4	0.1	0.004	NA	5.5E-01	---	8.1E-02
10061-01-5	cis-1,3-Dichloropropene [d]	---	---	---	---	---	---	---
10061-02-6	trans-1,3-Dichloropropene [d]	---	---	---	---	---	---	---
60-57-1	Dieldrin	0.04	1	0.004	NA	1.2E-01	---	4.2E-03
84-66-2	Diethyl phthalate	63000	2000	470	NA	1.0E+05	---	2.9E+04
297-97-2	O,O-Diethyl O-2-pyrazinyl phosphorothioate; Thionazin	---	---	---	---	---	---	---
60-51-5	Dimethoate	---	---	---	1.3E+01	1.4E+02	---	7.3E+00
60-11-7	p-(Dimethylamino)azobenzene	---	---	---	---	---	---	---

See text for source references. "---" = value is not currently available. "NA" = value is not applicable for this constituent: refer to the SSL values given in the columns labeled "Ingestion", "Inhalation" and "Protection of GW."

CAS No.	Constituent	Soil Screening Level (mg/kg)					GW Screening Level (ug/L)	
					Region 9 PRG			
		Ingestion	Inhalation	Protection of GW [a]	Residential	Industrial	MCL	R9 PRG [b]
57-97-6	7,12-Dimethylbenz[a]anthracene	---	---	---	---	---	---	---
119-93-7	3,3-Dimethylbenzidine	---	---	---	4.8E-02	2.1E-01	---	7.3E-03
122-09-8	alpha, alpha-Dimethylphenethylamine	---	---	---	---	---	---	---
105-67-9	2,4-Dimethylphenol	1600	---	9	NA	1.4E+04	---	7.3E+02
131-11-3	Dimethyl phthalate	---	---	---	1.0E+05	1.0E+05	---	3.7E+05
99-65-0	m-Dinitrobenzene	---	---	---	6.5E+00	6.8E+01	---	3.7E+00
534-52-1	4,6-Dinitro-o-cresol	---	---	---	---	---	---	---
51-28-5	2,4-Dinitrophenol	160	---	0.3	NA	1.4E+03	---	7.3E+01
121-14-2	2,4-Dinitrotoluene	0.9	---	0.0008	NA	1.4E+03	---	7.3E+01
606-20-2	2,6-Dinitrotoluene	0.9	---	0.0007	NA	6.8E+02	---	3.7E+01
88-85-7	Dinoseb; DNBP; 2-sec-Butyl- 4,6-dinitrophenol	---	---	---	6.5E+01	6.8E+02	7	3.7E+01
117-84-0	Di-n-octyl phthalate	1600	10000	10000	NA	1.0E+04	---	7.3E+02
123-91-1	1,4-Dioxane	---	---	---	4.0E+01	1.7E+02	---	6.1E+00
122-39-4	Diphenylamine	---	---	---	1.6E+03	1.7E+04	---	9.1E+02
298-04-4	Disulfoton	---	---	---	2.6E+00	2.7E+01	---	1.5E+00
115-29-7	Endosulfan (mixture)	470	---	1.80E+01	---	4.1E+03	---	2.2E+02
959-98-8	Endosulfan I [d]	---	---	---	---	---	---	---
33213-65-9	Endosulfan II [d]	---	---	---	---	---	---	---
1031-07-8	Endosulfan sulfate	---	---	---	---	---	---	---
72-20-8	Endrin	23	---	1	NA	2.0E+02	2	1.1E+01
7421-93-4	Endrin aldehyde	---	---	---	---	---	---	---
100-41-4	Ethylbenzene	7800	400	13	NA	2.3E+02	700	1.3E+03
97-63-2	Ethyl methacrylate	---	---	---	1.4E+02	1.4E+02	---	5.5E+02
62-50-0	Ethyl methanesulfonate	---	---	---	---	---	---	---
52-85-7	Famphur	---	---	---	---	---	---	---
206-44-0	Fluoranthene	3100	---	4300	NA	2.7E+04	---	1.5E+03
86-73-7	Fluorene	3100	---	560	NA	9.0E+01	---	2.4E+02
76-44-8	Heptachlor	0.1	4	23	NA	4.2E-01	0.4	1.5E-02
1024-57-3	Heptachlor epoxide	0.07	5	0.7	NA	2.1E-01	0.2	7.4E-03
118-74-1	Hexachlorobenzene	0.4	1	2	NA	1.2E+00	1	4.2E-02

See text for source references. "---" = value is not currently available. "NA" = value is not applicable for this constituent: refer to the SSL values given in the columns labeled "Ingestion", "Inhalation" and "Protection of GW."

CAS No.	Constituent	Soil Screening Level (mg/kg)					GW Screening Level (ug/L)	
					Region 9 PRG			
		Ingestion	Inhalation	Protection of GW [a]	Residential	Industrial	MCL	R9 PRG [b]
87-68-3	Hexachlorobutadiene	8	8	2	NA	2.4E+01	---	8.6E-01
77-47-4	Hexachlorocyclopentadiene	550	10	400	NA	4.6E+03	50	2.6E+02
67-72-1	Hexachloroethane	46	55	0.5	NA	1.4E+02	---	4.8E+00
70-30-4	Hexachlorophene	---	---	---	2.0E+01	2.0E+02	---	1.1E+01
1888-71-7	Hexachloropropene	---	---	---	---	---	---	---
591-78-6	2-Hexanone	---	---	---	---	---	---	---
193-39-5	Indeno(1,2,3-cd)pyrene	0.9	---	14	NA	2.6E+00	---	9.2E-02
78-83-1	Isobutyl alcohol	---	---	---	1.1E+04	1.0E+05	---	1.8E+03
465-73-6	Isodrin	---	---	---	---	---	---	---
78-59-1	Isophorone	670	4600	0.5	NA	2.0E+03	---	7.1E+01
120-58-1	Isosafrole	---	---	---	---	---	---	---
143-50-0	Kepone	---	---	---	2.5E-02	1.1E-01	---	3.7E-03
7439-92-1	Lead	400	---	---	NA	4.0E+02	---	4.0E+00
7439-97-6	Mercury (total)	23	10	2	NA	5.1E+02	---	1.1E+01
126-98-7	Methacrylonitrile	---	---	---	2.0E+00	8.1E+00	---	1.0E+00
91-80-5	Methapyrilene	---	---	---	---	---	---	---
72-43-5	Methoxychlor	390	---	160	NA	3.4E+03	40	1.8E+02
74-83-9	Methyl bromide; Bromomethane	110	10	0.2	NA	2.3E+01	---	8.7E+00
74-87-3	Methyl chloride; Chloromethane	---	---	---	1.2E+00	2.6E+00	---	1.5E+00
56-49-5	3-Methylcholanthrene	---	---	---	---	---	---	---
74-95-3	Methylene bromide; Dibromomethane	---	---	---	6.5E+02	6.8E+03	---	3.7E+02
75-09-2	Methylene chloride; Dichloromethane	85	13	0.02	NA	1.8E+01	---	4.3E+00
78-93-3	Methyl ethyl ketone; MEK	---	---	---	7.1E+03	2.7E+04	---	1.9E+03
74-88-4	Methyl iodide; Iodomethane	---	---	---	---	---	---	---
80-62-6	Methyl methacrylate	---	---	---	7.6E+02	2.8E+03	---	4.9E+02
66-27-3	Methyl methanesulfonate	---	---	---	---	---	---	---
91-57-6	2-Methylnaphthalene	---	---	---	---	---	---	---
298-00-0	Methyl parathion; Parathion methyl	---	---	---	1.6E+01	1.7E+02	---	9.1E+00
108-10-1	4-Methyl-2-pentanone; Methyl isobutyl ketone	---	---	---	7.7E+02	2.8E+03	---	1.6E+02

See text for source references. "---" = value is not currently available. "NA" = value is not applicable for this constituent: refer to the SSL values given in the columns labeled "Ingestion", "Inhalation" and "Protection of GW."

CAS No.	Constituent	Soil Screening Level (mg/kg)					GW Screening Level (ug/L)	
					Region 9 PRG			
		Ingestion	Inhalation	Protection of GW [a]	Residential	Industrial	MCL	R9 PRG [b]
91-20-3	Naphthalene	3100	---	84	NA	2.4E+02	---	2.4E+02
130-15-4	1,4-Naphthoquinone	---	---	---	---	---	---	---
134-32-7	1-Naphthylamine	---	---	---	---	---	---	---
91-59-8	2-Naphthylamine	---	---	---	---	---	---	---
7440-02-0	Nickel	1600	13000	130	NA	3.4E+04	---	7.3E+02
88-74-4	o-Nitroaniline	---	---	---	3.9E+00	4.1E+01	---	2.2E+00
99-09-2	m-Nitroaniline	---	---	---	---	---	---	---
100-01-6	p-Nitroaniline	---	---	---	---	---	---	---
98-95-3	Nitrobenzene	39	92	0.1	NA	9.4E+01	---	3.4E+00
88-75-5	o-Nitrophenol	---	---	---	---	---	---	---
100-02-7	p-Nitrophenol	---	---	---	---	---	---	---
56-57-5	4-Nitroquinoline 1-oxide	---	---	---	---	---	---	---
924-16-3	N-Nitrosodi-n-butylamine	---	---	---	2.2E-02	5.5E-02	---	2.0E-03
55-18-5	N-Nitrosodiethylamine	---	---	---	3.0E-03	1.3E-02	---	4.5E-04
62-75-9	N-Nitrosodimethylamine	---	---	---	8.7E-03	3.7E-02	---	1.3E-03
86-30-6	N-Nitrosodiphenylamine	130	---	1	NA	3.9E+02	---	1.4E+01
621-64-7	N-Nitrosodipropylamine; Di-n-	0.09	---	0.00005	NA	2.7E-01	---	9.6E-03
10595-95-6	N-Nitrosomethylethylamine	---	---	---	2.0E-02	8.7E-02	---	3.1E-03
59-89-2	N-Nitrosomorpholine	---	---	---	---	---	---	---
100-75-4	N-Nitrosopiperidine	---	---	---	---	---	---	---
930-55-2	N-Nitrosopyrrolidine	---	---	---	2.1E-01	9.1E-01	---	3.2E-02
99-55-8	5-Nitro-o-toluidine	---	---	---	1.3E+01	5.8E+01	---	2.0E+00
56-38-2	Parathion	---	---	---	3.9E+02	4.1E+03	---	2.2E+02
1336-36-3	Polychlorinated biphenyls; PCBs	1	---	---	NA	3.4E-01	---	8.7E-03
See Note c)	Polychlorinated dibenzo-p-dioxins; PCDDs	---	---	---	---	---	---	---
See Note c)	Polychlorinated dibenzofurans; PCDFs	---	---	---	---	---	---	---
608-93-5	Pentachlorobenzene	---	---	---	5.2E+01	5.5E+02	---	2.9E+01
76-01-7	Pentachloroethane	---	---	---	---	---	---	---
82-68-8	Pentachloronitrobenzene	---	---	---	1.7E+00	7.3E+00	---	2.6E-01
87-86-5	Pentachlorophenol	3	---	0.03	NA	7.9E+00	---	5.6E-01

See text for source references. "---" = value is not currently available. "NA" = value is not applicable for this constituent: refer to the SSL values given in the columns labeled "Ingestion", "Inhalation" and "Protection of GW."

CAS No.	Constituent	Soil Screening Level (mg/kg)					GW Screening Level (ug/L)	
					Region 9 PRG			
		Ingestion	Inhalation	Protection of GW [a]	Residential	Industrial	MCL	R9 PRG [b]
62-44-2	Phenacetin	---	---	---	---	---	---	---
85-01-8	Phenanthrene	---	---	---	---	---	---	---
108-95-2	Phenol	47000	---	100	NA	1.0E+05	---	2.2E+04
106-50-3	p-Phenylenediamine	---	---	---	1.2E+04	1.0E+05	---	6.9E+03
298-02-2	Phorate	---	---	---	1.3E+01	1.4E+02	---	7.3E+00
109-06-8	2-Picoline	---	---	---	---	---	---	---
23950-58-5	Pronamide	---	---	---	4.9E+03	5.1E+04	---	2.7E+03
107-12-0	Propionitrile; Ethyl cyanide	---	---	---	---	---	---	---
129-00-0	Pyrene	2300	---	4200	NA	1.0E+02	---	1.8E+02
110-86-1	Pyridine	---	---	---	6.5E+01	6.8E+02	---	3.7E+01
94-59-7	Safrole	---	---	---	---	---	---	---
7782-49-2	Selenium	390	---	5	NA	8.5E+03	50	1.8E+02
7440-22-4	Silver	390	---	34	NA	8.5E+03	---	1.8E+02
93-72-1	Silvex; 2,4,5-TP	---	---	---	5.2E+02	5.5E+03	50	2.9E+02
100-42-5	Styrene	16000	1500	4	NA	6.8E+02	---	1.6E+03
18496-25-8	Sulfide	---	---	---	---	---	---	---
93-76-5	2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid	---	---	---	6.5E+02	6.8E+03	---	3.7E+02
1746-01-6	2,3,7,8-TCDD; 2,3,7,8-Tetrachlorodibenzo-p-dioxin	---	---	---	3.8E-06	2.4E-05	---	4.5E-07
95-94-3	1,2,4,5-Tetrachlorobenzene	---	---	---	2.0E+01	2.0E+02	---	1.1E+01
630-20-6	1,1,1,2-Tetrachloroethane	---	---	---	2.4E+00	5.4E+00	---	4.3E-01
79-34-5	1,1,2,2-Tetrachloroethane	3	0.6	0.003	NA	1.1E+00	---	5.5E-02
127-18-4	Tetrachloroethylene; Perchloroethylene; Tetrachloroethene	12	11	0.06	NA	1.7E+01	5	1.1E+00
58-90-2	2,3,4,6-Tetrachlorophenol	---	---	---	2.0E+03	2.0E+04	---	1.1E+03
3689-24-5	Tetraethyl dithiopyrophosphate	---	---	---	2.0E+03	2.0E+04	---	1.1E+03
7440-28-0	Thallium (total)	---	---	0.7	5.4E+00	1.2E+02	2	---
7440-31-5	Tin	---	---	---	4.6E+04	1.0E+05	---	2.2E+04
108-88-3	Toluene	16000	650	12	NA	8.8E+02	1000	7.2E+02
95-53-4	o-Toluidine	---	---	---	---	---	---	---

See text for source references. "---" = value is not currently available. "NA" = value is not applicable for this constituent: refer to the SSL values given in the columns labeled "Ingestion", "Inhalation" and "Protection of GW."

CAS No.	Constituent	Soil Screening Level (mg/kg)					GW Screening Level (ug/L)	
					Region 9 PRG			
		Ingestion	Inhalation	Protection of GW [a]	Residential	Industrial	MCL	R9 PRG [b]
8001-35-2	Toxaphene	0.6	89	31	NA	1.7E+00	3	6.1E-02
120-82-1	1,2,4-Trichlorobenzene	780	3200	5	NA	5.5E+03	70	1.9E+02
71-55-6	1,1,1-Trichloroethane;	---	1200	2	NA	3.0E+03	200	7.9E+02
79-00-5	1,1,2-Trichloroethane	11	1	0.02	NA	1.5E+00	5	2.0E-01
79-01-6	Trichloroethylene; Trichloroethene	58	5	0.06	NA	7.0E+00	5	1.6E+00
75-69-4	Trichlorofluoromethane	---	---	---	3.8E+02	1.3E+03	---	1.3E+03
95-95-4	2,4,5-Trichlorophenol	7800	---	270	NA	6.8E+04	---	3.7E+03
88-06-2	2,4,6-Trichlorophenol	58	200	0.2	NA	1.7E+02	---	6.1E+00
96-18-4	1,2,3-Trichloropropane	---	---	---	1.4E-03	3.1E-03	---	1.6E-03
126-68-1	O,O,O-Triethyl phosphorothioate	---	---	---	---	---	---	---
99-35-4	sym-Trinitrobenzene	---	---	---	3.3E+00	3.4E+01	---	1.8E+00
7440-62-2	Vanadium	550	---	6000	NA	1.2E+04	---	2.6E+02
108-05-4	Vinyl acetate	78000	1000	170	NA	2.6E+03	---	4.1E+02
75-01-4	Vinyl chloride	0.3	0.03	0.01	NA	3.5E-02	2	2.0E-02
108-38-3	m-Xylene	160000	420	210	NA	3.2E+02	---	1.4E+03
95-47-6	o-Xylene	160000	410	190	NA	3.2E+02	---	1.4E+03
106-42-3	p-Xylene	160000	460	200	NA	3.2E+02	---	---
1330-20-7	Xylene (total)	160000	410	190	NA	3.2E+02	10000	1.4E+03
7440-66-6	Zinc	23000	---	12000	NA	1.0E+05	---	1.1E+04

a) Migration to groundwater with a dilution attenuation factor of 20. It should be noted that at sites where little or no dilution or attenuation of soil leachate concentrations would be expected between the source and a nearby receptor, a DAF of 20 may not be conservative enough. This situation may apply at sites with shallow water tables, fractured media, karst topography, or source size greater than 30 acres. For such situations, the *Technical Background Document* should be consulted to determine migration to ground water SSLs based on a DAF = 1 (no dilution). Alternatively, a site-specific DAF may be developed using the methodology given in the *Technical Background Document* .

b) Region 9 PRG "Tap Water" value.

c) Note: If the PCDDs and/or PCDFs are suspected as potential constituents of concern, then the analysis must be conducted to identify and quantify the mixture of toxic PCDD/PCDF congeners. The results of congener analysis should be used to calculate a Toxic Equivalent (TEQ) concentration for the mixture. The TEQ concentration should be compared to the RBSLs for 2,3,7,8-TCDD. Please refer to the document: "Estimating Exposure to Dioxin-Like Compounds; Volume II: Properties, Sources, Occurrence and Background Exposures" (EPA/600/6-88/005Cb; June 1994).

d) For this constituent, refer to the values listed under corresponding mixture of isomers.

See text for source references. "---" = value is not currently available. "NA" = value is not applicable for this constituent: refer to the SSL values given in the columns labeled "Ingestion", "Inhalation" and "Protection of GW."

APPENDIX E

EXAMPLE QUALITY CONTROL PERFORMANCE CRITERIA FOR MATRIX SPIKES/MATRIX SPIKE DUPLICATES* AND SURROGATES FOR VOLATILE ORGANIC COMPOUNDS

	MS/MSD %Recovery		MS/MSD %RPD		Surrogate % Recovery	
Volatile Organic Compounds	**Water**	**Soil**	**Water**	**Soil**	**Water**	**Soil**
Toluene-d8					88-110	84-138
Bromofluorobenzene					86-115	59-113
1,2-Dichloroethane-d4					76-114	70-121
1,1-Dichloroethene	61-145	59-173	14	22		
Trichloroethene	71-120	62-137	14	23		
Benzene	76-127	66-142	11	21		
Toluene	76-125	59-139	13	21		
Chlorobenzene	75-130	60-133	13	21		

* The selection of matrix spiking compounds should be consistent with the investigation-specific requirements, as discussed in Instructions Section 5.3.2.

APPENDIX F

EXAMPLE QUALITY CONTROL PERFORMANCE CRITERIA FOR MATRIX SPIKES/MATRIX SPIKE DUPLICATES* AND SURROGATES FOR SEMIVOLATILE ORGANIC COMPOUNDS

Semivolatile Organic Compounds	Matrix Spike/Dup				Surrogate	
	%Recovery		%RPD		%Recovery	
	Water	Soil	Water	Soil	Water	Soil
Nitrobenzene-d5					35-114	23-120
2-Fluorobiphenyl					43-116	30-115
Terphenyl-d14					33-141	18-137
Phenol-d5					10-94	24-113
2-Fluorophenol					21-100	25-121
2,4,6-Tribromophenol					10-123	19-122
Phenol	12-110	26-90	42	35		
2-Chlorophenol	27-123	25-102	40	50		
1,4-Dichlorobenzene	36-97	28-104	28	27		
N-Nitroso-di-N-propylamine	41-116	41-126	38	38		
1,2,4-Trichlorobenzene	39-98	38-107	28	23		
4-Chloro-3-Methylphenol	23-97	26-103	42	33		
Acenapthene	46-118	31-137	31	19		
4-Nitrophenol	10-80	11-114	50	50		
2,4-Dinitrotoluene	24-96	28-89	38	47		
Pentachlorophenol	9-103	17-109	50	47		
Pyrene	26-127	35-142	31	36		

* The selection of matrix spiking compounds should be consistent with the investigation-specific requirements, as discussed in Instructions Section 5.3.2.

APPENDIX G

EXAMPLE QUALITY CONTROL PERFORMANCE CRITERIA FOR MATRIX SPIKES/MATRIX SPIKE DUPLICATES* AND SURROGATES FOR PESTICIDES/PCBS

	Matrix Spike/Duplicate				Surrogate	
	%Recovery		%RPD		%Recovery	
Pesticides/PCBs	**Water**	**Soil**	**Water**	**Soil**	**Water**	**Soil**
Tetrachloro-m-xylene					60-150	60-150
Decachlorobiphenyl					60-150	60-150
gamma-BHC (Lindane)	56-123	46-127	15	50		
Heptachlor	40-131	35-130	20	31		
Aldrin	40-120	34-132	22	43		
Dieldrin	52-126	31-134	18	38		
Endrin	56-121	42-139	21	45		
4,4' -DDT	38-127	23-134	27	50		

* The selection of matrix spiking compounds should be consistent with the investigation-specific requirements, as discussed in Instructions Section 5.3.2.

APPENDIX H
EXAMPLE SUMMARY OF SAMPLING AND ANALYSIS PROGRAM

SWMU[1]	SAMPLE MATRIX	FIELD PARAMETERS	LAB[3] PARAMETERS	INVESTIGATIVE SAMPLES	MATRIX DUPLCT	MATRIX SPIKE[5]	BLANKS[6]	MATRIX TOTAL
#1-DSO LANDFILL	Soil	Qualitative screening with PID	Metals[2] VOCs[2] SVOCs[2]	No. Total 88 88 6 6 6 6	No. Total 9 9 1 1 1 1	No.Total 4 4 1 1 1 1	No. Total. 0 0 0 0 0 0	 101 8 8
#2-Storm water Retention Pond	Water	Qualitative screening with PID pH Specific Conductance Temperature	Metals VOCs SVOCs Cyanide	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 2 1 1 1 1	4 5 4 4
	Soil/ Sediment	Qualitative screening with PID	Metals VOCs SVOCs Cyanide	5 5 5 5 5 5 5 5	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	6 6 6 6
#8, 9-Water Acid Tanks	Soil	Qualitative screening with PID	Metals pH	25 25 25 25	3 3 3 3	1 1 1 1	0 0 0 0	29 29
#13-Waste Acid Pit	Soil	Qualitative screening with PID Field pH	Metals pH	14 14 14 14	2 2 2 2	1 1 1 1	0 0 0 0	17 17

(1) Figure 1-2 shows the location of each SWMU
(2) Samples will be composited for metals and semivolatiles. See Section 3.1.2 of Work Plan for a description of sample locations.
(3) Analytes selected include 40 CFR Part 264, Appendix IX metals, cyanide, Target compound list volatiles and semivolatiles. See Tables 4-4, 4-5, and 4-6.
(4) The frequency of sampling is one for this RFI.
(5) Additional sample volume required for matrix spike/matrix spike duplicate.
(6) Blank totals include estimated trip, field blanks, and rinse blanks.

APPENDIX H
EXAMPLE SUMMARY OF SAMPLING AND ANALYSIS PROGRAM

SWMU[1]	SAMPLE MATRIX	FIELD PARAMETERS	LAB PARAMETERS	INVESTIGATIVE SAMPLES No.	INVESTIGATIVE SAMPLES TOTAL	MATRIX DUPLICATES No.	MATRIX DUPLICATES TOTAL	MATRIX SPIKE[5] No.	MATRIX SPIKE[5] TOTAL	BLANKS[6] No.	BLANKS[6] TOTAL	MATRIX TOTAL
#21, 22-slag Reclaim Dust Collector and Dumpster	Soil	Qualitative screening with PID	Metals	3	3	1	1	0	0	0	0	4
#25-Outfall 005	Water	Qualitative screening with PID	SVOCs	2	2	1	1	1	1	1	1	5
		pH	VOCs	2	2	1	1	1	1	2	2	6
		Specific Conductance										
		Temperature	Metals	2	2	1	1	1	1	1	1	5
			Cyanide	2	2	1	1	1	1	1	1	5
		Qualitative screening with PID										
	Soil		SVOCs	3	3	1	1	1	1	0	0	4
			VOCs	3	3	1	1	1	1	0	0	4
			Metals	3	3	1	1	1	1	0	0	4
			Cyanide	3	3	1	1	1	1	0	0	4
Back ground Samples	Soil	Qualitative screening with PID	Metals	20	20	2	2	1	1	0	0	23
			VOCs	5	5	1	1	1	1	0	0	7
		Field pH	SVOCs	5	5 20 20	1	1	1	1	0	0	7
			Cyanide			2	2	1	1	0	0	23

(1) Figure 1-2 shows the location of each SWMU.
(2) Samples will be composited for metals and semivolatiles. See Section 3.1.2 of Work Plan for a description of sample locations.
(3) Analytes selected include 40 CFR Part 264, Appendix IX metals, cyanide, Target compound list volatiles and semivolatiles. See Tables 4-4, 4-5, and 4-6.
(4) The frequency of sampling is one for this RFI.
(5) Additional sample volume required for matrix spike/matrix spike duplicate.
(6) Blank totals include estimated trip, field blanks, and rinse blanks.

APPENDIX I - GUIDELINES FOR APPENDIX IX TESTING AND ASSOCIATED SPECIALIZED ANALYTICAL METHODS

I. TABLE OF CONTENTS

315-320) **This attachment isn't included in the electronic version of this file.**

III Petitions to Delist Hazardous Wastes - Constituents of Petroleum Refining Wastes, 1985 Skinner List and 1993 Updated Skinner List.

IV Volatiles in soil - Directive for change, December 22, 1997

V Sample Preparation of Soils/Solids for Metals Analysis

VI The Challenge of Remediating Chromium-Contaminated Soil (Excerpted from Environmental Science and Technology, vol. 30, no.6, 1996, pp. 248A - 251A) **This attachment is not included in the electronic version of this file.**

II. APPENDIX IX - DEFINITION AND TESTING OPTIONS

"Appendix IX" is defined as the list of Hazardous Constituents required for groundwater monitoring at RCRA regulated hazardous waste treatment, storage, and disposal facilities, during compliance monitoring and/or corrective actions at these facilities. Appendix IX is codified in 40 CFR 264, Subpart F and was promulgated in the Federal Register of July 9, 1987. Appendix IX of 40 CFR 264 contains 222 constituents and replaced an earlier regulation requiring the larger list of Appendix VIII to 40 CFR 261 as the basis for groundwater monitoring. Appendix IX also appropriately contains 17 constituents of Superfund's Contract Laboratory Program (CLP), as of 1987, that were not part of Appendix VIII.

The list of Appendix IX Hazardous Constituents are codified as regulation. Analytical methods from SW-846 and practical quantitation limits (PQLs) for each constituent are provided in the regulations for information purposes; however, these methods and PQLs are stated as not being part of the Appendix IX regulation. The Appendix IX list has not been updated since 1987. Knowledge gained in the last ten (10) or more years of analytical measurements has not changed analytical methods guidance or accuracy of stated PQLs in the Appendix IX regulation. The analytical methods manual of SW-846 has been updated three times since the 1987 publication of Appendix IX, so that methods suggested by the regulation are no longer in use, or have even been deleted from SW-846. When instrument calibration records or analytical method performance have been observed in the last 10 years many informational PQLs suggested by the regulation have found to be seriously in error, especially for the 80 or 90 constituents not tested by the CLP.

The list of Appendix IX constituents, itself, has not been updated (additions or deletions) since 1987, although draft updates were reviewed by Region 5 in the early 1990's. Experimental evidence suggests certain constituents should be deleted. There is a need for other compounds (ex. cis-1,2-dichloroethene) to be added. The Appendix IX list is commonly utilized in RCRA Corrective Actions/RCRA Facility Investigations (RFIs) as a parent list of constituents to be considered for analysis of soils and groundwaters.

When selecting Appendix IX constituents, for good or bad, a certain amount of testing was funded by U.S. EPA 1) to appropriately winnow the list of Appendix VIII constituents; and 2) to respond to a petition from the State of Michigan to increase, by more than 100, the number of Appendix VIII organic constituents. The following reports are available in the Region 5 U.S. EPA Library on microfiche:

1. GC-MS Suitability Testing of RCRA Appendix VIII and Michigan List Analytes, U.S. EPA, EPA/600/S4-87/024, January 1988;

2. Capillary Column GC-MS Determination of 77 Purgeable Organic Compounds in Two Simulated Liquid Wastes, U.S. EPA, EPA/600/S4-88/030, Sept. 1988.

3. Screening of Semivolatile Organic Compounds for Extractibility and Aqueous Stability by

SW-846 Method 3510, U.S. EPA, EPA/600/S4-88/005, April 1988.

4. Validation of SW-846 Methods 8010, 8015, and 8020, U.S. EPA, EPA/600/S4-88/006, March 1988.

5. Heated Purge and Trap Method Development and Testing, U.S. EPA, EPA/600/S4-88/029, September 1988.

Testing for all Appendix IX Hazardous Constituents can be done generically, after appropriate sample preparation (water, waste, soil, etc.) using the following test procedures from SW-846:

1. Method 8260 for volatiles;
2. Method 8270 for semivolatiles;
3. Method 8080 for chlorinated hydrocarbon pesticides/PCBs;
4. Method 8150 for chlorinated herbicides (3);
5. Methods 8280 or 8290 for 2,3,7,8 TCDD, PCDDs, and PCDFs;
6. Method 6010 (ICP emission spectroscopy) for metals;
7. Graphite furnace atomic absorption (GFAA) for As, Pb, Se, & Tl;
8. Method 9010 for cyanide; and
9. Various test procedures for Sulfide (water matrix).

The above test procedures are the minimum number of multiparameter analytical methods necessary to screen for Appendix IX constituents, with little thought for data quality objectives. Laboratories and consulting engineering firms will often propose these nine methodologies for complete Appendix IX analysis, using analytical methodologies common to Superfund's Contract Laboratory Program(CLP). Approximately, 80 organic chemical constituents, PCDDs/PCDF, herbicides, tin, and sulfide are part of Appendix IX, but are not CLP target compounds. Environmental analytical laboratories routinely test for organic CLP Target Compound List (TCL) compounds using Methods 8260, 8270, and 8080 and for the inorganic CLP Target Analyte List (TAL) constituents of metals and cyanide. Appendix IX measurements usually involve apportioning the 80 extra organic constituents of Appendix IX to either Method 8260 or Method 8270, use of Method 8150 for the 3 listed herbicides, and use of miscellaneous test procedures for sulfide (water) and tin. Any testing for PCDDs/PCDFs usually involves a specialized contract laboratory separate from the laboratory used for the rest of the Appendix IX constituents. This is Appendix IX based on lowest cost and available routine methods. Commercial laboratories can be reluctant to use non-routine test procedures.

Selection and review of analytical methods/test procedures for Appendix IX Hazardous Constituents usually consists of:

1. Selection/development of analytical methods for site-specific contaminants based on site-specific DQOs and/or on site-specific sample matrices.

Site-specific contaminants that are not part of Appendix IX require special thought.

2. Selection of test procedures for the approximately 80 organic compounds that are part of Appendix IX but not part of the CLP TCL.

   Reviews of analytical methods for Appendix IX testing should emphasize these 80 organic compounds. Experience exists for testing of the remaining 142 constituents. Errors are often observed for method selection or instrument calibration for the 80 compounds - they are uncommon to many environmental laboratories.

3. Review of calibration procedures/records for the Appendix IX Hazardous Constituents .

   Eight (8) years ago, approximately half of the laboratories under review for Appendix IX testing did not use authentic compounds for instrument calibration for the above 80 organic compounds. Tentatively identified compounds (TICs) were used for GC/MS compound identification and quantitation for the 80 compounds. This unacceptable practice is still observed, (infrequently).

Before selection and review of Appendix IX test procedures, the following Hazardous Constituents or groups of organic compounds should be reviewed as to their need for testing during a Corrective Action.

1. Polychlorinated dibenzo-p-dioxins (PCDDs), 2,3,7,8-tetrachloro-p-dioxin (2,3,7,8-TCCD), and polychlorinated dibenzofurans (PCDFs) (Methods 8280/8290).

2. Chlorinated herbicides (Method 8150).

3. Chlorinated hydrocarbon pesticides (Method 8080).

4. Polychlorinated biphenyls (PCBs) (Method 8080). (This should be done carefully as PCBs are ubiquitous to industrial sites).

5. Organophosphorus pesticides/phosphorus containing organic compounds (Method 8140).

6. Any of the 80 organic compounds that are not part of the CLP/TCL.

7. Tin

8. Sulfide (soil)

Negotiation of parameters or Hazardous Constituents to be tested for a Corrective Action often discusses the need for testing the above groups of organic parameters. Elimination of any parameter groups will simplify testing to be done. Sulfide in soil sometimes is proposed just

because Appendix IX is to be done for soil. Sulfide in soil is inappropriate (See "Methods of Soil Analysis", Part II), but sulfide has socially redeeming features for specific RCRA hazardous wastes and for river sediments. Sulfide in soil should not be part of a RFI.

The following Appendix IX Hazardous Constituent compound pairs cannot be differentiated by test procedures commonly used for semivolatile organic compounds:

1. 2-methylphenol (o. cresol) and 3-methylphenol (p. cresol)

   The compounds co-elute, with the same mass spectra, on the DB-5 capillary GC column commonly used for Method 8270.

2. N-nitrosodiphenylamine decomposes to diphenylamine in the injection port of GC instruments, resulting in common retention times and mass spectra for the two compounds via Method 8270.

Commercial Appendix IX instrument calibration standards may even place each component in separate solutions; however, they will not be differentiated. The CLP TCL contains 4-methylphenol but not 3-methylphenol; however, the presence of either phenol isomer will result only in the reporting of 4-methylphenol by the CLP. Each of the above two compound pairs should be noted as "either/or" on laboratory report forms or final reports when Method 8270 (and possibly Method 8040) is in use.

III. ALTERNATIVE ANALYTICAL METHODOLOGIES FOR APPENDIX IX SEMIVOLATILES

A commonly observed Corrective Action proposal is to test as many Appendix IX extractable organic compounds as possible by Method 8270. Alternative test procedures are available to improve the analytical performance, or sensitivity of analysis, for selected groups of semivolatile organic compounds. Negotiations for Corrective Actions should review the need for the following analytical methods, to improve analytical performance (versus Method 8270). Once you initiate use of Method 8080, 8100, 8120, or 8140 for any one compound data are captured for all compound listed below for each test procedure:

a. Chlorinated Hydrocarbons - Method 8120

The following chlorinated hydrocarbon compounds of Appendix IX can be tested by the Method 8120 metholologies using the same extraction, extract clean-ups, and instrumentation of Method 8080. Method 8120 uses a different GC temperature program than Method 8080 to obtain retention times smaller than the retention times of Method 8080 chlorinated hydrocarbon pesticide compounds. The following Appendix IX chlorinated hydrocarbons can be effectively tested by Method 8120 with a 100 fold, or more, increase in sensitivity versus Method 8270.

1. 1,2-dichlorobenezene
2. 1,3-dichlorobenezene
3. 1,4-dichlorobenezene
4. Hexachlorobenzene *- S, W
5. Hexachlorobutadiene *-W
6. Hexachlorocyclopentadiene * -W
7. Hexachloroethane * -W
8. Hexachloropropene
9. Pentachlorobenzene
10. Pentachloroethane
11. 1,2,4 - trichlorobenzene
12. 1,2,4,5 - tetrachlorobenzene
13. Pentchloronitrobenzene * -W

* - The increased sensitivity of Method 8120 is needed to detect Region 9 PRGs for soil (S) or Region 5 Risk Based Screening Levels (RBSLs) for water (W). Method 8270 does not detect PRGs or RBSLs for these compounds.

b. <u>Chlorinated Hydrocarbons - Method 8080</u>

Laboratories usually implement Method 8080 using the target compounds of the Superfund CLP. The following Appendix IX compounds can be added to the CLP target compound list of Method 8080 by adding appropriate calibration standards.

1. Aramite * -W
2. Chlorobenzilate * -W
3. Diallate * -W
4. Isodrin
5. Kepone * -S,W
6. Pronamide
7. Hexachlorobenzene *-W
8. Hexachlorocyclopentadiene * -W
9. Pentachloronitrobenzene * -W

* - The increased sensitivity of Method 8080 is needed to detect Region 9 PRGs for soil (S) or RBSLs for water (W). Method 8270 does not detect PRGs or RBSLs for these compounds.

The first 6 compounds above fit into the retention time region of the Method 8080 target compounds. The last 3 compounds are in the retention time region just prior to the Method 8080 analytes.

Kepone has very poor chromatography performance by either Method 8080 or Method 8270. Method 8080 provides better sensitivity of analysis for kepone than Method 8080, but is still undesirable. Kepone is a waste of time by
Method 8270.

c. Organophosphous Compounds/Pesticides - Method 8140

The following 9 organophosphous compounds or pesticides can be tested using phosphorus specific GC detectors of Method 8140. Analysis by Method 8140 provides analytical performance and sensitivity superior to Method 8270.

1. Thionazine, or O,O-diethyl O-2-pyrazinyl phosphorothioate
2. Dimethoate * -W
3. Disulfoton * -W
4. Famphur
5. Methyl parathion * -W
6. Parathion
7. Phorate * -W
8. Sulfotepp, or tetraethyl dithiopyrophosphate
9. O,O,O-triethyl phosphorothioate

* - The increased sensitivity of Method 8140 is needed to detect Region 5 RBSLs for water (W). Method 8270 does not detect these listed RBSLs.

d Polynuclear Aromatic Hydrocarbons

Appendix IX lists 18 polynuclear aromatic hydrocarbon (PAH) compounds. Six of these PAH compounds are relatively toxic and require laboratory specific test procedures either by high pressure liquid chromatography (HPLC) Method 8310
or by a selected ion monitoring (SIM) option of Method 8270 to achieve
Region 9 PRGs for soil or Region 5 RBSLs for water. The seven (7) PAH compounds that can require these alternative methodologies are:

1. Benzo (a) anthracene * -W
2. Benzo (b) fluoranthene * -W
3. Benzo (k) fluoranthene * -W
4. Benzo (a) pyrene * -W
5. Dibenz (a,h) anthracene * -S,W
6. Indeno (1,2,3-cd) pyrene *-W
7. Chrysene

* - Method 8270 is insufficient in sensitivity to detect PRGs for soil (S) or DQLs for

water (W). Chrysene is added to assist in the chromatographic resolution and identification of Dibenz (a, h) anthracene.

It is not uncommon to measure these 7 PAH compounds by lab specific HPLC or SIM test procedures, as well as other PAH compounds with similar mass spectra, retention times, or associated presence/interference.

e. Methylester Derivatization - Method 8150

Besides the commonly tested chlorinated hydrocarbon herbicides (2,4-D, 2,4,5TP Silvex, and 2,4,5T), Method 8150 can be used, with modification, to test for the following Appendix IX compounds:

1. Dinoseb, DNBP, or 2-sec.-butyl-4,6-dinitrophenol
2. Hexachlorophene *
3. Pentachlorophenol ** - W

* - Hexachlorophene is not detected by Method 8270, but can be determined by a Method 8150 modification. This will be discussed later.

** - Method 8270 is insufficient sensitivity to detect the Region 5 RBSLs for pentachlorophenol.

f. Nitrocompounds\Explosives - Method 8330

The following Appendix IX nitro organic compounds are part of a list of 12-15 target compounds much better tested by HPLC Method 8330 for explosives rather than by Method 8270. If explosive residues are site-specific contaminants at manufacturing or Department of Defense sites, Method 8330 will be used, which will include, or may include, the following Appendix IX constituents:

1. m - dinitrobenzene * -W
2. 2,4-dinitrotouene
3. 2,6-dinitrotoluene
4. nitrobenzene * -W
5. sym. trinitrobenzene

* - Region 5 RBSLs for water are not detected by Method 8270.

Many of these nitro compounds have undesirable analytical performance by Method 8270 and are best determined by Method 8330. A large technology base of research reports exists from the U.S. Army COE Cold Regions Research and Engineering Laboratory (CRREL), Hanover, New Hampshire to effectively implement Method 8330. Copies of

these reports and associated publications are maintained by the Region 5 Waste Management Branch.

g. Pentachlorophenol

Pentachlorophenol exhibits poor sensitivity, poor chromatography, and low recovery (20-40%) by Method 8270. The Region 5 RBSL is not detectable by Method 8270 for pentachlorophenol. Many analytical methods have been used for pentachlorophenol and other chlorinated or non-chlorinated phenols (e.g. Methods 8040, 8010, 8150). The exact procedures to use will depend on DQOs, and support laboratory capability and experience.

IV. ISOMERIC FORMS OF APPENDIX IX HAZARDOUS CONSTITUENTS

The following Appendix IX Hazardous Constituents, listed by 40 CFR 264, are one or more of possible isomeric forms:

1. 2-methyphenol, 3-methylphenol and 4-methylphenol

   The meta and para substituted phenols cannot be differentiated by Method 8270 and should be reported as “either/or”.

2. trans-1,2-dichloroethene vs. cis-1,2-dichloroethene

   The trans isomer is listed by Appendix IX, but not the cis isomer; however, the cis isomer is the principal isomer found in groundwater resulting from degradation of trichloro or tetrachloro ethanes/ethenes. Not listing the cis isomer originally came from the “priority pollutant” list of the EPA water programs containing only the trans isomer.

   The volatile Method 8240 of 10-15 years ago could not differentiate the two isomers as they co-eluted with the same mass spectra. Data reported as the trans isomer were actually the sum of both isomers.

   It is Region 5 WPTD policy to measure and report both isomers, or their sum, for RCRA measurements. Laboratories commonly have both isomers in their volatile calibration standards. The CLP TCL reports the sum of the two 1,2-dichloroethene isomers. Both isomers are regulated by the Safe Drinking Water Act.

3. cis-1,3-dichloropropene, trans-1,3-dichloropropene, and 1,2- dichloropropane

   The listed dichloropropene pair are two of 6 possible isomers. The listed 1,2-

dichloropropane compound is one of four possible structural isomers. Certain of the non-listed isomers are regulated by the Safe Drinking Water Act.

4. 1,2,4-trichlorobenzene and 1,2,4,5-tetrachlorobenzene

   The listed trichlorobenzene and tetrachlorobenzene compounds are each one of three possible structural isomers. Five of the six possible isomers have been detected during a Region 5 RFI.

5. Substituted phenols, anilines, and benzenes

   Aromatic benzene, aniline, and phenol compounds, substituted with more than one functional group commonly have more than one isomeric form. While certain isomers are improbable, many isomers unlisted by Appendix IX have been detected during specific RFIs. Examples are tetrachlorophenols, and orthochloroaniline versus the listed parachloroaniline.

Past risk assessment review of data for certain unlisted isomeric forms could not differentiate their toxicity versus the listed compounds. It was apparent for certain RFIs that all isomeric forms should be determined on a site specific basis. Non-listed isomers were even in larger concentration than the listed isomers.

Unlike the example discussed above, the Appendix IX listed isomer 2,4,6-trichlorophenol is significantly more toxic than the listed 2,4,5-trichlorophenol isomer. If important for site specific purposes, both isomers will have to be tested, as well as the three unlisted trichloro isomers to provide unambiguous compound identifications.

Corrective Action planning should review the possible isomeric forms of site-specific contaminants and determine if all possible isomers should be added to the sites' target compound list. The above methylphenol and 1,2-dichloroethene isomer pairs need not be discussed, as they are routinely measured by environmental laboratories and need only to be labeled properly.

SW-846 Method 8121 documents retention time data for the three isomers trichlorobenzene and the three tetrachlorobenzene isomers. Method 8041 provides relative retention times for the three isomers of tetrachlorophenol and the five isomers of trichlorophenol. These retention times are directly applicable for Method 8270 which can be used for complete isomeric analysis of the above compounds. It is relatively easy to test for the complete isomeric forms of a listed hazardous constituent with proper planning, and use of authentic isomeric compounds for calibration standards.

V. ANALYSIS OF APPENDIX IX VOLATILE ORGANICS

Appendix IX to 40 CFR 264 lists many organic compounds that can be determined as "volatiles" by Method 8260 using purge and trap methodologies, such as Method 5030 (water) or Methods 5021 or 5035 (soils) for sample preparation. Laboratories will use either 5 ml, or 25 ml water sample aliquots, based on DQOs, to achieve 5 ug/l or 1 ug/l reporting limits, respectively, for volatiles of high purging efficiency (>80-90%).

Implementation of Appendix IX volatile determinations usually involves building on the calibration of Method 8260 for CLP TCL volatiles. Commercial environmental laboratories continually test for CLP TCL volatiles (or SDWA volatiles) on a day-to-day basis. An additional calibration standard mixture is used, or needed, to establish the mass spectral library, or Quant I.D. File, of the GC/MS instrumentation used for Appendix IX volatiles in excess of routine CLP TCL volatiles.

An acceptable laboratory SOP should describe preparation of one or more calibration standards for CLP TCL volatiles, and one (1) or more additional standard mixtures for the remaining Appendix IX volatiles. The laboratory SOP should detail example retention times, and primary and secondary mass spectral lines used for identification of each Appendix IX volatile compound, and any remaining volatile in these standards.

A laboratory SOP for Appendix IX volatiles should include example initial calibration records, with quant reports, for each set of 5 calibration standards and include all surrogate and internal standard compounds. An "extended quant report" with mass spectra for each analyte should also be provided for both a mid-range continuing calibration standard and for a continuing calibration standard at the lowest concentration of initial calibration for each calibration standard mixture. During the past 4 years, it has been noted that 80% of the commercial laboratories evaluated have mass spectral identification errors for Appendix IX volatiles. If Method 8260 is incorrectly calibrated, false negative errors will occur because experimentally determined reference spectra will differ from the mass spectra of native Appendix IX volatiles.

The correctness of calibration can be assessed by reviewing the experimental mass spectra of the above continuing calibration standards versus "NIST/EPA reference spectra", except in one instance. The "NIST/EPA reference spectra" is incorrect for dibromochloropropane. The experimental mass spectra for the low concentration continuing calibration standard audits the appropriateness of reporting limits.

The volatile organic compounds of Appendix IX that are in excess of CLP TCL volatiles are listed below and are taken from the non-regulatory "suggested methods" column of the Appendix IX codified regulation:

acetonitrile (wm)
acrolein (wm)
acrylonitrile (wm)
methacrylonitrile (wm)
methylene bromide
methyl iodide

allyl chloride
chloroprene
1,2-dibromo-3-chloropropane (DBCP)
1,2-dibromoethane (EDB)
cis-1,2-dichlorothene*
trans-1,4-dichloro-2-butene
dichlorodifluoromethane
1,4-dioxane (wm)
ethyl methacrylate
isobutanol (wm)
methyl methacrylate
pentachloroethane
2-picoline**
propionitrile (wm)
pyridine **
1,1,1,2-tetrachloroethane
1,2,3-trichloropropane
vinyl acetate **

* - cis-1,2-dichloroethene is a Region 5 requirement for RCRA corrective action

** - 2-picoline, pyridine, and vinyl acetate are not detectable as "volatiles"

(wm) - These are water miscible volatiles with undesirable purging efficiencies by Method 5030.

The above 24 volatiles are the compounds of concern for the analysis of "Appendix IX volatiles", because they are in excess of routine CLP TCL volatiles. The 24 volatiles are non-routine for most laboratories (cis-1,2-dichloroethene is routine) and have the following considerations:

1. cis-1,2-dichloroethene is a specialized Region 5 requirement to be tested and reported with Appendix IX volatiles and is also part of the CLP TCL.

2. 2-picoline and pyridine are suggested to be tested as a volatile, by 40 CFR 264; however, their purging efficiencies appear to be zero. These are best tested as a semivolatile by Method 8270. They are non-detectable as a volatile under the acid preservation conditions of sample collection for waters.

3. Vinyl acetate is usually not detectable. It has been deleted from the CLP TCL subsequent to promulgation of Appendix IX, because when added to Quarterly Blind reference samples of the CLP, it was never detected.

4. Pentachloroethane is best tested as a semivolatile by Method 8270. It is unstable and readily degrades to tetrachloroethene causing inaccurate standard concentrations of tetrachlorethene when present in the same standard solution.

5. **Water Miscible Volatiles**

   The above seven (7) volatiles marked with the symbol "wm" and pyridine are water miscible and mix with water in all proportions. Their purging efficiencies are low, and

undesirable. Attachment I to this addendum lists purging efficiencies for the seven (7) volatiles as a function of solution temperature. This table was taken from the above report EPA/600/S4-88/029, September 1988. These 7 volatiles are suggested to be tested by Method 8015 by codified Appendix IX, using an elevated solution temperature; however, commercial environmental laboratories no longer use Method 8015 except in special instances. When using Method 8260 the following reporting limits can be expected for the seven water miscible volatiles:

300-500 ug/l for 1,4-dioxane
300 ug/l for isobutanol
100-200 ug/l for acetonitrile and propionitrile and
50-100 ug/l for acrolein and acrylonitrile
10 ug/l for methacrylonitrile

The above reporting limits are commonly observed for these seven (7) water miscible volatiles by Method 8260, and are consistent with the purging efficiencies of attached Table 1. Published detection limits, or PQLs of SW-846 for Method 8240 or 8260 are overly ambitious, and are inconsistent with the attached purging efficiencies except for methacrylonitrile. If Method 8260 is to be used for determination of the above seven (7) water miscible volatiles, risk based Region 9 Preliminary Remediation Goals, for soils or Region 5 Risk Based Screening Levels (RBSLs) for water will be smaller than Method 8260 detection limits for the following water miscible volatiles:

acrolein
acryloitrile
acetonitrile
1,4-dioxane

Method 8260 is of insufficient sensitivity for these 4 volatiles. Alternate analytical methods are necessary to achieve desired sensitivity. Changing a 5 ml sample aliquot by Method 5030 to a 25 ml sample aliquot does not significantly improve sensitivity of analysis, because of the poor purging efficiencies. Desired sensitivity of analysis has been obtained for acrylonitrile by increasing solution temperature to 40 or 60°; however, this is not effective for the other three volatiles. Methacrylonitrile has been found sufficiently sensitive by Method 8260. Isobutanol and 1,4-dioxane are a waste of time by Method 8260.

If 5 of the seven (7) water miscible volatiles are of interest at a RCRA site, specialized site-specific test procedures will need to be developed by a support laboratory-especially for 1,4-dioxane. The two water miscible volatiles requiring no special effort are methacrylonitrile (which has acceptable sensitivity by Method 8260) and isobutanol (which is relatively non-toxic and a waste of time for testing). Update III to SW846 has added

specific test procedures for some of the five water miscible volatiles. See Methods 5031, 5032, 8031, 8032, and 8033. Unique test procedures for 1,4 dioxane have been implemented by commercial laboratories in Michigan, because of within-state 1,4 dioxane contamination, therefore; this is not an impossible task.

6. Acrolein, per initial method validation by Method 603 of 40 CFR 136 and following into Method 8030, requires a sample container separate from the remaining Appendix IX volatiles. 40 CFR 136 and Table 2-36 (page 2-48) of Chapter 2 to Update III of SW-846 both require a water sample of pH greater than 4 or 5 for acrolein. Remaining Appendix IX volatiles are to be collected at pH<2. Acrolein was thought to be unstable at pH2, or less. Limited studies by RCRA commercial labs have not found acid instability for acrolein in water; however, EPA guidance requires acrolein to be collected separately for acrolein. Acrylonitrile is also listed under this requirement but this compound is stable in acid. It is only a companion to acrolein when testing is done by Methods 603 or 8030.

7. The detection limit, or PQL of allyl chloride is suggested as 100 ug/l in codified Appendix IX of 40 CFR 264. Review of actual analytical performance by Method 8260 shows it to be 5 or 10 ug/l.

8. Calibration Standard Preparation

   The above discussion on Method 8260 SOPs specifies two or more calibration standard mixtures are necessary for Method 8260. It is assumed that one standard mixture will be that of the CLP TCL. The second standard mixture, or Appendix IX standard, should be fabricated in the following way:

   a. The Appendix IX standard should contain chloroprene. The stock solution solvent for this volatile is xylene and must not be added to the TCL standard, as it will destroy xylene calibrations.

   b. The above seven (7) water miscible volatiles should be in the Appendix IX standard, as these 7 compounds typically have few mass spectral lines (2 or 3). Mass spectral interferences are commonly observed when mixed with the TCLs. Their qualitative identification is more difficult when they are added to the TCL standard.

   c. DB-624 is the capillary GC column most often used for Method 8260 and provides these mass spectral interferences for coeluting compounds.

      i. trans-1,4-dichloro-2-butene and 1,2,3-trichloropropane coelute on the DB 624 column. Both have the same base peak often used as the primary quant ion. Ideally, they should be in separate calibration standards. If they are both

in the Appendix IX standard, the SOP should discuss this problem and how it is resolved.

ii. Ally chloride and acetonitrile coelute. Acetonitrile only has mass spectral lines of 41, 40, and 39, which are all present in allyl chloride. These two volatiles must be in two separate standards; except, care must be taken to resolve allyl chloride from carbon disulfide in the TCL standard. Allyl chloride and carbon disulfide have common mass spectral lines. Allyl chloride must be separated from acetonitrile so that allyl chloride does not cause false negative detections of acetonitrile.

d. Laboratories commonly purchase their stock standard solutions from commercial sources. Two problems are observed with these commercial standards:

i. Allyl chloride and acetonitrile are commonly provided in the same stock solution. The overwhelming interference of allyl chloride on acetonitrile is discussed above.

ii. Methacrylonitrile is prepared at 10 times too large a concentration within a mixture of the other water miscible volatiles.

e. The remaining compounds of the above twenty-four (24) Appendix IX volatiles can be apportioned to either standard. It is commonly observed that:

i. 2-picoline and pyridine are not added to either standard, since they are not detectable by Method 8260;

ii. it does not matter if vinyl acetate is present, or not, since it has not been detected during CLP interlab testing;

iii. dichlorodifluoromethane and trichlorofluoromethane are commonly added to the TCL standard. GC temperature program conditions must be established to resolve dichlorodifluoromethane from chloromethane, and to resolve chloroethane from vinyl chloride. Each of these compound pairs have common mass spectral lines that hinder quantitation or identification if the pairs are unresolved;

vi. pentachloroethane is part of Method 8270 and not added to Method 8260. If it is ever part of the fabricated Method 8260 standards it should be in the Appendix IX standard so as not to interfere with tetrachloroethene (TCL) upon degradation.

VI. PROBLEM OR NON-DETECTABLE APPENDIX IX CONSTITUENTS

Appendix IX contains certain Hazardous Constituents that are not detectable, or have extremely poor or abysmal analytical performance, by commonly used SW-846 test procedures (Methods 3510, 8270, etc.). This section of the addendum lists these "problem compounds" and recommends certain of these "problem constituents" be reported as "not detectable." If these "problem compounds" are deemed important at a site, site-specific or alternative methods will need to be developed by the support laboratory for their measurement.

The method evaluation report "Screening of Semivolatile Organic Compounds for Extractability and Aqueous Stability by SW 846 Method 3510", cited above, recommends the following compounds be deleted from Appendix IX for the reasons cited:

1. Aramite - 50% loss during 5 days storage;
2. 1,12-Dimethylbenz(a)anthracene-erratic chromatography;
3. 1,4-Dinitrobenzene - hydrolysis loss during extraction. This is not an Appendix IX constituent, but 1,3-dinitrobenzene is part of Appendix IX with no water extraction loss problems.
4. Isosafrole - unfavorable distribution coefficient for water extraction by methylene chloride;
5. 1-Naphthylamine - 55% loss during seven day storage due to oxidation of analyte. These losses were not observed for 2-naphthylamine;
6. Pentachloroethane - 75% loss by hydroloysis during pH conditions of Method 3510 extraction.
7. Hexachlorophene - Apparent loss on storage (discussed below in more detail);
8. Dimethoate - While not recommended for deletion, data show significant losses during pH 12 extraction conditions of study.

The extraction conditions of the study used a base-neutral/acid extraction of water (basic first then acid extraction) for a simplified version of Method 3510. In Update II and III to SW 846, the pH order of extraction has been changed versus the pH conditions of Method 3510 in 1987. Methods 3510, and 3520 (cont. Liq-liq) now extract waters under acid conditions first, followed by basic conditions, or an acid-neutral/basic extraction. Conditions for dimethoate 1,4-dinitrobenzene, and pentachloroethane could now be improved but this has not been validated.

Method 3520 is now the most common extraction procedure. Hydrolysis problems could be more pronounced by Method 3520, because the extraction time period is longer by Method 3520 than by Method 3510. The above method validation report used only the extraction time period of Method 3510.

Fom evaluation of commercial laboratories during the past eight years, poor performance has been noted for the following Appendix IX constituents:

1. 1,4-Dioxane and isobutanol have such poor purging efficiencies by Methods 8240/8260 or 5030 that their testing is a waste of time. Detection limits of 300 to

1000 ug/l are common. The toxicity of 1,4-dioxane warrants alternative, lab specific methods when it is to be measured.

2. Aramite, p. phenylenediamine, and hexachlorophene are often not detected when standards are injected in Method 8270 instrumentation. Only 2 labs evaluated in the last 8 years have demonstrated acceptable mass spectra for p-phenylenediamine. No one detects hexachlorophene by Method 8270.

3. Attachment II to this addendum is a poster session presentation from the 1995 WT/QA EPA Symposium. This presentation describes why hexachlorophene is not detectable by Method 8270. Hexachlorophene can be determined using a modification of Method 8150 to provide the compound's dimethylester for appropriate chromatography.

4. Dimethoate and pentachloroethane show significant hydrolysis losses during initial basic pH extraction of the 1987 version of Method 3510. The more recent initial acid pH condition of Method 3510/3520 can well alleviate this problem, but this has never been thoroughly validated. Dimethoate is stable during the neutral pH conditions used for Methods 8140/8141.

5. Famphur and kepone provide poor or erratic chromatography during analysis by Method 8270. Kepone is a definite waste of time by Method 8270. Famphur can be determined appropriately by Methods 8140/8141. Kepone's analysis can only be considered qualitative or semi-quantitative (with Method 8081 being more sensitive than Method 8270). Detection limits for kepone can be elevated 10 to 100 times larger than comparable chlorinated hydrocarbon pesticides (ex. - mirex).

6. At times, commercial suppliers of standards and certain laboratories at times have not been able to find a source for aramite.

7. At one time, EPA's Office of Solid Waste drafted changes to Appendix IX. The compound 4-nitroquinoline-1-oxide was to be deleted from the Appendix IX list (along with several of the above compounds) because this constituent was an experimental pharmaceutical that was not produced in any significant commercial quantities.

8. Tin was deleted from the CLP Inorganics Target Analyte List soon after the 1987 promulgation of Appendix IX to 40 CFR 264. Tin was rarely, if ever detected at Superfund sites. Insoluble tin compounds or tin oxides are not solubilized completely by the acid reagents of Methods 3010/3050 used for sample preparation. Tin exhibits severe spectral interferences from other elements during testing by Method 6010. Tin measurements should not be considered reliable, or of environmental significance except for organotin compounds.

9. Phorate and sym.-trinitrobenzene commonly co-elute on the DB-5 GC capillary column used for Method 8270. Each compound has the same major quant ion of 75 units. When the two compounds are in the same Method 8270 calibration standard, care must be taken in selection of primary quant ions and secondary confirmatory ions for each compound. Misidentification of phorate or trinitrobenzene by Method 8270 has often been observed.

10. Aniline and phenol often co-elute on the DB-5 GC column of Method 8270. The two compounds should not be in the same calibration standard solution as phenol's mass spectra destroys the accuracy of the aniline spectra. Calibration for aniline and phenol must be carefully reviewed so that false negatives do not occur for aniline.

SUMMARY

1. Hexachlorophene and p. phenylenediamine should be reported as "not detectable" in Appendix IX data reports, for commonly used SW-846 test procedures. Hexachlorophene can be determined, if necessary, using modifications of Methods 8150/8151.

2. The analysis of Aramite, isosafrole, 1-naphthylamine, and kepone is uncertain. The chromatography of kepone is so abysmal that quantitative determinations of kepone are improbable.

3. Pentachloroethane should be considered as an unstable, extractable semivolatile compound.

4. Determinations of 1,4-dioxane and isobutanol are insensitive and are not quantitative by Method 8260. Alternate analytical methods must be developed for 1,4-dioxane when important to a site.

5. Famphur and dimethoate are best done by Methods 8140/8141 rather than Method 8270.

6. There is little need or priority for the determination of 4-nitroquinoline-1-oxide or tin.

7. Calibration of Method 8270 for phorate aniline, and phenol sym.-trinitrobenzene must be done carefully, to eliminate mass spectral interferences for the four constituents.

VII. REGION 5 SKINNER LIST

A "Skinner List" of Appendix VIII Hazardous Constituents applicable to refinery wastes was developed by EPA's Office of Solid Waste. (Skinner refers to the name of the U.S. EPA official signing the guidance memorandum). Any Appendix VIII constituent believed applicable to refineries was included. In 1985, this list was shortened to a more practical list of constituents and published as "Constituents of Petroleum Refining Wastes" as part of EPA's guidance for "Petitions to Delist Hazardous Wastes". This 1985 list of Appendix VIII Hazardous Constituents applicable to refining processes became known as the "Skinner List", and has been used as the basis for many RCRA Facility Investigation measurements.

In 1993, EPA's Office of Solid Waste updated the Skinner List through additions to and deletions from the 1985 list as part of new EPA guidance for "Petitions to Delist Hazardous Wastes. The 1993 list is labeled "Constituents of Concern for Wastes from Petroleum Processes". Attachment III to this addendum is the 1985 Skinner List, and the 1993 updated Skinner List.

In 1997, Region 5's Waste Management Branch reviewed the 1985 and 1993 Skinner Lists, melded them, and established a broader list of refinery process waste constituents, or a "Region 5 Skinner List". The Region 5 Skinner List was developed on the basis of:

1. The 1985 and 1993 Skinner Lists were combined.

2. Hazardous Constituents deleted in 1993 from the 1985 list were retained if they are part of Superfund's CLP Target Compound List or Target Analyte List. Multiparameter test procedures such as Methods 8260, 8270, and 6010 are routinely calibrated for TCLs and TALs; therefore, there is no need to discard the data being captured for each sample's measurements.

3. The 1985 Skinner List constituents deleted in 1993 were also deleted from the Region 5 list (or deemed optional) if they are impossible or impractical analytical measurements (e.g-methyl chrysene, benzenethiol), if they are not part of Appendix IX or the CLP TCL/TALs, and if they are not considered toxic by Region 9 Preliminary Remediation Goals (PRGs), or Region 5 RBSL.

4. A list of polynuclear aromatic hydrocarbon (PAH) constituents, with low concentration PRGs and common to the 1985 or 1993 lists, was established for low level HPLC/fluorescence measurements.

5. Special considerations for specific constituents are:

    a. The 1985 constituent quinoline, deleted in the 1993 list, was retained by Region 5 because of its relatively toxic PRG/RBSL.

b. Methyl tertiary butyl ether (MTBE) was added to the Region 5 list because of its wide usage as a gasoline additive. It is a principal gasoline additive, but is not usually handled or added to gasoline at a refinery. Environmental laboratories usually have this compound in their calibration standards for Method 8015 and 8260.

c. The 1985 list provides for "methyl chrysene". No distinction is made for its different structural isomers. GC/MS mass spectra for methyl chrysene can not be easily differentiated from closely eluting isomers of methyl dibenz(a, h)anthracene. This constituent was deleted from the optional Region 5 list because inappropriate analytical measurements would occur.

d. Benzenethiol, or thiophenol, can be found in refinery wastes of caustic pH values. Benzenethiol is unstable in water/soils of neutral or acid pH values. Benzenethiol rapidly degrades in organic solvents used to prepare instrument calibration standards. Benzenethiol is part of Appendix VIII and the 1985 Skinner List, but never made it to Appendix IX to 40 CFR 264, because of its instability in the environment or in analytical standards. It is listed as an optional Region 5 constituent.

e. Cobalt was deleted from the 1985 list. Silver and zinc were added to the 993 Skinner List. All three are in the Region 5 Skinner List because heir concentrations are captured by commonly used multiparameter ICP emission spectroscopy measurements (Method 6010).

The Region 5 Waste Management Branch Skinner List is provided below:

Region 5 Waste Management Branch "Skinner List" -

Constituents of Concern for Wastes from Petroleum Processes

A. Inorganics

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Cyanide
Lead
Mercury
Nickel
Selenium
Silver
Vanadium
Zinc

B. Volatile Organics

Benzene	Ethylene dibromide (EDB)
Carbon disulfide	Methyl ethyl ketone (MEK)
Chlorobenzene	Styrene
Chloroform	Toluene
1,2-Dichloroethane	1,1,1-Trichloroethane
1,1-Dichloroethane	Trichloroethene
1,4-Dioxane	Tetrachloroethylene
Ethylbenzene	Xylenes (total)

C. Semivolatile Organics

Acenaphthene	1,4-Dichlorobenzene*
Anthracene	Diethyl phthalate
Benzo(a)anthracene	2,4 Dimethylphenol
Benzo(b)fluroranthene	Dimethyl phthalate
Benzo(k)fluoranthene	2,4 Dinitrophenol
Benzo(a)pyrene	Fluoranthene
2-ethylhexyl	Fluorene
Bis(2-ethylexyl) phthalate	Indeno(1,2,3-cd)pyrene
Chrysene	Naphthalene
o-Cresol	4-Nitrophenol
m-Cresol	Phenanthrene
p-Cresol	Phenol
Dibenz(a,h)anthracene	Pyrene
Di-n-butyl phthalate	Pyridine
1,2-Dichlorobenzene*	Quinoline
1,3-Dichlorobenzene*	

*- can be tested as a volatile

D. Low Concentration Polynuclear Aromatic Hydrocarbons (Optional)

Benzo(a)anthracene	Chrysene*
Benzo(b)fluoranthene	Dibenz(a,h)anthracene
Benzo(k)fluoranthene	Indeno(1,2,3-cd)pyrene
Benzo(a)pyrene	

*Chrysene is added to this group to assist the chromatographic resolution of chrysene from Dibenz(a,h)anthracene in sample extracts.

E. Optional Semivolatile Organics (Deleted from 1985 List)

Indene

1-Methylnaphthalene*
Benzenethiol**
Dibenz(a,h)acridine

*Note that 2-Methylnaphthalene is part of Appendix IX and is a CLP TCL organic. 1-Methylnaphthalene is not on these lists.

**Benzenethiol can be detected in certain petroleum refinery wastes. Its measurement must compensate for its instability at neutral and acid pH values during sample preparation and its unstable instrument calibration standards.

VIII. SPECIALIZED ANALYTICAL METHOD TOPICS - RCRA CORRECTIVE ACTIONS

Laboratory evaluations for Appendix IX determinations, review of analytical chemistry literature, or changes/updates in "Test Procedures for Evaluating Solid Waste", SW-846, 3rd edition during the past eight (8) years all have provided a focus on sample types unique to RCRA Corrective Actions, on non-routine analytical methods for specialized/important chemical analyses or on inadequacies in routine analytical methods when applied to RCRA Facility Investigations or Appendix IX determinations. These topics are listed and discussed below.

A. Volatile Organic Compounds in Soil

Update III to SW-846, published in the Federal Register of June 13, 1997, deleted traditional sample collection procedures for volatiles in soil from Update II (and prior editions) and now specifies that soil aliquots are to be collected in the sealed sample vial that will be used for analysis - see Methods 5021 and 5035, and Section 5000 of Update III to SW-846. Alternatively, soil aliquots can be collected in methanol to be tested by a "high concentration" option per details of Method 5035.

Attached to this addendum is a Region 5 Waste, Pesticides, and Toxics Division directive of December 22, 1997, that specifies Update III procedures for volatiles in soil will be followed for all RCRA Facility Investigations (RFIs) and Corrective Actions starting January 1, 1998. See Attachment IV. Various options are discussed for volatiles in soil/solids.

After implementing the policy options of the December 22, 1997 Directive, one item requires further clarification:

1. Section 6.2.3 of Method 5035 allows, as an option, the collection of bulk soils, with no preservative, for high concentration soils. See also Sections 7.3, 7.3.1, 7.3.2, and 7.3.3 of Method 5035.

2. Method 5021 has sections corresponding to Item #1 above.

The use of an unpreserved bulk soil is to be avoided, and is inconsistent with the field methanol preservative or with use of the En-Core sampler (or equivalent).

Whenever solid sample types or matrixes prevent use of the En-Core sample or of methanol preservative, the unpreserved bulk sample is used as a back-up and this technique so noted in resulting analysis reports. Emergency environmental sampling conditions may well mandate use of the bulk sample technique; however, verification of contaminant-free soil should never be done using bulk sample technique subsequent to site remediation.

B. Sample Collection/Preservation for Acrolein

Both 40 CFR 136 (NPDES monitoring) and Table 2-36 of Chapter 2 to SW-846 (Update III) specify both acrolein and acrylonitrile are to be collected/preserved at a pH>4, for analysis by Methods 603 or 8030. This applies to Method 8260 or any other volatile test procedures. Initial validation of 40 CFR 136 methods noted that acrolein is unstable at pH values less than 4. Acrylonitrile is believed stable at acid and neutral pH values. Most aqueous samples for Appendix IX volatiles are preserved at a pH less than 2. To perform testing of Appendix IX volatiles, per SW-846, requires collection of volatiles in one container at pH<2 and collection of a separate container in a neutral pH range for acrolein alone. This doubles the number of analyses for volatiles.

Two laboratories, that have been evaluated for Appendix IX testing, have not observed an instability for acrolein in water at a pH<4. One priority pollutant volatile is unstable at pH2 and this is 2-chloroethylvinyl ether. This volatile decomposes instantly in acid; this effect was not noted for acrolein.

SW-846 currently requires use of a volatile sample bottle for acrolein that is separate from the bottles used to collect waters at pH2 for the remaining Appendix IX volatiles. We are uncertain if this is really necessary.

C. pH Value for Soil/Solids

RCRA Corrective Actions commonly test soils/solids from individual Solid Waste Management Units (SWMUs). The pH values of soils or solids at these individual sites are commonly of neutral pH value; however, many soils, slag, fly ash, lagoon solids, and other solids from these sites (many 100 years of age) have extreme pH values - pH2 or pH12. Caustic pH values for lime sludges are often observed. RCRA solid extraction procedures (Methods 3540/3550) do not require measurement of soil/solid pH values, for subsequent testing by Methods 8040, 8080, 8120, 8140, 8270 etc.. A knowledge of soil/solid pH values is necessary for herbicides by Method 8150, desirable for sample collection of volatiles, and helpful in interpretation of TCLP results. Sample extraction procedures of Superfund's Contract Laboratory Program (CLP) corresponding to Methods 3540/3550 require measurement of soil/solid pH values prior to extraction for semivolatile/extractable organic

compounds. Soil pH values are a routine deliverable for the CLP Organics Statement of Work (SOW), and can be easily done by government and commercial laboraories.

If soils of caustic pH value are extracted per Methods 3540/3550, recovery of acidic target compounds (ex.-phenol) will be undesirable or zero percent. Recovery of acid matrix spikes or acid surrogate spikes will also be apparently out of control or even zero percent recovery. Basic compounds will not extract from low pH value soils. It would be a waste of time to reextract the soils, as is often done when surrogate recoveries are out of control.

Two alternatives are available for soils with pH values outside the range of pH5-9:

1. Accept this fact and declare acidic compound data as unusable for high pH value soils/solids and basic compound data as unusable for low pH value soils. Representative surrogate and matrix spike compound recoveries will be out of control. Soils need not be reextracted if these surrogate recoveries are out of control.

2. Adjust pH value of soils to between pH 5 and pH 9 prior to sample extraction; however, there is no commonly accepted procedure for this neutralization.

For RCRA Corrective Actions at industrial facilities, measure soil pH prior to sample extraction and include this soil measurement as part of the QAPP and lab SOPs. Discuss corrective actions when pH values are extreme as part of the RFI QAPP.

D. <u>Sample Preparation of Soils/Solids for Metals Analysis</u>

The usability and accuracy of metals data for soil is often limited by the sample aliquots selected for the analysis. "Wet" soil aliquots of 1g for most metals, and 0.1-0.2g for mercury, are used for metals determinations of soil, solid, slag, rocks, sediments, sludge, etc.

The usability of metals data cannot be assured unless representative soil/solid portions are first dried at 60°C, or less (to prevent mercury loss), then homogenized with particle size reduction. Data usability is monitored through use of matrix spike and sample duplicate QC audits. RCRA Facility Investigations and Corrective Actions should utilize drying of sample aliquots, homogenization, and particle size reduction for metals analysis of soils/solids. Attachment V to this addendum demonstrates the undesirable/unusable data obtained by "wet" soil aliquots for lead. Sample drying/homogenization/particle size reduction is an acceptable technique in draft Update IV to SW-846.

E. <u>Sample Preparation for Soils/Solids (non-Appendix IX)</u>

SW-846, 3rd edition and its Updates provides guidance for preparation of soils/solids for volatile and semivolatile organics and for metals (acid extractable). U.S. EPA publications

generally do not provide effective guidance for preparation/extraction of soils/solids for chemical parameters other than those mentioned above. Certain RFI Work Plans or QAPPs have specified the measurement of non-Appendix IX contaminants in soil/solid, but rarely describe or note the sample preparation. When a laboratory's procedures were reviewed, it was found that soils were extracted only with water, and not an extraction reagent suitable for the parameter(s) of interest. A water extraction is suitable only for chloride or nitrate and few other parameters.

Work Plans and QAPPs should describe sample preparations for soils/solids that are suitable for the parameters of interest. For general chemistry parameters in soil, EPA guidance provides effective measurements for very few general chemistry parameters such as Kjeldahl nitrogen, or total fluoride by Bellack distillation. The following text provides excellent guidance for preparation of soils/solids for common chemical parameters, and should be consulted by laboratories, and QAPP preparers/reviewers:

"Methods of Soil Analysis", Part II 2nd edition, 1982, or 3rd edition, 1997.

This text is published by the American Society of Agronomy, Inc. and the Soil Science Society of America, Inc., Madison, Wisconsin. Sample preparations for soils are discussed. Analytical literature is cited. Guidance for many soil parameters such as organic carbon are more effective than from EPA manuals whose test procedures were developed for waters.

F. <u>Hexavalent Chromium in Soil (and Water)</u>

Historically, this has been a troublesome analysis, especially for hexavalent chromium in soil. A variety of extraction reagents and analytical measurements have been proposed. Method 3060 for chromium (VI) in soil was deleted from SW-846, 3rd edition, Revision 0 because of unacceptable accuracy.

A recent literature article - "The Challenge of Remediating Chromium-Contaminated Soil", Env. Sci & Tech., <u>30</u>, No.6, 248A (1996) - provides an excellent discussion of measuring and remediating chromium (VI) in soil. See Attachment VI. During analytical sample preparation, soluble and insoluble [$CaCrO_4$, $Pb(CrO_4)$, etc.] can be dissolved/leached from soils at neutral to alkaline pH. This same process can convert a certain amound of Cr(III) to Cr(VI) through oxidation by manganese (III or IV) hydroxides or oxides causing a positive error.

The most significant error in Cr(VI) analysis of soil extracts has been caused by the analytical measurement of the hexavalent chromium itself. Chromium (VI) analytical methods use test procedures requiring acid conditions. When the soil extract is turned acid for analytical measurement, the chromium (VI) reacts with reducing agents in the soil extract, frequently causing a zero percent recovery.

SW-846 Method 3060A, published as part of Update II to SW-846, describes an alkaline digestion suitable for leaching chromium(VI) from soil. This digestion was developed with the State of New Jersey, causing a significant improvement in accuracy versus the original Method 3060 digestion. Final analytical determination of chromium(VI) is done by diphenyl carbizide colorimetry (Method 7196A) or by ion chromatography with post column colorimetry. Ion chromatography is the preferred option, since it separates Cr(VI) from its matrix interferences (reducing agents) prior to colorimetric measurement of chromium(VI).

SW-846 Method 3060A should be implemented with the maximum allowable ratio of digestion volume to soil/solid sample weight that allows detection of the action level for Cr(VI) in soil. Method 3060A requires a high degree of QC effort to demonstrate Cr(VI) results are accurate. Soil aliquots are separately spiked with both Cr(III) and Cr(VI) to assess interferences, almost on a sample-by-sample basis.

G. Sulfide in Water - Use of Zinc Acetate Preservative

Iodimetric determinations of sulfide in water are often done using Method 9030 of SW-846 Revision 0, in conjunction with the zinc acetate preservative. The Method 9030 and its source test procedure (Method 376.1) from "Methods for Chemical Analysis of Water and Wastes" contain technical errors for the use of zinc acetate preservative.

When zinc acetate is added to a water and adjusted to alkaline pH value, zinc hydroxide forms as a precipitate. The zinc hydroxide acts as a carrier for zinc sulfide. The presence of significant sulfide is noted by a black precipitate of zinc sulfide mixed with the flocculant, white zinc hydroxide. Zinc acetate acts not only as a preservative, but also as a separation step for sulfide from its water matrix.

As the sulfide analysis is initiated, the supernatant liquid over the zinc sulfide/zinc hydroxide precipitate is discarded (centrifuging, decanting, filtering) and the sulfide containing precipitate is tested iodimetrically. The sample supernatant contains reduced species (ferrous iron, sulfur compounds, etc.) that will be a positive interferent in the sulfide tests (Methods 9030 or 376.1).

Proper use of zinc acetate as both a preservative and a separation can be found in "Standard Methods for the Examination of Water and Wastewater", 18th edition, Part 4500, Methods A, C, D, and E. Use of iodimetric sulfide determinations should be referenced to "Standard Methods" and followed as directed. SW-846 provides inappropriate directions for use of zinc acetate as both a preservative and separation technique when using the original Method 9030 or Update III's Method 9034.

The proper use of zinc acetate as a preservative for SW-846 Methods 9030B and 9031 should be reviewed versus the information of "Standard Methods".

H. High pH value, Sulfide Containing Groundwaters at Steel Mill Sites

A RCRA Facility Investigation (RFI) at a significant Region 5 steel mill site has provided a unique, but important groundwater sample type. The groundwater matrix caused sample collection/preservation and certain Appendix IX test procedures to be modified. General chemistry analyses used to characterize the site's groundwater also required modification.

Steel mills can be built on fill from slag, fly ash, bottom ash, etc. These are high pH value solids (pH12-13). Shallow groundwater under the fill exhibits pH values of 10 to 13, negative redox potentials, zero dissolved oxygen, sulfide concentrations of 50 to 100 mg/l, large ammonia concentrations, excellent clarity with insignificant suspended solids, insignificant metals concentrations (unfiltered or dissolved), insignificant cation concentrations of calcium and magnesium (due to high pH value) but large potassium concentrations and large dissolved solids concentrations. Seventy (70) percent of a recent steel mill site's groundwater was estimated to be of high pH value (pH10-13). Analytical methods and sample collection/preservation techniques must be rethought for this groundwater or sample type. Certain, but not all, of the modifications are applicable to other high pH value waters/wastes such as "lime ponds" or lime [$Ca(OH)_2/CaCO_3$] sludges.

Laboratories and consulting engineering firms selected for RFIs at sites with the above anoxic, sulfide, and high pH value conditions should be flexible and provide appropriate analytical solutions. Strict adherence to SW-846 test procedures (written for routine groundwater conditions) will provide inappropriate results. Region 5 Review of QAPPs and Work Plans needs to be flexible and thoughtful. It is best for laboratories to perform some initial method evaluations/validations for sulfide containing waters or high pH value solids, prior to analysis of actual RFI samples.

The high pH value or anoxic sulfide groundwater conditions will cause some Appendix IX constituents to be relatively unimportant (metals) while others have larger import than usual (vinyl chloride metabolite from any trichloroethene). Planning for RFIs with high pH value sulfide containing groundwaters or soils is not a trivial exercise. Field/laboratory procedures, believed routine, have to be rethought. See known examples below:

1. Sample Collection/Preservation Problems

Lime sludge or high pH value, sulfide containing groundwaters can contain significant carbonate and hydroxide alkalinity with pH values between 10 and 13. Acidification with HCl for volatiles, large quantities of HNO_3 for metals, and H_2SO_4 for nutrients and demand is not practical and may cause more problems than it solves. Acidification for volatiles will cause degassing of the volatiles from evolved carbon dioxide. Addition of H_2SO_4 to lime sludges will cause precipitation of $CaSO_4$. A pH value of 13 can cause dissolution of zinc hydroxide precipitate used for preservation of sulfide. Acidification with sulfuric acid for

chemical oxygen demand (COD) will cause evolution of hydrogen sulfide that should be included in the COD measurements.

Recommendations:

a. High pH value groundwaters do not require acidification to prevent biodegradation of analytes. Caustic is a biocide. These sample types can be collected unaltered for organic, demand and nutrient analyses, in individual containers, full to the brim, to minimize aeration of the groundwater and loss of sulfide. Acidification for preservation of volatiles must not be done.

b. For routine levels of alkalinity (<1000 mg/l $CaCO_3$), acidification with nitric acid is practical for metals analysis. When samples are encountered requiring more than 10 mls acid preservative, it is better to not use the preservative for metals and alert the receiving laboratory to this fact.

c. Separate, individual containers are recommended for BOD, TOC, and COD if all three parameters are to be tested in order to minimize loss of sulfide. Holding times should be 24-48 hours for BOD and COD. TOC is not as critical as COD for unaltered samples, as sulfide is not included in the TOC measurement.

d. For anoxic, high pH value groundwaters the preservation of sulfide can be important. The use of zinc acetate to form zinc hydroxide (that traps zinc sulfide) is important. Problems may occur for pH13 waters in that the amphoteric zinc hydroxide may dissolve as zincate anion.

e. For high pH value groundwaters with large sulfide concentrations, the shelf life of sulfate is critical. Analysis of sulfate 1 to 2 weeks after collection can be biased high due to sample aeration and oxidation of sulfide to sulfate. Preservation of sulfate can be done with nitric acid acidification, if practical, or by collection of an individual container with unaltered aliquot and sulfate analysis upon laboratory receipt.

f. There is no need to add the sodium hydroxide preservative for cyanide analysis, if the groundwater is pH11 or larger. Review of analytical literature indicates that free cyanide anion reacts with reduced sulfur species at high pH values and is not expected to be present in these sulfide containing groundwaters. Thiocyanate does not form. Ferro and ferricyanide anions can be expected present in the alkaline sulfide containing groundwaters and will be a major portion of measured total cyanide.

2. Analytical Methodology Considerations

a. For high pH value, sulfide containing waters, REDOX potential becomes a useful field measurement. A positive REDOX potential is indicative of groundwater with a finite dissolved oxygen content and no significant sulfide concentration. A large negative REDOX potential indicates anoxic waters that contain sulfide.

b. A low sodium error glass electrode is necessary for measuring pH values larger than 11. Normal glass electrodes provide inaccurate pH results at pH 12.

c. Forms of alkalinity (hydroxide, carbonate, and bicarbonate) have often been estimated for high pH waters from data for pH and total alkalinity. See Standard Methods, 19th edition, Method 4500-CO_2D. This process or methodology should not be used for high pH value lime sludge or sulfide containing waters, because -

(1) Method 4500-CO_2D is applicable on to waters with dissolved solids less than 500 mg/l.

(2) The lime sludge waters contain significant suspended solids of $Ca(OH)_2$ and $CaCO_3$. The total alkalinity determination of Method 4500-CO_2D is based only on dissolved constituents and becomes inaccurate when alkaline suspended solids are present.

(3) Sulfide, when present, is titrated as part of the total alkalinity, and destroys the accuracy of Method 4500-CO_2D.

For high pH value lime sludge or sulfide containing groundwaters, alkalinity forms are best determined by reference to representative pH titration curves, after initial removal of alkaline suspended solids by filtration. Hydroxide ion can be directly determined by an ASTM procedure by initially removing carbonate anions by addition of strontium chloride to form insoluble strontium carbonate.

d. Method 9010 cyanide test procedures of SW-846 (Updates II or III) are flawed, inaccurate, untrustworthy, and faulty for the sulfide containing groundwaters. The cyanide tests are written for “total cyanide” and “cyanide amenable to chlorination”. Large negative values are routinely noted for “cyanide amenable to chlorination” for sulfide containing groundwaters. EPA’s reference methods for cyanide (ASTM, “Methods for Chemical Analysis of Water and Wastes” and SW-846) are flawed for problematic sample types, especially those with sulfide interferences.

The ASTM cyanide methodology uses lead carbonate ($PbCO_3$) to remove sulfide prior to distillation separation of cyanide. The "Methods for Chemical Analysis of Water and Wastes", Method 335.2, uses cadmium carbonate ($CdCO_3$) for sulfide removal. The carbonates are added prior to distillation, cadmium or lead sulfide is formed, and these insoluble sulfides are removed by filtration along with the excess $CdCO_3$ or $PbCO_3$. The filtration step also removes any insoluble cyanide content in the water's suspended solids. Dissolved species of cyanide are measured.

SW-846 cyanide Method 9010 uses bismuth nitrate to "remove" sulfide. No filtration removal of bismuth sulfide is done prior to cyanide distillation. The bibliography of Method 9010 does not reference/justify the choice of bismuth nitrate reagent. Two research reports (unpublished) are cited but are no longer available. The nitrate anion associated with bismuth reagent can be an interferent in the cyanide test. The bismuth cation is a strong acid that can markedly lower sample pH to pH2 during sample pretreatments.

The main problem with the bismuth reagent is there is no removal of bismuth sulfide prior to distillation of cyanide. Bismuth sulfide has a solubility product similar to that of CdS and PbS. Bismuth sulfide is soluble in acid (see CRC "Handbook of Chemistry and Physics"). Hydrogen sulfide will be released during the acidic distillation of cyanide in EPA Method 9010. The resulting distillate, in sodium hydroxide reagent, will contain both sulfide and cyanide. This has been demonstrated for a high pH value, sulfide containing groundwater at a steel mill site.

The colorimetric determination of cyanide suffers from sulfide interference. Independent investigators have noted a positive interference of sulfide on cyanide when sulfide concentrations are approximately 1 mg/l. For larger sulfide concentrations (10-100 mg/l), a severe negative interference is noted in the cyanide test. Sulfide interferences are not the same for the macro distillation of Method 335.2 versus the more modern midi distillation apparatus. SW-846 Method 9010 must be considered more flawed than ASTM methodology and Method 335.2 test procedures when sulfide is present. Removal of sulfide in the cyanide distillate, through use of the bismuth cation is not documented or completely studied.

If a lab is to determine cyanide in sulfide containing waters, it will need to do a certain amount of methodology development to first define the effect(s) of sulfide on their analytical system(s), then demonstrate an effective removal of interferring sulfide.

The most accurate measure of cyanide in a sample distillate could be

considered ion chromatography. Authentic identification of the cyanide could be made, as well as any other cyanide type species (thiocyanate, cyanate, etc.). The standard colorimetric determination is non-specific for cyanide as the colorimetric oxidation reduction reaction responds to a variety of reducing agent interferences (sulfide) or oxidizing agents (chlorine). Ion chromatograph sensing platinum electrodes are poisoned by sulfide and have not been found effective when sulfide is present at 5 mg/l or more. Ion chromatography is the best alternative
for cyanide analysis, if the effect(s) of sulfide can be minimized. This has yet to be done.

e. The accurate measurement of BOD, COD, and TOC in high sulfide concentration waters is not trivial. For neutral pH oxygenated waters, the ratios of COD to BOD to TOC results fall within expected values based on stoichiometry of carbon, hydrogen, and oxygen in the organic compounds of interest. When sulfide is present, the ratios are unexpected and very inaccurate if no precautions are taken. One hundred (100) mg/l sulfide provides an oxygen demand of 200 mg/l.

TOC is a measurement only of carbon. Chemical oxygen demand (COD) measures the oxygen demand due to organic carbon, sulfide, other reduced sulfur species, as well as any other reducing agent. For an anoxic sulfide containing groundwater, samples for COD should be collected with minimal aeration or headspace. Resulting oxygen demand will be the sum of both TOC and sulfide. Addition of acid, used for routine sample preservation, will destroy sulfide and cause negative errors in the COD determination.

BOD is imprecise in the presence of sulfide. Initial dissolved oxygen values are determined 0 to 20 minutes after sample dilution, to remove an “initial oxygen demand”. Per “Standard Methods”. Sulfide is considered an interferent in the BOD test. When large sulfide concentrations are present, the amount of sulfide remaining in diluted sample aliquots can be quite variable at the time initial dissolved oxygen values are determined. Resulting BOD results are very imprecise, and unreliable.

f. Nitrate determinations usually utilize the cadmium amalgam reduction methodology. Sulfide will poison the cadmium reduction column and cause the analytical system to crash. There is no need to measure nitrate or nitrate + nitrite in sulfide containing waters as sulfide and nitrate are incompatible. The principal inorganic nitrogen parameter will be ammonia when sulfide is present.

g. Pesticide/PCB determinations of sulfide containing, anoxic waters suffer

from interference by associated sulfur compounds. Removal of sulfur interferences is commonly done by metallic mercury treatment of sample extracts.

h. Semivolatile determinations by Method 8270 also suffer from high pH value waters containing sulfide. The extent and correction of these interferences is not fully known. A certain amount of pilot work is needed for these sample types before embarking on major groundwater measurements by Method 8270.

On way to improve sample extraction of high pH value waters is to initially extract the sample at pH 12, then again at pH less than 2. This is preferable to initial acid pH extraction. Initiating the extraction at pH 12 or 13 will save a neutralization step, and minimize effects the effects of hydrogen sulfide degassing during acid extraction conditions.

Attachment I Table 9. Dependence of Heated Purge and Trap Recovery on Purge Temperature Excerpted from Heated Purge and Trap Method Development and Testing, U.S. EPA, EPA/600/S4-88/029, September, 1988

Percent Recovery (a) at the Given Temperature

Analyte	22 ° C (b) Mean ± DM ©	22 ° C (b) vs. 99 ° C	40 ° C Mean ± DM ©	40 ° C vs. 99 ° C	60 ° C Mean ± SD (d)	60 ° C vs. 99 ° C	85 ° C Mean ± DM ©	85 ° C vs 99 ° C	99 ° C Mean ± DM
acrolein	22 ± 7	24	40.9 ± 1.1	45	53 ± 4	58	73.1 ± 0.8	80	91.3 ± 0.2
Methyl ethyl ketone	11 ± 2	15	23.3 ± 0.8	32	50 ± 6	68	70.3 ± 0.6	97	72.5 ± 0.3
Methacrylonitrile	(b)	-	48.3 ± 0.2	70	60 ± 6	86	68.4 ± 0.9	99	69.2 ± 0.5
Acrylonitrile	18 ± 3	22	40.5 ± 0.8	50	62 ± 6	76	81.0 ± 0.1	99	81.8 ± 0.4
Acetonitrile	6.8 ± 1.2	9	14.6 ± 0.9	19	28 ± 2	36	58.4 ± 1.2	75	78.4 ± 1.4
Propionirile	7.2 ± 1.5	9	16.6 ± 1.1	22	35 ± 3	45	68.2 ± 0.9	89	76.6 ± 0.6
1,4 dioxane	0.0	0.0	2.7 ± 1.2	8	8.2 ± 0.8	25	21.1 ± 0.5	64	33 ± 8
isobutanol	2.9 ± 0.4	3	6.0 ± 0.7	9	21.2 ± 1.4	31	57.7 ± 1.0	84	68.5 ± 2.3
Cyclohexanone	1.7 ± 0.9	4	2.6 ± 0.2	6	9.1 ± 0.8	20	31.9 ± 0.8	69	46 ± 7

(a) Versus injections of an identical spiking qliquot through the GC injector septum.

(b) The room temperature data were generated in an experimental trial different from that of the other four temperatures and the analyte methacrylonitrile was not included in that work.

© DM = Deviation from the mean for two replicates.

(d) SD= Standard deviation for three replicates.

Attachment II

1985 Skinner List

Metals

antimony
arsenic
barium
beryllium
cadmium
chromium
cobalt
lead
mercury
nickel
selenium
vandaium

Volatiles

benzene
carbon disulfide
chlorobenzene
chloroform
1,2 - dichloroethane
1,4 - dioxane
ethyl benzene
ethylene dibromide
methyl ethyl ketone
styrene
toluene
xylene

Semivolatile compounds (base/neutral extractable)

anthracene
benzo(a)anthracene
benzo(b)fluoranthene
benzo(k)fluoroanthene
benzo(a)pyrene
bis (2-ethylhexyl) phthalate
butyl benzyl phthalate
chrysene
dibenz(a.h) acridine
dibenz(a,h)anthracene
dichlorobenzenes
diethyl phthalate
7,12 - dimethylbenz(a)anthracene
dimethyl phthalate
di(n)butyl phthalate
di(n)octyl phthalate
fluoranthene
indene
methyl chrysene
1-methyl naphthalene
naphthalene
phenanthrene
pyrene
pyridine
quinoline

Semivolatile compounds (acid extractable)

benzenethiol
cresols
2,4 - dimethylphenol
2,4 dinitrophenol
4-nitrophenol
phenol

1993 Skinner List

Metals	**Organics**	2,4 dinitrotoluene
antimony	acenaphthene	di-n-octyl phthalate
arsenic	benzene	1,4 dioxane
barium	benzo(a)anthracene	ethyl benzene
beryllium	benzo(b)fluoroanthene	ethylene dibromide
cadmium	benzo(a)pyrene	fluoranthene
chromium	bis(2-ethylhexyl) phthalate	fluorene
cobalt	butyl benzyl phthalate	indeno(1,2,3-cd) pyrene
lead	carbon disulfide	methyl ethyl ketone
mercury	chlorobenzene	naphthalene
nickel	chloroform	nitrobenzene
selenium	chrysene	phenol
silver	cresols	pyrene
vanadium	dibenz(a,h)anthracene	pyridine
zinc	di-n-butyl phthalate	styrene
	1,2-dichlorobenzene	tetrachloroethylene
	1,4-dichlorobenzene	toluene
	1,2 dichloroethane	1,1,1 trichloroethane
	1,1 dichloroethylene	trichloroethylene
	7,12 dimethylbenz(a)anthracene	xylenes (total)
	2,4 dimethylphenol	

EXAMPLE INSTRUMENT CALIBRATION

Instrument	Method Reference	# Standards Initial Calibration	Accept/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency Initial Calibration Verification[1]	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[1]	Acceptance/ Rejection Criteria Continuing Calibration Verification
GC/MS volatiles	SW-846 (8240.8260)	5	%RSD<30% (CCC) 1,1-dichloroethene; chloroform 1,2-dichloropropene; toluene ethyl benzene; vinyl chloride RF>0.30 (SPCC) chloromethane; 1,1-dichloroethane; bromoform (0.25); 1,1,2.2.-tetrachloroethene; chlorobenzene	As needed	As needed	± 20%	daily 12 hr.	CCC % D < 25% same SPCC criteria as initial calibration
	40CFR136.624	5	all cmpds %RSD <35% or use calibration curve	As needed	As needed	± 20% R	daily 24 hr.	Compare w/ Table 9.5 "Q" (attached)
	CLP SOW 2/88	5	same as SW846	As needed	As needed, usually w/PE's	± 20% R	daily 12 hr.	same as SW-846
FAA	SW-846 EPA600/ 4-79/080 CLP	4 4 4	Correlation coefficient must be ≥ 0.995	At least daily, or as required (when CCV fails acceptance criteria)	Every calibration	90-110%R 90-110%R 90-110%R	Every 10 analytical samples	90-110%R 90-110%R 90-110%R
CVAA	SW-846 EPA600/ 4-79/080 CLP	4 4 4				80-120%R 80-120%R 80-120%R		80-120%R 80-120%R 80-120%R
ICP	SW-846 EPA600/ 4-79/080 CLP	1 1 1				90-110%R 90-110%R 90-110%R		90-110%R 90-110%R 90-110%R
GFAA	SW-846 EPA600/ 4-79/080 CLP	4 4 4				85-115%R 85-115%R 90-110%R		85-115%R 85-115%R 90-110%R
pH Meter	SW-846 CLP	3 3	± 0.1 STD units of true value			± 0.1 STD units of true value		± 0.1 STD units of true value

Instrument	Method Reference	# Standards Initial Calibration	Accept/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency Initial Calibration Verification[(1)]	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[(1)]	Acceptance/ Rejection Criteria Continuing Calibration Verification
GC/MS volatiles	CLP-SOW OLMO 1.5	5	min RF Bromoform 0.10 Vinyl Chloride 0.10 1,1-dichloroethene 0.10 1,1-dichloroethane 0.20 Chloroform 0.20 1,2-dichloroethane 0.10 1,1,1-trichloroethane 0.10 carbon tetrachloride 0.10 bromodichloromethane 0.20 cis-1,3-dichloropropene 0.20 trichloroethene 0.30 dibromochloromethane 0.10 1,1,2-trichloroethane 0.10 benzene 0.50 trans-1,3-dichloropropene 0.10 bromoform 0.10 tetrachloroethene 0.20 1,1,2,2-tetrachloroethane 0.50 toluene 0.40 chlorobenzene 0.50 ethylbenzene 0.10 xylene 0.30 bromofluorobenzene 0.20 all % RSD <20.5 Other target compounds must meet minimum RF of 0.10 No % RSD criteria	As needed	As needed usually w/PE's	± 20% R	Daily every 12 hours	RF criteria same as initial cal. % D <25.0
	EPA 524.2	5	% RSD < 20% or use cal curve all target compounds	As needed	As needed	± 20%	Daily every 8 hours	All compounds RF%D <30% ISTD areas >30%m <150% of initial cal.

Instrument	Method Reference	# Standards Initial Calibration	Accept/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency Initial Calibration Verification[(1)]	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[(1)]	Acceptance/ Rejection Criteria Continuing Calibration Verification
GC/MS semi-volatiles	SW846-8270	5	%RSD < 30% (CCC) acenaphthene 1,4-dichlorobenzene hexachlorobutadiene N-nitroso-diphenylamine di-octylphthalate fluoranthene benzo(a)pyrene 4-chloro-3-methylphenol 2,4-dichlorophenol 2-nitrophenol phenol pentachlorophenol 2,4,6-trichlorophenol RF>0.05(SPCC) N-nitrosodipropylamine hexachlorocyclopentadiene 2,4-dinitrophenol 4-nitrophenol	As needed	As needed	± 20%R	Daily, every 12 hours	CCC % D < 25% same SPCC criteria as initial cal.
	40CFR136 625	5	%RSD <35% or cal, curve all compounds	As needed	As needed	± 20%R	Daily every 24 hours	% D < 20%
	CLP SOW 2/88	5	Same as SW946-8270	As needed	As need w/PE's	± 20%R	Daily every 12 hours	Same as SW846-8270

Instrument	Method Reference	# Standards Initial Calibration	Accept/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency Initial Calibration Verification[(1)]	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[(1)]	Acceptance/ Rejection Criteria Continuing Calibration Verification
GC/MS semi-volatiles	SW846-8270	5	%R < 30%(CCC) acenaphthene 1,4-dichlorobenzene hexachlorobutadiene N-niroso-diphenylamine di-octylphthalate fluoranthene benzo(a)pyrene 4-chloro-3-methylphenol 2,4-dichlorophenol 2-nitrophenol phenol pentachlorophenol 2,4,6-trichlorophenol RF>0.05(SPCC) N-nitrosodipropylamine hexachlorocyclopentadiene 2,4-dinitrophenol 4-nitrophenol	As needed	As needed	± 20%R	Daily, every 12 hours	CCC % D < 25% same SPCC criteria as initial cal.
	40CFR 136 625	5	%RSD<35% or cal, curve all compounds	As needed	As needed	± 20%R	Daily every 24 hours	% D < 20%
	CLP SOW 2/88	5	Same as SW946-8270	As needed	As needed w/PE's	± 20% R	Daily every 12 hours	Same as SW846-8270

Instrument	Method Reference	# Standards Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency of Initial Calibration Verification[1]	Acceptance Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[1]	Acceptance/Rejection Criteria Continuing Calibration Verification
GC/MS semi-volatiles	CLP-SOW OLMO1.5	5	min.RF phenol 0.80 bis(2-chloroethyl)ether 0.70 2-chlorophenol 0.80 1,3-dichlorobenzene 0.60 1,4-dichlorobenzene 0.50 1,2-dichlorobenzene 0.40 2-methylphenol 0.70 4-methylphenol 0.60 N-nitrosodipropylamine 0.50 hexa-chloroethane 0.30 nitrobenzene 0.20 isophorone 0.40 2-nitrophenol 0.10 2,4-dimethylphenol 0.20 bis(2-chloroethoxy)methane 0.30 2,4-dichlorophenol 0.20 1,2,4-trichlorobenzene 0.20 naphthalene 0.70 4-chloro-3-methylphenol 0.20 2-methylnaphthalene 0.50 2,4,6-trichlorophenol 0.20 2,4,5-trichlorophenol 0.20 2-chloronaphthalene 0.80 acenaphthylene 1.30 2,6-dinitrotoluene 0.20 acenaphthene 0.80 dibenzofuran 0.80 2,4-dinitrotoluene 0.20 4-chlorophenylphenylether 0.40 fluorene 0.90 4-bromophenylphenylether 0.10 hexachlorobenzene 0.80					%D < 25 RF criteria same as initial calibration

Instrument	Method Reference	# Standards Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency of Initial Calibration Verification[1]	Acceptance/Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[1]	Acceptance/Rejection Criteria Continuing Calibration Verification
GC/MS-semi volatiles	CLP SOW OLM01.5		pentachlorophenol 0.50 phenanthrene 0.70 anthracene 0.70 fluoranthene 0.60 pyrene 0.60 benz(a)anthracene 0.80 chrysene 0.70 benzo(b)fluoranthene 0.70 benzo(k)fluoranthene 0.70 benzo(a)pyrene 0.70 indeno(1,2,3,cd)pyrene 0.50 dibenz(a,h)anthracene 0.40 benzo(ghi)perylene 0.50 nitrobenzene d5 0.20 2-fluorobiphenyl 0.70 terphenyl-d[14] 0.50 phenol-d[5] 0.80 2-fluorophenol 0.60 2-chlorophenol-d[4] 0.80 1,2-dichlorobenzene-d[4] 0.40 %RSD < 20.5%. Other target compounds have no %RSD but must have RF>0.01					
	EPA525	6	%RSD < 30% all compounds Chromatographic separation of isomers	As needed	As needed	± 20%R	daily, every eight hours	RF % D < 30% ISTD areas > 30% < 150% from initial cal.

Instrument	Method Reference	# Standards Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency of Initial Calibration Verification[1]	Acceptance/Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[1]	Acceptance/Rejection Criteria Continuing Calibration Verification
GC/NPD	N-P containing pesticides EPA 507	3	RF < 20% RSD or single point (single point must be within 20% of sample concentration)	As needed when CCV > 20% diff., upon detection of analyte after running low level single point to demonstrate detectability[2]	quarterly	20%D	2 times daily, beginning and end of day	20%D
	Organophosphorus pesticides SW-846 8141	5	RF < 20% RSD or cal. curve	Daily	quarterly	15%D	Daily	15%D
	Simetryn & Terbutryn EPA 619	3	RF < 10% RSD or cal. curve	Daily	As needed and with the prep of new std.	10%D	Each working shift	10%D
	Nitrosamines EPA 607	3	RF < 10% RSD or cal. curve		As needed and with the prep of new std.	15%D	Each working day	15%D
GC/FID	SW-846 8015	5	RF < 20% RSD or cal. curve	As needed when CCV > 15%D	Quarterly	15%D	Daily	15%D
	SW-846 8100	5	RF < 20% RSD or cal. curve	With each analytical sequence	As needed and with the prep of new std.	15%D	Daily	15%D
	SW-846 8030	3	RF < 20% RSD or cal. curve	As needed when CCV > 15%D	As needed, with prep of new	15%D	Daily, 10% ending	15%D

Instrument	Method Reference	# Standards Initial Calibration	Accept/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency Initial Calibration Verification[1]	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[1]	Acceptance/ Rejection Criteria Continuing Calibration Verification
HPLC	EPA 531.1	3-5	RF < 20% RSD or single point or calibration curve	As needed, when CCV > 20%D	Quarterly	20%D	Min. of 2 1 beg. 1 end	20%D
	SW-846 8310	3	RF < 20% RSD or cal, curve	As needed, when CCV > 15%D or every 6 months	As needed, with prep of new std.	15%D	Daily, 10%	15%D
	EPA 610	5	RF < 10% RSD or cal. curve	When CCV > 15%D	As needed, with prep of new std	15%D CCV vs. cal. curve	Daily, 10%	15%D
GC-PID/ELC ELCD	EPA 502.2	3-5	RF < 10% RSD or cal. curve or single point cal.	When CCV > 20%D	As needed, with prep of new std. or quarterly	20%D	Daily	20%D
	EPA 601	3	RF < 10% RSD or cal. curve	As needed, when ICV or CCV > Table 2 criteria	As needed, with prep of new std.	See method 601 table 2 criteria 30%D (Q Valve)	Daily Note: ICV = CCV in this case (different source than calibration stds.)	For % Rec. see method 601 Table 2 (Q Valve)
	EPA 602	3	RF < 10% RSD or cal. curve	As needed, when ICV or CCV > Table 2 Criteria			Daily, 10% ending	15%D %D
	SW-846 8010				As needed, with prep of new std.	15%D		
	SW-846 8020					15%D		
GC-PID/ELCD	SW-846 8021	5	RF < 20% RSD or cal. curve	As needed, when CCV > 15%D	As needed with prep of new std.	15%D	Daily 10%, ending	15%D

Instrument	Method Reference	# Standards Initial Calibration	Accept/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency Initial Calibration Verification[(1)]	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[(1)]	Acceptance/ Rejection Criteria Continuing Calibration Verification
FTIR	EPA 418.1	5	20%D Correlation Coeff. (r) ≥0.995	When CCV is > 20%D	As needed, with prep of new std.	20%D	Beg, and end of each sequence	20%D
	Standard Method 503	5	20%D Correlation Coeff. (r) ≥ 0.995	When CCV is > 20%D	As needed, with prep of new std.	20%D	Beg, and end of each sequence	20%Dv
GC-ECD	EPA 548.1 (Endothall)	3	Linearity < 20% RSD	Each Run	As needed with each new std. quarterly at a minimum	80-110%	Every fifth injection	Primary column %D <15. Conf. column %D < 20.R.T. Shift, Capp. column <0.3%.RT Shift MegaBore Columns <1.5%
	CLP-SOW 2/88	3	Linearity <20% RSD Generate calibration curve for all single analytes detected in samples where the % RSD ≥ 10% Retention time windows: Wide Bore capp. column: ± 0.75% Narrow Bore Capp. column: ± 0.15%	Each run or every 72 hours	As needed with each new std. quarterly at a minimum	80-110%	Every fifth injection	Primary column %D <15. Conf. column %D <20.RT Shift, Capp. columns <0.3% RT Shift MegaBore Colums <15% Breakdown criteria:DDT <20% Endrin <20% Combined <30%

Instrument	Method Reference	# Standards Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency of Initial Calibration Verification[1]	Acceptance/Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[1]	Acceptance/Rejection Criteria Continuing Calibration Verification
GC/ECD	EPA 508	3	Linearity <20% RSD	Each Run	As needed, With each new std. Quarterly at a minimum	80-110%R	Every fifth injection	Primary column %D<15. Conf. column %D <20.R.T.Shift, Capp. columns <0.3%.RT Shift MegaBore Columns <1.5% Breakdown criteria: DDT <20% Endrin <20%
	EPA 504	5	Linearity <20% RSD	Each Run	As needed, With each new std. Quarterly at a minimum	80-110%R	Every fifth injection	Primary column %D <15, Conf. column %D <20.R.T.Shift, Capp. columns <0.3% RT Shift MegaBore Columns <1.5%
	APHA 509A (Stand-ard Methods)	3	Linearity <20% RSD	Each Run	As needed With each new std. Quarterly at a minimum	80-110%R	Every fifth injection	Primary column %D <15, Conf. column %D <20R.R.T.Shift, Capp. columns<0.3% RT Shift MegaBore Columns <1.5% Breakdown criteria: DDT <20% Endrin <20% Combined <30%

Instrument	Method Reference	# Standards Initial Calibration	Accept/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency Initial Calibration Verification[1]	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification[1]	Acceptance/ Rejection Criteria Continuing Calibration Verification
GC-ECD	EPA 608	3	Linearity < 20% RSD	Each Run	As needed. With each new std. Quarterly at a minimum	80-110%R	Every fifth injection	Primary column %D <15. Conf. column %D <20. R.T.Shift, Capp. columns <0.3%. RT Shift Mega-Bore Columns <1.5% Breakdown criteria: DDT <20% Endrin <20% Combined <30%
	SW-846 8080 SW-846 8150	5	Linearity <20% RSD	Each Run	As needed. With each new std. Quarterly at a minimum	80-110%R	Every fifth injection	Primary column %D <15. Conf. column %D <20. R.T.Shift, Capp. columns <0.3%. RT Shift Mega-Bore Columns <1.5% Breakdown criteria: DDT <20% Endrin <20% Combined < 30%
GC-ECD	EPA 515.1	3	Linearity <20% RSD	Each Run	As needed. With each new std. Quarterly at a minimum	80-110%R	Every fifth injection and beginning and end of run.	Primary column %D <15. Conf. column %D <20. R.T.Shift, Capp. columns <0.3%. RT Shift Mega-Bore Columns <1.5%
	EPA OLM01.3	3+Instr. Blank Multi-Comp. Targets Calib. as single point	All peaks 100% resolved. Performance evaluation mixtures (PEMs) ≤ 25.0 RPD. 1 Chromatogram from each of 2 indiv. A&B must yield peak highs of 50-100% of full scale. Resolution of midpoint std. mixes A&B ≥ 90% linearity ≤ 20% RSD except: Surrogates ≤ 30% Any 2 targets ≤ 30% Resolution check mix ≤ 60% Breakdown of DDT & Endrin ≤ 20%, Combined ≤ 30%	Each Run	As needed. With each new std. Quarterly at a minimum	80-110%R	Every 12 hours (PEM or indiv. A&B)	PEMs and Indiv. A&B within RT windows of init. calibration PEMs RPD ≤ 25.0. Resolution of PEM must be 100%. Resolution of indiv. A&B ≤ 90% Breakdown of DDT & Endrin ≤ 20% Combined ≤ 30%

1. Number of Standards Run is 1, unless noted otherwise
2. Only when an unusally large analyte list requires analysis of more than one standard mix for injection by GC/NPD.

GC/MS - VOLATILES
CONTINUING CALIBRATION CHECK - EPA METHOD 624

Range for "Q" in ug/L

Benzene	12.8-27.2	trans-1,3-Dichloropropene	10.0-30.0
Bromoform	14.2-25.8	Ethylbenzene	11.8-28.2
Carbon tetrachloride	14.6-25.4	Bromomethane	2.8-37.2
Chlorobenzene	13.2-26.8	Chloromethane	D-40.8
Chloroethane	7.6-32.4	Methylene Chloride	12.1-27.9
2-Chloroethylvinyl-ether	D-44.8	1,1,2.2-Tetrachloroethane	12.1-27.9
Chloroform	13.5-26.5	Tetrachloroethene	14.7-25.3
Dibromochloromethane	13.5-26.5	Toluene	14.9-25.1
Bromodichloromethane	13.1-26.9	trans-1,2-Dichloroethene	13.9-26.1
1,4-Dichlorobenzene	12.6-27.4	1,1,1,-Trichloroethane	15.0-25.0
1,1-Dichloroethane	14.5-25.5	1,1,2-Trichloroethane	14.2-25.8
1,2-Dichloroethane	13.6-26.4	Trichloroethene	13.3-26.7
1,1-Dichloroethene	10.1-29.9	Trichlorofluoromethane	9.6-30.4
1,2-Dichloropropane	6.8-33.2	Vinyl Chloride	0.8-39.2

APPENDIX K
EXAMPLE PREVENTATIVE MAINTENANCE FOR LABORATORY INSTRUMENTATION

INSTRUMENT	ACTIVITY	FREQUENCY
Gas Chromatograph/Mass Spectrometer	Change septum	Monthly/as needed
	Check carrier gas	Daily
	Change carrier gas	When pressure reaches 100 psi
	Change gas filters	Semi-annually/as needed
	Change trap on Tekmar	As needed/poor sensitivity
	Change GC column	As needed/poor sensitivity
	Clean MS source	As needed/poor sensitivity
	Check pumps for leaks	Monthly
	Leak Check septum	As needed/when leak suspected
	Check gas flow	As needed
	Clean VOC purge glassware	As needed
	Cut capillary column	As needed
	Replace liner	As needed/contamination susp.
	Replace SVOC seal	As needed/contamination susp.
Lachat Qulkchem AE	Dry and clean random access sampler	Daily
	Clean sample boats	Daily
	Coat rollers of pump with silicone spray	Every 2,500 samples
	Replace pump tubes	Monthly
	Replace flames at port of valve module	Every 2,500 samples
	Clean unions of the valve	Every 2,500 samples
	Replace O-rings	When necessary
	Clean each port of the valve	Weekly
	Clean fitting of manifolds	Every 2,500 samples

INSTRUMENT	ACTIVITY	FREQUENCY
TOC	Replace water in IC Chamber	Weekly
	Clean IC chamber	As needed
	Clean underside of IC Inlet valve	As needed
	Check combustion tube	Daily
	Repack quartz wool in comb, tube	As needed
	Check TC inlet valve	Daily
	Clean TC inlet valve	As needed
	Refill acid bottle	When 2/3 empty
GPC	Change seals and oil motor on positive displacement pump	Ever 1500-2000 hours of use
	Repack column	When column flow is restricted or operating pressure increases
	Check system pressure	Check daily when operating
	Replace mesh at column effluent/influent	Replace if torn or wrinkled
	Check calibration, pressure and solvent flow	Check weekly
Atomic Absorption Furnace	Clean furnace windows	Daily
	Check plumbing connections	Daily
	Change graphite tube	As needed
	Check gases	Daily
	Check autosampler and tubing	Daily
ICAP	Clean filters	Monthly
	Check gas flow	Daily
	Change tubing	Weekly
	Clean nebulizer	As needed
	Check autosampler and tubing	Daily
Gas Chromatograph-Volatiles	Check Hall propanol flow	Daily
	Check Hall furnace temp.	Daily

INSTRUMENT	**ACTIVITY**	**FREQUENCY**
	Check PID sensitivity	Daily
	Change lamp	As needed
	Rinse purge devices	Daily
	Bake purge devices	Daily
	Check carrier gases	Daily
	Change carrier gases	As needed
	Check column flows	Daily
	Check for gas leaks	At each column change
	Replenish electrolytic conductivity detector solvents	As needed
	Clean transfer lines	As needed
Gas Chromatograph-Semivolatiles	Change septum	Every 100 shots or as needed
	Check carrier gas	Daily
	Change carrier gas	When pressure reaches 250 psi
	Change in-line filters	Every 6 mos. or as needed
	Remove first foot of capillary column	As needed
	Clean ECD	As needed
	Clean Nitrogen-Phosphorous Detector	As needed
	Check system for gas leaks	At each column change
	Replace column	As needed
	Clean FID	As needed
	Replace capillary injection port liner	At column change or as needed
	Replace capillary injection port seal	As column change or as needed
	Measure gas flow	After changing column
	Check syringe	Daily
	Change syringe	As needed

EQUIPMENT MONITORING

EQUIPMENT TYPE	ACTIVITY	FREQUENCY
Ovens	Temperature monitoring	Twice daily
Refrigerators	Temperature monitoring	Twice daily
Incubators	Temperature monitoring	Twice daily
Walk-in Cooler	Temperature monitoring	Twice daily

APPENDIX L
EXAMPLE PREVENTATIVE MAINTENANCE FOR FIELD INSTRUMENTS

INSTRUMENTS	MAINTENANCE PROCEDURES/SCHEDULE	SPARE PARTS IN STOCK
Photovac MicroTIP Photoionization Detector	1. Calibrate beginning and end of each day and as necessary during use. 2. Check battery, and recharge when low. 3. Clean lamp window every 24 hours of operation. 4. Replace dust filter every 240 hours of operation. 5. Replace sample pump every 5000 hours of operation.	1. Battery charger 2. Spare lamps 3. Spare filter cartridges
Thermo Environmental Model 5808 Photoionization Detector	1. Calibrate beginning and end of each day, and as necessary during use. 2. Check battery, and recharge when low. 3. Clean lamp and dust filter as needed. 4. Replace water traps if they become wet.	1. Spare lamps 2. Spare dust filters.
Field Gas Chromatograph	1. Change injector septa daily. 2. Repack column when separation and linearity becomes poor. 3. Clean PID lamp before each initial calibration; change when sensitivity lost. 4. Clean injector port/liner weekly.	1. Septa 2. Empty columns and column packing 3. PID lamps 4. Injector lines
pH Meter	1. Calibrate beginning and end of each day, and as necessary during use. 2. Replace electrodes as needed.	1. pH buffers 2. Batteries 3. Spare electrodes
Conductivity Meter	1. Calibrate beginning and end of each day, and as necessary during use. 2. Check redline and replace batteries if does not calibrate.	1. Batteries
HNu Model Photoionization Detector	1. Calibrate beginning and end of each day, and as necessary during use. 2. Check battery, and recharge when low. 3. Clean UV lamp, ion chamber, and fan if calibration falls outside 10% of the calibration standard, or if readings are erratic.	1. Battery charger 2. Spare lamps

APPENDIX M
GUIDELINE FOR THE PREPARATION OF STANDARD OPERATING PROCEDURE OF FIELD AND LABORATORY MEASUREMENTS

Analytical methods, including both qualitative and quantitative methods, to be used by a laboratory selected for a specific project shall be submitted for review/approval prior to use in project activities. These analytical methods should be submitted in the form of Standard Operating Procedures (SOPs), which shall describe in detail the exact procedure and material required to analyze the samples. The following items shall be included in each SOP:

1. Scope and Application.

2. Safety precautions.

3. Sample Size Requirements, and Sample Collection (including sample handling, preservation and holding time).

4. Instrumental Detection Limits and/or Method Detection Limits, and working linear ranges for each parameter.

5. Interferences and Corrective Measurements.

6. Apparatus (including instruments, and instrumental parameters/conditions), and materials.

7. Reagents.

8. Calibration Procedures (including the preparation of calibration standard solutions, instrument tuning and performance check, etc.)

9. Sample preparations (i.e., extraction, digestion, distillation, etc.)

10. Diagram or tables that describes/outlines the procedure.

11. Step-by-step Analytical procedure (including separate procedure for each sample matrix if the method is used for more than one sample matrix).

12. Details of calibration (including the equation used for the calculation).

13. Quality control (QC) requirements (i.e., analysis of method blank, reagent blank, duplicate samples, etc.)

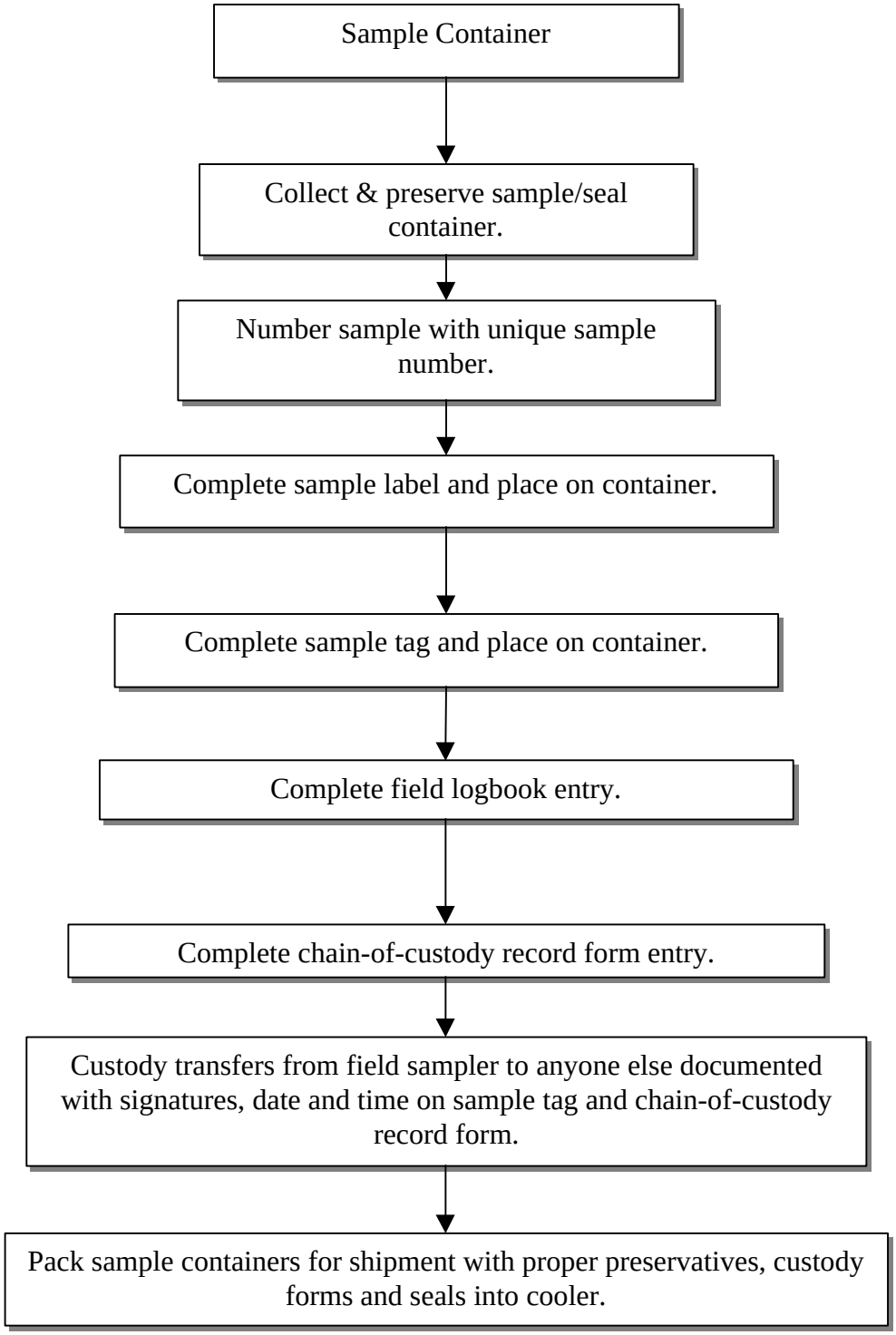
14. Data reporting requirements (including data reporting units and data reporting format.)

15. Preventative Maintenance

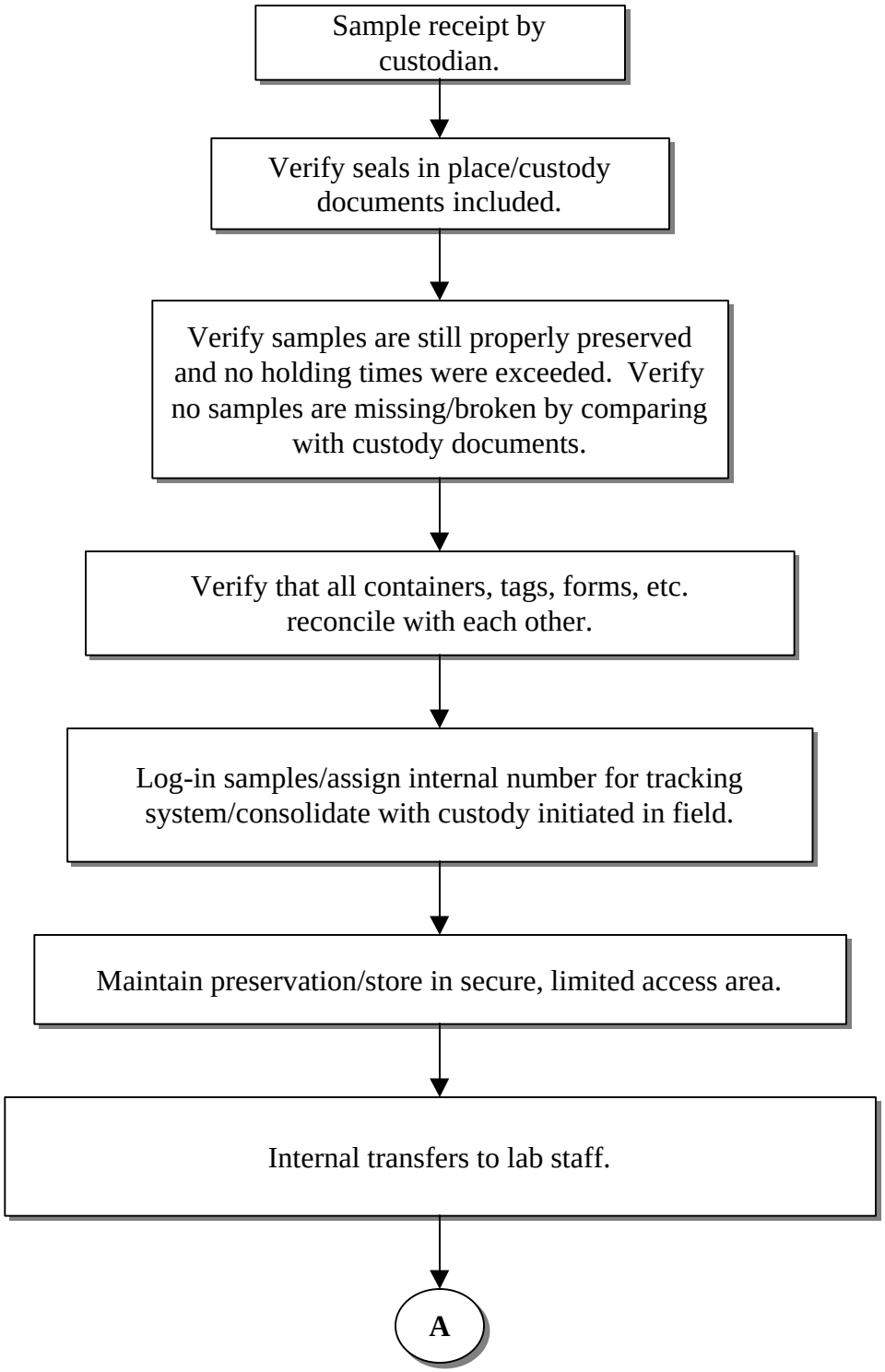
16. References

Method validation data, if available, should be attached to the SOP to support the limitation and applicability of the method. If the method validation data are not available, the SOP shall include the effort of method validation to be done prior to the use of this method for sample analysis.

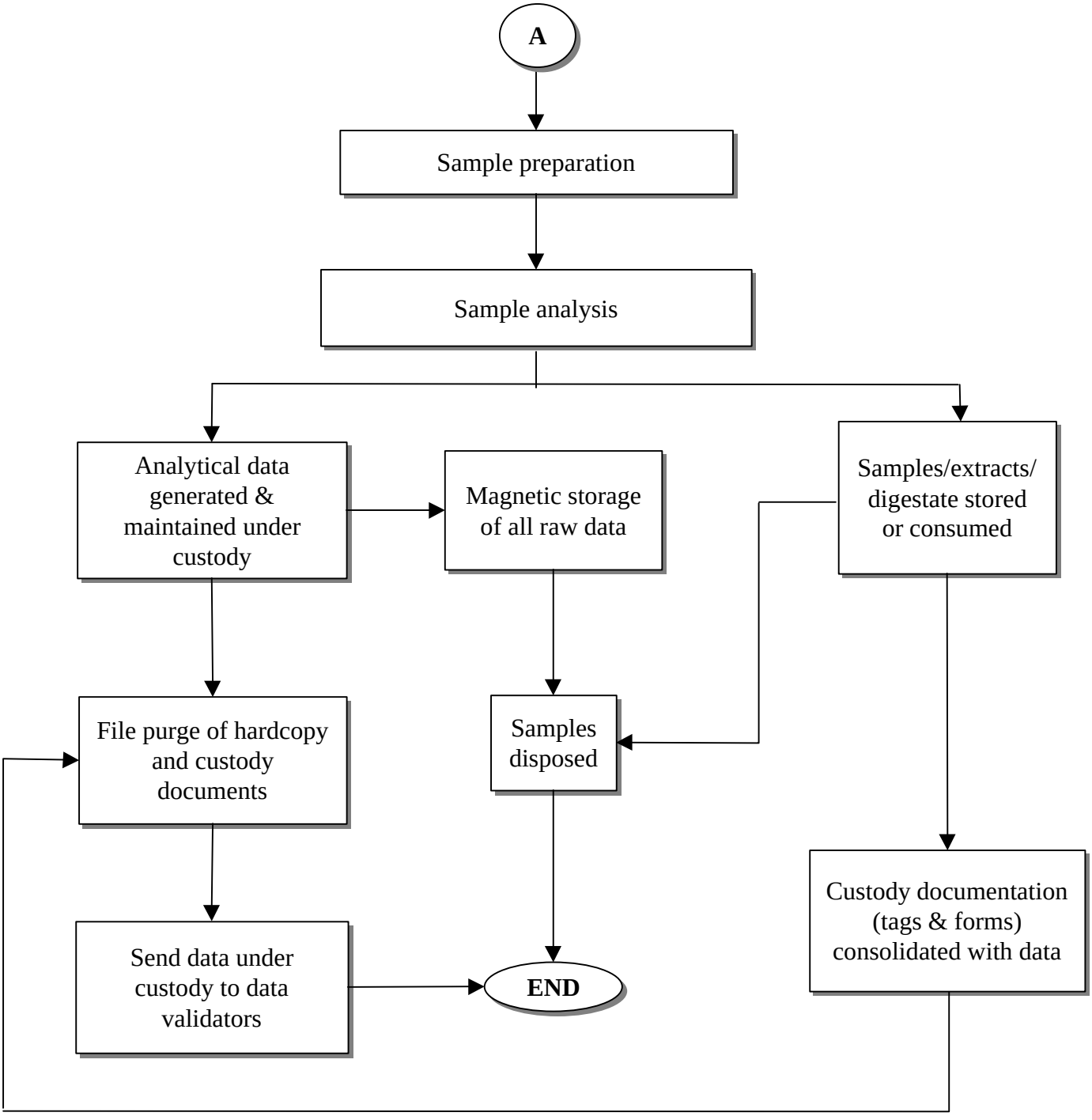
EXAMPLE FIELD CUSTODY SEQUENCE



EXAMPLE LAB CUSTODY SEQUENCE



EXAMPLE LAB CUSTODY SEQUENCE (continued)



SAMPLE TAG INSTRUCTIONS

1. Enter your project number for the site, which may be the first six digits of the CRL log number (see page C-21).

2. Enter the sampling station code, i.e., MWI, BLK. SSI. etc.

3. Enter date of sampling.

4. Enter time of sampling (military time only).

5. Specify "grab" or "composite" sample with an "X".

6. Insert station location. If the sample is a field blank or if to be used for the spike or duplicate analysis, notate here.

7. Obtain signature of sample team leader.

8. Indicate presence of preservative with an "X".

9. Specify analytes for analysis with an "X".

10a. Indicate traffic report number (i.e., EW846 or MEX013) for that sample if the samples are being shipped to the CLP. If the samples are going to the CRL, list the CRL log number.

10b. Indicate the case number.

11. Leave BLANK (for laboratory use only).

12. Enter any desired analyses not listed on the tag provided (e.g., PCB's ammonia. sulfide, etc.) and mark the box with an "X".

NOTE: Each sample container should have a separate tag. All field blanks should be designated as such on the sample tags, either in the 'Remarks' field (10a and 10b) or in the 'Station Location' field (5).

Appendix P

From: Norman R. Niedergang, Director
Waste, Pesticides and Toxics Division

To: All Staff Managing Corrective Action Projects

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 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 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.

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.

X-Ray Fluorescence:

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 an 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.

APPENDIX Q

MEMORANDUM

SUBJECT: Sample Preparation of Soils/Solids for Metals Analysis

FROM: David A. Payne, Chemist
Toxics Program Section
Waste, Pesticides and Toxics Division

TO: Oliver Fordham, Chemist
SW-846 Methods Team
Office of Solid Waste (5307W)
U.S. EPA Headquarters

DATE: July 16, 1996

This memo is written to request SW-846 methodologies, (Method 3050 series) for sample preparation of soils/solids for metals analysis, be changed to recognize the utility of dried, homogenized soils/solids prior to acid digestion. Method 3050, and other succeeding methods in this series, specifies a 1 g. representative, "wet" aliquot be selected, but does not specify how this is to be done. Even smaller aliquots (0.2g.) are used for mercury analyses. One (1) gram of a "wet" soil is often not representative of the entire soil/solid sample.

I provide QA support to our Division's RCRA Facility Investigations for enforcement and permitting programs. The usability of metals data for soils/solids can not be assured unless representative portions are first dried at 60°C, or less (to prevent mercury loss), then homogenized with particle size reduction. Data usability is monitored through QC audits of matrix spikes and sample replicates. Present day analytical instruments (ICP emission spectrometers) are controlled with calibration errors and measurement repeatability of less than 10%. Data quality is more a function of sample aliquot selection, than analytical measurement, when soil/solid aliquots are not homogenized.

I have attached an example data set to illustrate the undesirable use of "wet" sample aliquots. Attachments 1 and 2 to this memo provide ICP and graphite furnace results, respectively, for lead in soil using triplicate, one (1) gram "wet" aliquots. The soil were from a Superfund lead site and were 10-15% moisture. The third soil replicate value is estimated by subtracting the lead matrix spike concentration from the matrix spiked value. An undesirable 2 to 3-fold variation in sample results is observed.

For the high concentration level lead measurements (ICP emission spectroscopy), precision of measurement was undesirable for 12 of 15 soil QC audits. Any analysis of variance would show that sample aliquot selection had a larger effect on data quality than analytical measurement. If sample homogenization, with particle size reduction had been practiced, desirable data quality would probably have been obtained. The cost/time of sample homogenization would have been small compared to the cost of sample collection, and any resampling. Desirable data quality can be defined as the difference in replicate sample aliquots being less the 20% relative percent deviation.

The Environmental Protection Agency (EPA) does recognize, recommend, and specify homogenization of soils prior to sample aliquot selection. Please see the documents listed below for EPA's lead program:

3. "Residential Sampling for Lead: Protocols for Dust and Soil Sampling, Final Report", EPA 747-R-95-001, March 1995.

4. "Pb-Based Paint Laboratory Operations Guidelines: Analysis of Pb in Paint, Dust, and Soil Revision 1.0", EPA 747-R-92-006, May 1993.

Procedures for drying and homogenization of soils are described in these guidance documents.

Other references are available for soil preparation techniques. I have included a copy of Chapter 21 from:

Methods of Soil Analysis, Part II,
Second Edition,
American Society of Agronomy,
Soil Science Society of America,
Madison, Wisconsin,
1982

Section 21-3 of this reference discusses sample preparation techniques for lead in soil.

Attachments

cc: A. Debus, RCRA
J. Morris, CRL

FIELD EQUIPMENT OPERATION AND MAINTENANCE PROCEDURES - pH (HYDROGEN ION ACTIVITY) METER

Page 1 of 8
SOP Number: 05-03-02
Effective Date: 02/15/98

Technical Approval: _____ Date:_____

QA Management Approval: _____ Date:_____

SOP Description

This Standard Operating Procedure (SOP) describes the procedure to be used by **[Contractor]** field staff for measuring the hydrogen ion concentration (pH) of various liquids. pH is commonly used as an indicator of the corrosivity of a liquid aqueous sample. The term pH refers to the hydrogen ion concentration of a solution and is expressed as the logarithm to the base 10 of the reciprocal (i.e., negative logarithm) of the concentration of hydrogen ions at a given temperature, as follows:

$$pH = \log 1/[H^+] = -\log [H^+]$$

where: $[H^+]$ = concentration of hydrogen ions.

The determination of pH in water is a measure of the acidity or alkalinity of the water sample. A pH value less than 7.0 shows a tendency toward acidity while a value greater than 7.0 shows a tendency toward alkalinity. The pH of most natural waters ranges between 6.0 and 9.0; but there are notable exceptions, such as mine drainage water and unbuffered rain water in some regions (which are more strongly acidic). This procedure is applicable to groundwater, surface water, and saline water, as well as aqueous domestic and industrial wastes. Accurate determination of pH cannot be made in nonaqueous media, suspensions, colloids, or solutions with high ionic strength.

This procedure supplements (i.e., does not replace) the pH meters' manufacturers' calibration, operation, and maintenance instructions.

FIELD EQUIPMENT OPERATION AND MAINTENANCE PROCEDURES - pH (HYDROGEN ION ACTIVITY) METER

Page 2 of 8
SOP Number: 05-03-02
Effective Date: 02/15/98

General Procedures

Related SOPs

This SOP is to be used in conjunction with the other relevant or applicable SOPs found in the following SOP categories:

Section No.	Section Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures

Equipment and Apparatus

- **pH Meter** - consists of a potentiometer, a glass electrode, a reference electrode (or combination electrode), and a temperature-compensating device. The pH meter and associated electrodes are standardized against two reference buffer solutions that closely bracket the anticipated sample pH. Optimally, two pH meters should be taken into the field in case one malfunctions.

- **Reagents** - secondary standard buffer solutions (i.e., pH=4, pH=7, and pH=10) purchased from commercial vendors must be used. Standard solutions must be replaced every six to twelve months.

- **Multi-Range pH Test Paper** - to determine pH ranges and approximate pH values.
- **Beakers** - preferably polyethylene or Teflon-coated.
- **Distilled or Dionized Water** - used to rinse the instrument prior to and after use.
- **Kimwipes or Tissues** - used to wipe the instrument.
- **Thermometer** - preferably a non-breakable type with readings in degrees Fahrenheit and Centigrade should be used.
- **Field Logbook** - to record data.

Activities to Perform

Currently, two types of pH meters are used by **[Contractor]** staff. They are the DspH-3 (which is a combination pH and conductivity digital meter)[1] and Instrument Model 47 Mini-pH meter. **[Contractor's]** policy is that during all activities requiring the use of in-house equipment, the complete manufacturer's instruction manual will be sent to the field along with the equipment. The Equipment Coordinator is responsible for checking the equipment prior to shipment and for ensuring that a copy of the instruction manual is included. The Equipment Coordinator conducts another inspection when the equipment is returned to the Equipment Room.

The following steps are to be performed by the **[Contractor]** field team leader or designee when using pH meters.

- Prior to the field activity, check the meter for mechanical and electrical failures, weak batteries, and acid-cracked or fouled electrodes. When not in use, keep the electrodes moist. Refer to the manufacturer's instruction manual. Check pH recorders for recording and time-scale accuracy.

[1] For the conductivity component of this meter, refer to SOP No. 05-06-XX.

- Record the type of pH meter used in the field logbook.

- Following the manufacturer's instructions provided with each type of meter, test the meter against standard buffer solutions before using. Thereafter, check the meter periodically against two buffers that bracket the expected pH value of the sample. Use a fresh aliquot of buffer solution for each measurement. When sampling throughout a work day, calibrate the meter between samples.

- For pH meters without an automatic temperature compensation, bring the sample and buffer to the same temperature, if possible. If the sample temperature differs more than 2°C from the buffer solutions, adjust for the temperature difference following the manufacturer's instructions.

- Thoroughly rinse the electrode with distilled or deionized water and remove the excess water between immersion in each buffer solution and sample. If the water is suspected to be hazardous or contain hazardous constituents, it must be collected and disposed of as hazardous waste (e.g., in the same manner as the monitoring well purge water). See SOP No. 02-04-XX, Management of Investigative Derived Waste.

- Immerse the electrode in-situ whenever possible. If it is necessary to measure pH on a portion of the waste stream (e.g., for groundwater samples), use an inert stirrer or swirl the electrode at a constant rate until the meter reading reaches equilibrium. The rate of stirring used must minimize carbon dioxide entrainment at the air-water interface of the sample.

- Note and record the pH measurement to the nearest 0.1 pH unit in the field logbook; repeat the measurement until values differ by no more than 0.1 pH unit (two or three volumes are usually sufficient).

- Place the electrodes in the storage solution between samples.

- Turn off the meter after the last reading.

- Rinse the electrodes thoroughly with distilled or deionized water; store in the appropriate storage solution, as described in the manufacturer's instruction manual for the specific meter

or electrode. If the sampled material is suspected to be hazardous or contain hazardous constituents, it must be collected and disposed of as a hazardous waste (e.g., in the same manner as monitoring well purge water). See SOP No. 02-04-XX, Management of Investigative Derived Waste.

Procedures for Special Conditions

The following procedures address special conditions.

- Coatings of oily material or particulate matter can impair the electrode's operation and response. Remove these coatings by gently wiping the electrode with a clean Kimwipe or tissue, followed by a distilled-water rinse. Dispose of the Kimwipe or tissue with used gloves and other disposable equipment. Preferably, make arrangements for disposal of these wastes at the facility.

- Poorly buffered samples with low specific conductance values (less than 200 μmhos) may cause fluctuations in the pH readings. Equilibrate the electrodes by immersing them in three or four portions of the sample and taking pH measurements in a subsequent fresh portion of the sample.

- The glass electrode may be affected by a sodium error in solutions with a pH>10. Reduce this error by using special "low sodium error" electrodes.

- Use multi-range pH test paper to determine pH ranges and approximate pH values, or for concentrated hazardous waste samples which could damage the pH meter.

Contamination Avoidance

Sampling tools, instruments, and equipment must be protected from sources of contamination prior to their use and decontaminated after use as specified in SOP No. 02-03-XX, Equipment Decontamination. The pH meter must be thoroughly rinsed with distilled or deionized water between samples and placed in the storage solution. Liquids and materials from decontamination operations must also be handled in accordance with SOP No. 02-04-XX, Management of Investigative Derived Waste. Sample containers must be protected from sources of

contamination.

Sampling personnel are to wear chemical-resistant gloves when using the meter and handling any samples. Gloves must be decontaminated or disposed between samples.

Health and Safety

It is **[Contractor's]** policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include steel-toed shoes, safety glasses, and chemical-resistant gloves.

A site-specific health and safety checklist/plan must be developed by the field team leader or designee and approved by the Health and Safety Director or designee prior to implementation in the field. This checklist/plan must be reviewed prior to beginning work.

Any deviation(s) from an approved site-specific health and safety checklist/plan must be documented in the field logbook.

QA/QC

The pH meter must be calibrated in accordance with the manufacturer's instruction manual, prior to daily use. Thereafter, the meter is to be checked periodically against two buffers that bracket the expected value of the sample(s).

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific procedures, the minimum QA/QC requirements for this activity are listed below.

Control of Deviations

When feasible, any departure from specified requirements must be justified and authorized by the field team leader prior to deviating from the requirements. Deviations are to be sufficiently documented in the field logbook to allow repetition of the activity as actually performed.

Verification

Verification activities are required, including surveillance and periodic record audits. These activities are to be documented in the field logbook and will become part of the completed project records.

Comments and Notes

None at this time.

Attachments

None at this time.

References

American Society for Testing and Materials, Standard Test Methods for pH of Water; ASTM Method D1293-84.

[Contractor], Field Equipment Manufacturers' Instruction Manuals Handbook, Winter 1995.

[Contractor], Health and Safety Program, Winter 1995.

Appendix E, Field Sampling Protocols and Guidance, U.S. Department of Energy, The Environmental Survey Manual, DOE/EH-0053, August 1987.

U.S. Department of the Interior, Ground Water Manual: A Guide for the Investigation,

Development and Management of Ground-Water Resources, Washington, D.C., 1981.

U.S. Environmental Protection Agency, A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, Washington, D.C., 1987.

U.S. Environmental Protection Agency, Data Quality Objectives for Remedial Activities - Development Process, EPA/540/G-87/003, Washington, D.C., 1987.

Standard Methods for the Examination of Water and Wastewater, 16th Edition, Method 423, 1985.

U.S. Environmental Protection Agency, Standard Operating Procedures for EPA Region IV Activities, February 1, 1991.

EXAMPLE RCRA QAPP

U.S. EPA REGION 5

REVISION: APRIL 1998

EXAMPLE RCRA QUALITY ASSURANCE PROJECT PLAN
U.S. EPA REGION 5

The following document has been prepared by U.S. EPA Region 5 to facilitate preparation of a RCRA investigation Quality Assurance Project Plan (QAPP) based on U.S. EPA Quality Assurance Management Staff and Region 5 requirements. This Example RCRA QAPP is intended to serve as a tool for the production of QAPPs to be used for RCRA Subtitle C corrective action investigations. In addition, it may also be useful for the production of QAPPs for other RCRA investigations, including but not limited to, Subtitle D activities and underground storage tank (UST) investigations.

The Example RCRA QAPP (Example) is based on a relatively simple example investigation designed to address a variety of potential issues associated with the development of a RCRA investigation QAPP. The focus of the Example is the development of appropriate investigation objectives using a decision process appropriate for a RCRA investigation. In addition, example text providing the information required in the U.S. EPA Region 5 *RCRA QAPP Instructions* is included.

The example used to develop this document in no manner addresses all required information for all types of investigations. The example is limited to the collection of soil, sediment, groundwater and surface water samples to undergo field and/or laboratory analysis for PCBs and metals. The specific sampling and analytical requirements for a given investigation may involve a far wider variety of sample matrices, such as waste slag, fly ash, biota, tissue, liquid wastes, oil/water mixtures, multiple phase liquid samples, etc., and analytical parameters including (but not limited to) Appendix IX, water quality parameters, soil characterization methods, or site-specific methods developed for site-specific starting materials, products or contaminants.

It is critical to realize that this RCRA QAPP Example is not a stand-alone document, but rather must be used in conjunction with the U.S. EPA Region 5 *RCRA QAPP Instructions* and a pre-QAPP meeting with the appropriate U.S. EPA Project Coordinator/Permit Writer and U.S. EPA RCRA Enforcement/Permitting QA Coordinator. Full participation in a pre-QAPP meeting is likely to reduce the time and effort expended on preparing an acceptable QAPP. In order for this to occur, facility representatives are strongly encouraged to first develop preliminary project objectives prior to the pre-QAPP meeting.

The Example is organized according to the standard 16 Element QAPP structure. While this structure is generally recommended for RCRA project purposes, other organizational formats are acceptable, provided all requirements expressed herein have been substantively addressed. The use of different formats may be helpful if, for example, it is a multi-media investigation where the regulated facility encounters competing guidances. However, under such circumstances, the organizational format should be discussed during the pre-QAPP meeting.

The following formatting conventions are used in the Example RCRA QAPP.

- Information critical to the preparation of all QAPPs is provided in shadow boxes throughout the Example.

- Facility-specific information necessary to complete a subsection is noted in **BOLD UPPERCASE TEXT** generally contained within square brackets.

- Short checklists, designed to aid the QAPP preparer in determining if all critical information has been provided follow each element of the Example.

The Example RCRA QAPP has been prepared as a service to members of the regulated community in the process of developing or assessing a RCRA investigation QAPP. If you have any comments regarding improvements to the Example RCRA QAPP, please contact Margaret McCue, Associate Division Director of the Waste, Pesticides and Toxics Division of U.S. EPA Region 5, at (312)886-0653.

If additional technical guidance is needed, the QAPP preparer is encouraged to contact the assigned U.S. EPA Project Manager/Permit Writer or the U.S. EPA RCRA QA Coordinator who participated in the facility's pre-QAPP meeting. For issues relating to specific technical areas, the reader can contact the RCRA QC Coordinator, Human Health Risk Coordinator or Ecological Risk Coordinator at (312)886-7435.

Note, the Example RCRA QAPP has not been developed for use with field investigations associated with boilers and industrial furnaces (BIFs). For investigative activities related to BIF units, the U.S. EPA Region 5 BIF Coordinator may be contacted at (312)886-7435.

DOs AND DON'Ts TO FACILITATE QAPP APPROVAL

1. **DO NOT** attempt to write a QAPP without proper consultation with appropriate subject matter experts.

   DO consult with ecologists, human health risk assessors, laboratory chemists and hydrogeologists before drafting the objectives of a RCRA investigation.

2. **DO NOT** submit the laboratory quality assurance (QA) program plan attached in an appendix to satisfy project-specific QAPP information. A generic laboratory QAPP contains extraneous and ambiguous tables and information.

   DO append or otherwise incorporate into the QAPP the laboratory information that is project-specific (e.g. laboratory chain-of-custody, internal performance and system audits, etc.) to address certain elements outlined in this document.

3. **DO NOT** reproduce tables containing key information such as types of samples, numbers of investigational and quality control (QC) samples per matrix, or lists of target compounds in different QAPP or workplan sections. There should be one table of each kind of information contained in the QAPP.

   DO provide section and page-specific references when referring to the tabular information in the QAPP, Field Sampling Plan, or RFI Workplan. By doing so, errors due to incomplete revisions to tables will be minimized.

4. **DO NOT** submit photocopied pages from Test Methods For Evaluating Solid Waste (SW-846) as laboratory Standard Operating Procedures (SOPs). If, for any reason, there is a need to refer to SW-846, specific references to it may be made, as in specifying which methods were used as a guideline in preparing the SOPs.

   DO submit laboratory-specific SOPs for review.

5. **DO NOT** submit copies of manufacturer's guides to operating instrumentation such as field equipment commonly used to detect volatile organic compounds (VOCs), or for the measurement of pH, Eh, turbidity and specific conductance. U.S. EPA evaluates the operator's SOP for calibrating and maintaining such instruments.

   DO submit field method procedures in the form of SOPs.

6. **DO NOT** submit a multiple choice list indicating which methods will be used to analyze certain hazardous constituents. Only the instrumental and preparatory, cleanup, extraction and/or digestion procedures that will actually be utilized for analysis should be indicated in the QAPP. If SW-846 offers a selection of possibilities for performing the analyses, then the QAPP must specify which methods will actually be used.

7. **DO NOT** submit a QAPP to U.S. EPA for review until a laboratory has been selected by the facility for completing all work. Once a selection has been made, laboratories cannot be changed without good cause.

8. **DO NOT** select a laboratory until after the specific project objectives have been identified.

   DO work with appropriate subject experts and regulatory personnel to develop meaningful project objectives and decision rules early in the process and before the QAPP is written.

9. **DO NOT** write the QAPP until a pre-QAPP meeting has been held. This meeting involves representatives of the laboratory, the facility, and the U.S. EPA for the purpose of defining project objectives and evaluating potential QA problems during implementation of the workplan.

10. **DO** provide in the QAPP the complete list of hazardous constituents to be measured and reported for the facility project. Such lists will be consistent with those constituent lists for which the methods have been validated.
11. **DO** provide information on sample tags. Sample tags are required for all samples taken in the field, as part of the chain-of-custody.

12. **DO** provide a data deliverables package which will reflect a Contract Laboratory Program ("CLP-like deliverables") format in cases where data is needed to support a human health or ecological risk study. (The CLP forms are not required but the same information must be supplied.)

13. **DO** provide for a data validation process which will validate 100% of the data by a party independent of the laboratory generating such data. This validation will be performed prior to transmittal to U.S. EPA. All data must be made available to U.S. EPA immediately upon request.

14. **DO** provide copies of the draft QAPP and any revisions to the appropriate laboratory personnel in order to ensure the laboratory can meet the requirements of the QAPP.

15. **DO NOT** submit the entire QAPP document upon resubmittal.

    DO submit only those sections which were revised from the previous submittal.

16. **DO** consider the use of field analytical strategies as outlined in, *The Use of Field Methods to Support RFI Streamlining*, U.S. EPA, Region 5 memorandum, June 20, 1997.

17. **DO** selectively consider using historical data to supplement data required in a facility investigation, as outlined in, *Historical Analytical Data usage in the RFI Process*, Region 5 Memorandum, April 1998.

18. **DO NOT** use the low level purge and trap technique for analyses of VOCs in soil, permitted by U.S. EPA prior to June 13, 1997 (RCRA QAPP Instructions Appendix B).

    DO follow guidance offered in *Determination of Volatiles in Soil - Directive For Change*, Region 5 memorandum, December 22, 1997.

19. **DO** thoroughly familiarize yourself with this document and the U.S. EPA Region 5 QAPP Policy, as contained in *RCRA QAPP Instructions*, prior to (1) obtaining appropriate support staff needed to select objectives and decision rules which will be founded on measurement data; and (2) prior to participating in the pre-QAPP meeting with U.S. EPA. (See items #1 and 9 above.)

TITLE/SIGNATURE PAGE

The names, titles and responsibilities presented here must be consistent with those in Element 4 and as cited in other elements of the QAPP where personnel responsibilities are discussed, such as Elements 11, 12 and 15.

QUALITY ASSURANCE PROJECT PLAN
FOR THE RCRA **[PROJECT TYPE]** AT
[FACILITY NAME]
U.S. EPA ID NUMBER **[ILD 000 000 000]**
REVISION **[NUMBER]**

[DATE OF SUBMITTAL]

Prepared by: **[CONTRACTOR NAME]**

Prepared for: **[FACILITY/CONTRACTOR]**

_____	_____
[NAME - FACILITY PROJECT MANAGER]	Date
_____	_____
[NAME - CONTRACTOR PROJECT MANAGER]	Date
_____	_____
[NAME - CONTRACTOR QA OFFICER]	Date
_____	_____
[NAME - LABORATORY QA MANAGER]	Date
_____	_____
[NAME] U.S. EPA RCRA Project Manager/ Permit Writer	Date
_____	_____
[NAME] U.S. EPA RCRA Enforcement/ Permitting QA Coordinator	Date

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PROJECT DESCRIPTION

STOP! This is the most important element of the QAPP. Pay most careful attention to the development of the Project Objectives! Once the Project Objectives have been accurately developed and articulated, the project specific objectives can be readily determined, and it will be possible to complete all required portions of the QAPP.

1.0 Project Description

The project description outlines the overall scope of the investigation to be performed and its basis, including the pertinent permit requirements for a permit issued on a specific date. See Instructions Section 3.0.

This QAPP presents the organization, objectives, planned activities, and specific QA/Quality Control (QC) procedures associated with the RFI for the **[FACILITY NAME]** in **[FACILITY LOCATION]** in response to **[SPECIFIC PERMIT OR ORDER OF CONSENT REFERENCE]**. Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses will be described. All QA/QC procedures will be structured in accordance with applicable technical standards, U.S. EPA's requirements, regulations, guidance, and technical standards. This QAPP has been prepared in accordance with the U.S. EPA Region 5 QAPP policy as presented in *U.S. EPA RCRA QAPP Instructions*, and other relevant guidance documents, including *The Use of Field methods to Support RFI Streamlining*, U.S. EPA, Region 5 Memorandum, June 20, 1997 and **[LIST APPLICABLE GUIDANCE HERE].**

1.1 Introduction

In this section, the overall scope of the project is described. The current status and QAPP preparation guidelines are explained. See Instructions Section 3.1.

This QAPP has been prepared on behalf of **[FACILITY]** by **[CONTRACTOR]**. A Project Management Plan, a QAPP, and a Health and Safety Plan have been appended to the RFI Work plan, dated **[DATE]**. A Field Sampling Plan has also been prepared, which has been entirely incorporated into the QAPP through specific reference.

1.1.1 Overall Project Objectives and Decision Statements

One purpose of this RFI is to gather sufficient information to quantify risk to human health (Baseline Risk) and ecological receptors (Preliminary Ecological Risk Assessment (PERA) in the event that environmental contamination is determined to be present. The objectives of the RFI are to determine the nature and extent of contamination at or migrating off-site from the facility.

Overall objectives of the data collection will be as follows:

- Verify and further define the nature and extent of contamination in previously identified on-site and off-site areas (soil, groundwater, sediment and surface water matrices). Data quality must be sufficient to allow comparison with established action levels or regulatory standards (screening levels).

- Determine the nature and extent of contamination in previously uninvestigated areas. Laboratory data will eventually be compared to established human health and ecological target decision levels. The target decision levels for all project parameters are summarized in **[REFERENCE TO TABLE PROVIDING ALL PERTINENT CRITERIA; SEE TABLES 1.1 THROUGH 1.5 FOR EXAMPLES]**.

- Collect sufficient data for all contaminated media and/or biota to support a human health baseline risk assessment, preliminary ecological risk assessment, and feasibility study for corrective measures.

The Decision Statement for this investigation is as follows: What is the nature, risk and extent of select "RCRA metals" and PCB contamination in onsite or offsite soil, sediment, surface water and groundwater media that presents unacceptable risks, which would therefore warrant remedial action?

Associated specific objectives for field and laboratory data collection are tabulated in Section 1.4 of this QAPP.

1.1.2 Project Status/Phase

[FACILITY AND CONTRACTOR] will utilize an integrated and phased approach for the RFI. During the RFI, data collection will be conducted in phases, with the results of the human health baseline risk assessment and preliminary ecological risk assessment being determining factors in decisions regarding the necessity for additional phases of investigation.

The Phase I field investigation will include the following activities:

- Surface soil (0 to 24 inches) sampling for verification and site characterization both on-site and off-site;
- Subsurface soil sampling along existing and previously excavated sewer lines, and in areas where deeper soil removals have occurred;
- Groundwater sampling;
- Residential well sampling;
- In-situ permeability testing of aquifer materials;
- Surface water sampling;
- Sediment sampling;
- Ecological habitat characterization; and
- Site survey for both threatened and endangered species and state species of concern.

Samples will be analyzed for PCBs and a select list of "RCRA metals." A limited number of samples will also be analyzed for cation exchange capacity (CEC), Atterburg limits, percent moisture, grain size distribution, and total organic carbon (TOC) to determine soil physical parameters and their effect on contamination migration.

Data from the Phase I investigation will be qualitatively and statistically evaluated to determine whether a Phase II investigation is necessary. If Phase I data suggests that sufficient site characterization information has been collected, **[FACILITY AND CONTRACTOR]** will proceed with the human health risk assessment and the preliminary ecological risk assessment (PERA) for the site. A technical memorandum presenting the Phase I data and recommendations of the risk assessments will be prepared and submitted to the U.S. EPA. After a review of the technical memorandum the need for implementing a Phase II investigation and detailed ecological risk assessment(DERA) will be evaluated in light of the data requirements for the feasibility study. The rationale and scope of any Phase II investigation will be discussed with and approved by the U.S. EPA prior to implementation.

1.1.3 QAPP Preparation Guidelines

This QAPP has been prepared in accordance with the *U.S. EPA Region 5 RCRA QAPP Instructions*. Furthermore, in meetings held with the U.S. EPA in which the Region's protocol

for presentation of QAPPs was discussed, additional guidance was received on how to prepare this QAPP. One of these meetings was a formal "pre-QAPP" meeting.

1.2 Site/Facility Description

Sufficient information to allow for a basic understanding of the facility in order to evaluate the technical soundness of the sampling rationale must either be presented here or specific references to the associated work plan provided. See Instructions Section 3.2.

A brief description of the facility, its geological setting, and associated features is presented in the section below.

1.2.1 Location

The **[FACILITY]** is an inactive lead-acid battery manufacturing operation located in **[CITY, COUNTY, STATE]**. The facility occupies approximately 18 acres within the northern portion of the **[NAME OF WATER BODY]** watershed, along the eastern bank of the **[RIVER OR LAKE NAME]** and located on U.S. Highway **[FACILITY ADDRESS]** northwest of the city of **[NAME]**. The facility location and surrounding area are shown on Figure 1.1. The facility is bordered on the north by **[STREET NAME]** Street, on the south by **[STREET NAME]** Street, on the west by a State Highway garage and on the east by the parking lot of a local inn. The study area for the **[FACILITY]** RFI includes the **[ADJOINING SITE NAME]** property and off-site areas immediately surrounding the site.

1.2.2 Facility/Site Size and Borders

This information is provided in Section XXX, on pages ___ through ___ of the RFI Work plan, which has been incorporated into this QAPP by reference, and in Figures X.X and X.X of the RFI Work plan.

1.2.3 Natural & Manmade Features

This section is addressed in Section XXX, on pages ___ through ___ of the RFI Work plan, which is hereby incorporated into this QAPP through reference.

1.2.4 Topography

See Section X.X and Figure X.X of the RFI Work plan for information concerning the site's general topography.

1.2.5 Local Geology and Hydrogeology

See Section XXX, page ___, and Section XXX, pages ___ through ___ of the RFI Work plan for information concerning the site's physical features, population and land use, geology and soil, groundwater resources and surface hydrology and drainage (i.e., receiving watershed).

1.2.6 Surrounding Land Use

This section should present sufficient information to allow for a preliminary understanding of potential risk pathways in order to support chosen target decision levels (see Section 1.1.1 above). As such, it is strongly recommended that a person with experience in determining risk pathways be consulted during the preparation of this section. See Instructions Sections 3.2 and 3.6.2.

There are XX residences located within XX miles of the facility. The areas to the north and east are primarily light industrial, including **[TYPES OF FACILITIES CAN BE PROVIDED]**. A state recreation area is located one-half mile east of the facility, **[SPECIFIC FEATURES INCLUDING WATER BODIES AND RECREATIONAL ACTIVITIES CAN BE PROVIDED]**. **[NAME OF SCHOOL]** is located one half mile south of the facility.

1.2.7 Ecological Communities and Habitats

Alterations of habitats and/or ecological communities resulting from changes due to the operation and/or presence of the facility must be discussed here. This subsection should be prepared by an ecologist or ecological risk assessor with prior experience in studies similar to the subject investigation. It is strongly recommended that such an expert be consulted prior to the submittal of the QAPP. See Instructions Section 3.6.1.

The study area for the **[FACILITY]** RFI has terrestrial communities comprised of **[PROVIDE A DESCRIPTION FOR EACH GENERAL CATEGORY SUCH AS: WOODED, GRASSLAND, DUNE, ETC.]** along with aquatic communities comprised of **[PROVIDE A DESCRIPTION FOR EACH GENERAL CATEGORY SUCH AS: LENTIC (LITTORAL, LIMNETIC AND BENTHIC); LOTIC; WETLANDS AND TEMPORARY PONDS]**.

1.3 Site/Facility History

The information presented in this section must be sufficiently detailed to support analytical parameter and sampling location decisions. See Instructions Section 3.3.

1.3.1 General History

The facility was established in **[DATE]** to manufacture lead acid batteries, primarily for cars and trucks, first by the **[DOCUMENT HISTORY OF OWNERSHIP AND OPERATION]**, which used the name **[XXX]** when it bought the facility in **[DATE]**. **[CURRENT OWNER]** acquired the site in **[YEAR]**.

Over the years of operation, successive industrial sewer lines became plugged with lead sludge. The plugged line was typically left in place and a new line installed. As a result of leaks and sewer line backups, the soils around some of these sewers and associated sumps were found to be contaminated with lead. The upper soils around the holding lagoon also showed elevated levels of lead and PCBs. Other contaminants of concern are PCBs that were found in the soil around the transformer pad, the nearby water tower pad, and below a section of the main process building (see Figure X.XX).

During normal plant operation, manufacturing process wastes and wastewater became laden with lead, lead oxides, sulfuric acid, and lead sulfates. The plant's ventilation system and processes released air laden with lead contaminants to the atmosphere surrounding the facility **[REFERENCE REPORT]**. Prior to 1978, wastewater was sent through the on-site industrial sewer system, then directly to the **[CITY/COUNTY/ETC.]** sanitary sewer system. Beginning in **[DATE]**, wastewater effluent was subject to pH treatment on-site, followed by placement into a wastewater sedimentation lagoon. Overflow from the lagoon went to the **[NAME]** Publicly Owned Treatment Works, and occasionally to the adjacent **[NAME]** river.

Soil on and in the vicinity of the facility has been contaminated with lead, predominantly from airborne particulates. Malfunctions and accidental spills have also

contributed to contamination of on-site soils with high concentrations of lead and other metals.

Sediments in the lagoon and **[NAME]** river may also be contaminated with PCBs from site operations. Several groundwater springs on site discharge directly into the **[NAME]** river and may contribute to surface water contamination. Due to the potentially contaminated soils on site, runoff from the site may be contributing to surface water and sediment contamination as well.

1.3.2 Past Data Collection Activities

Prior to inclusion in a QAPP, historical data must first be carefully scrutinized. Evaluations of historical data must be performed in accordance with Region 5's Historical Data Memorandum. See Section 3.3 and Appendix A of the Region 5 QAPP Instructions.

The **[SITE NAME]** has been subject to a number of investigations since **[DATE]**. The following summaries are based on a review of reports and supporting documents submitted by consultants and information obtained from the project files of the U.S. EPA and the **[STATE ENVIRONMENTAL AGENCY]**. The results obtained under each study have been carefully evaluated using the Region 5 Memorandum Concerning the Use of Historical Data. None of these results will be used to substitute for data needed for the present study. However, the proposed target parameter list, which is based on site operational history and waste management practices, is consistent with the results of the historical data sets.

Beginning in **[DATE]**, **[FACILITY OWNER]** has contracted with **[CONTRACTOR NAMES]**, to assess the degree of contamination at the facility, and evaluate remedial actions for the identified contamination problems. These include on-site contaminated soils, the plugged sewer lines, the pH treatment system and surrounding soils, and the PCB contamination.

- **[SYNOPSIS OF PREVIOUS STUDY INCLUDING ASSESSMENT OF DATA QUALITY, WITH REFERENCE.]**

- **[SYNOPSIS OF PREVIOUS STUDY INCLUDING ASSESSMENT OF DATA QUALITY, WITH REFERENCE.]**

- **[SYNOPSIS OF PREVIOUS STUDY INCLUDING ASSESSMENT OF DATA QUALITY, WITH REFERENCE.]**

Pursuant to these studies more then 7,000 cubic yards of lead and PCB-contaminated soil have reportedly been removed from on-site **[PREVIOUS STUDY REFERENCE]**. The cleanup standard was to remove all lead-contaminated soil down to a level below 250 ppm, as recommended and approved by the **[STATE ENVIRONMENTAL AGENCY]**. Soils contaminated with PCBs were removed from the facility in two separate actions. In the first action, PCB soils were reportedly removed down to a level below 50 ppm **[PREVIOUS STUDY REFERENCE]**. In the second action, soils were removed to a level below 2 ppm **[PREVIOUS STUDY REFERENCE]**. Verification samples for these removal actions will be taken in accordance with this QAPP.

1.3.3 Current Status

Based on reports and documents reviewed for the site, and a current assessment of all available information, the following target compounds and source area release mechanisms have been targeted for further investigation.

- Past Facility Operations. Records indicate that during the active period of battery manufacture, the plant's ventilation system and processes released lead-laden air and possibly other contaminants including **[LIST SPECIFIC CONTAMINANTS]** to the atmosphere. Malfunctions and accidental spills also may have released both organic and inorganic contaminants to the environment.

- Wastewater Sewers. During plant operations, manufacturing process wastewater, containing lead oxides, lead sulfates, sulfuric acid, and possibly other metals was sent through the industrial sewer system to be discharged to the **[CITY]** publicly owned treatment works (POTW). After **[DATE]**, wastewater was subject to pH adjustment and sedimentation prior to discharge to the POTW. Documents indicate that as industrial sewers became plugged with lead, they were left in place and new sewer lines were installed adjacent to the old. Reports indicate the soils around some of the sewer lines were heavily contaminated with lead, suggesting leaks. Other reports indicate that plugged sewers caused wastewater to back up in sumps and manholes causing wastewater releases to the ground surface.

- Surface Impoundment. The surface impoundment located in the southwest corner of the facility received pH adjusted wastewater for sedimentation. Documents indicate concerns over cracks in the concrete lining and the integrity of joints in the concrete construction. Concerns regarding overtopping of the impoundment have also been reported. Sample analysis of the sludge which settled in the wastewater lagoon indicates that high levels of waste lead, iron, aluminum, arsenic, barium, and calcium were generated during the manufacturing process.

- PCB Transformers. Records indicate that two PCB transformers located near the northwest corner of the facility leaked, releasing contaminated dielectric fluid to surrounding soils.

The historical release of contaminants as described above resulted in the contamination of on-site soils and potentially the adjoining **[NAME]** facility and nearby buildings. Although significant attempts have been made to remediate the contamination (i.e., on-site soil removal, sewer excavations, etc.), potentially significant concentrations of PCBs, lead and other metals may remain in soils or sediments even though the primary sources have been removed. At this time, these soils and sediments constitute a secondary source of contamination, potentially affecting human and ecological targets in the area of the site. Similarly, lead contamination in

on-site structures may present a continuing exposure point for workers, residents, and visitors to the area. Sediments in the abandoned wastewater lagoon and adjacent **[NAME]** River may pose a threat to ecological receptors. Groundwater contamination is also possible from leaching compounds in the soils, and may contribute to surface water contamination where springs discharge to the **[NAME]** River.

1.4 Project Objectives and Intended Data Usages

The complete decision criteria for the subject investigation must be fully described in this section. For each decision to be made, specific, quantitative criteria must be provided. Furthermore, it is strongly recommended that careful attention be paid to the development of this section prior to the writing of the remainder of the QAPP. Although a relatively simple case is presented here, similar strategies may be employed for other or additional key target field and laboratory parameters. See Instructions Section 3.4.

For this project, it will be necessary to gather sufficient information to evaluate the nature and extent of releases from solid waste management units, and also to determine whether unreasonable risks to human and ecological receptors are associated with the areas. This could include evaluation of the impact of releases on human health and ecological receptors both within and beyond the facility property boundary, if applicable.

The data collection activity will specifically address the following concerns:

(A) To evaluate the impact of soil and groundwater contamination on human health risk, assuming the land use of the potentially impacted property is residential; and

(B) To evaluate the impact of sediment, soil, and surface water contamination on ecological receptors.

Parameters listed in Tables 1.1 through 1.5 are the proposed critical measurement parameters for this project. However, other constituents will be reported as the methods **[CITE ALL METHODS TO BE USED DURING THE SUBJECT INVESTIGATION WHICH HAVE TARGET ANALYTES IN ADDITION TO THE PROJECT-SPECIFIC ANALYTES**] have additional analytical capability. The other analytes to be reported are indicated in the attached method Standard Operating Procedures (SOPs), Sections X.X.

In order to determine the horizontal and vertical extent of PCBs and “RCRA metals” contained in soil, a geoprobe sampling device will be utilized to obtain samples for field analysis. Field analyses will be performed on soil samples using x-ray fluorescence for lead and immunoassay for PCBs. If detectable concentrations of these contaminants are detected at any location or soil

depth using these tests, (see Table 1.1) no further sampling shall be performed in the immediate vicinity. In this event, the sampling team will relocate to the next node of the grid (as explained in Section X.X of the Field Sampling Plan). This step shall be performed iteratively until no further concentrations of PCBs and lead are found using the field tests. Direct push sampling shall proceed to the water table until no contamination is demonstrated at any location on the basis of field tests.

When soil samples no longer contain detectable levels of PCBs or lead (respectively) based on field testing, then soil samples are to be collected from the nodes and several from beyond the nodes (as explained in Section X.X of the Field Sampling Plan) for fixed laboratory analysis of "RCRA metals" and PCBs. Note that grids from which soil samples are collected for fixed laboratory analysis of "RCRA metals" could differ from that from which samples are taken for analysis of PCBs. The decision rule associated with this outlined sampling activity is that if any constituents in Tables 1.2 through 1.5 are identified in discrete soil samples at concentrations exceeding the human health target decision levels indicated in Tables 1.2 through 1.5, then all collected data will be subjected to a baseline human health risk assessment. If any constituents are identified at concentrations exceeding the ecological target decision levels indicated in Tables 1.2 through 1.5, then all collected data will be subject to a preliminary ecological risk assessment. Details of the soil sampling activity are presented in Section X.X of the Field Sampling Plan.

If the statistically derived soil background levels are determined to be above the target decision levels, then a statistical comparison shall be made to the investigational areas. The statistical tests relevant to this case are **[NAME OF SPECIFIC STATISTICAL TEST(S) TO BE USED]**. The rationale for the chosen statistical tests is **[FULL RATIONALE FOR CHOSEN METHODS, INCLUDING STANDARD USE OF CITED TESTS, ALTERNATIVES CONSIDERED AND CHOICE OF DEFAULT PARAMETERS, IF APPLICABLE. WHEN ADEQUATELY DEVELOPED THIS DISCUSSION WILL BE SEVERAL PARAGRAPHS TO MULTIPLE PAGES]**.

If, on the basis of immunoassay and x-ray fluorescence field screening, no potentially "clean" areas can be determined, samples will be collected for fixed laboratory testing as indicated in Figure X.X of the Field Sampling Plan. This data will be utilized in a baseline human health risk assessment and preliminary ecological risk assessment, unless the facility proposes to implement a voluntary remediation program.

In order to determine the existence or extent of a plume with respect to the constituents of site interest, groundwater samples shall first be taken on a quarterly basis from existing upgradient groundwater monitoring wells according to procedures specified in Section X.X of the Field Sampling Plan. Existing monitoring wells shown on Figure X.X of the Field Sampling Plan are appropriately located for this RFI since **[PROVIDE THOROUGH DISCUSSION OF SUITABILITY OF EXISTING MONITORING WELLS, ADDRESSING LOCATIONS (VERTICAL AND HORIZONTAL), CONSTRUCTION AND CONDITION, OR PROVIDE A SPECIFIC REFERENCE TO THE ASSOCIATED WORK PLAN FOR THIS INFORMATION]**. Samples shall be delivered to **[LABORATORY NAME]** for analysis of "RCRA metals" and PCBs.

Ten additional locations downgradient from the existing monitoring wells have been selected for this preliminary study as well in order to further delineate the extent of any existing plume. These locations shall be sampled using direct push technology (geoprobe) and temporary cased wells shall be installed permitting quarterly sampling. Details of the groundwater sampling program are presented in Section X.X of the Field Sampling Plan.

The decision rules associated with this sampling activity are that if any constituents from Tables 1.2 through 1.5 are identified above the human health or ecological targeted levels in any monitoring wells in any of the quarterly sampling events, then the data will be used to map the plume boundaries and all generated data will be subjected to a baseline human health risk assessment and preliminary ecological risk assessment. In the case of constituents for which the groundwater reporting limit exceeds the target decision level, statistically valid comparisons shall initially be made to the upgradient monitoring well data. The appropriate statistical comparisons are described below. **[PROVIDE COMPLETE RATIONALE, AS DESCRIBED FOR SOIL SAMPLING ABOVE]**.

If no constituents are detected above the targeted decision levels in Tables 1.2 through 1.5 in any monitoring event, and monitoring well data suggests that SWMUs have not contributed contamination, then the baseline human health cumulative risk assessment and preliminary ecological risk assessments shall be performed using one-half the reporting limit values for the Tables 1.2 through 1.5 constituents for which analytical sensitivity was inadequate (i.e., arsenic, PCBs and lead). If the risks are deemed "not unreasonable" and there is no evidence of soil contamination per procedures described previously, then the facility may qualify for the "No Further Action" alternative as indicated below.

The rationale for proposed target decision levels in groundwater is **[PROVIDE THOROUGH RATIONALE FOR ALL TARGET DECISION LEVELS, ADDRESSING BASIS FOR CHOOSING SPECIFIC GOALS (SUCH AS PRGS, RBCS, DEQLS) FOR GIVEN PARAMETERS, NOTING SPECIFIC SITUATIONS CHOSEN GOALS WERE DEVELOPED FOR (MEDIA, PATHWAYS, ETC.). WHEN PROPERLY DEVELOPED, THIS DISCUSSION WILL ALLOW THE READER TO ACCEPT THE BASIS AND APPLICABILITY, USING INFORMATION IN SECTIONS 1.2 AND 1.3 ABOVE, OF THE PROJECT GROUNDWATER DECISION CRITERIA.]**

Sediment sampling in the lagoon and river will also be conducted according to procedures described in Section X.X of the Field Sampling Plan. Sediment samples will be collected using the ponar grab method. In the wastewater lagoon, five sediment cores will be collected to characterize the vertical extent of contamination from historical deposition. In Phase I, the river sediment samples will only include surface sampling via ponar grabs. Surface water samples will be collected at various points in the river where groundwater springs have been identified, or along runoff pathways from the site. The sediment sampling locations are shown on Figure X.X of the Field Sampling Plan.

A habitat survey of the riparian zone and site study area will be conducted to determine ecologically sensitive areas and confirm the presence or absence of threatened and endangered species identified in the screening ecological risk assessment. A qualified biologist and/or ecologist will walk the site and record their observations. Observations will be made both qualitatively and quantitatively if possible. The macroinvertebrate community in the adjacent river will be sampled to determine species composition and abundance.

The risk assessments shall be prepared according to the following guidance documents:

- *Guidance for Data Useability in Risk Assessment (Part A) Final*, EPA, OERP, 9285.7-09A, April 1992;

- U.S. EPA's *Proposed Guidelines for Ecological Risk Assessment*, 61 Federal Register 47552, September 9, 1996;

- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final*, EPA 540-R-97-006, June 5, 1997; and

- *Ecological Risk Assessment Guidance for RCRA Corrective Action*, U.S. EPA Region 5, Interim Draft, October 1994.

As indicated previously for groundwater, for purposes of performing the risk assessment studies, levels of undetected contaminants shall be assumed to be present at concentrations equal to one-half of the respective measured method detection limits. If the risk assessment results appear favorable, then the need for Phase II may be obviated, and **[FACILITY NAME]** will seek the "No Further Action" alternative through a modification to its RCRA permit.

For metals, in cases where the reporting limit exceeds the health based or ecological based targeted value, statistically valid comparisons will be made to background concentrations in soil and upgradient wells. Background soil samples shall also be taken to assess whether the target decision levels which are health based or ecological based are less than the native soil concentrations.

Field monitoring will also be utilized for purposes of screening for worker health and safety. Furthermore, several measurements shall be performed on groundwater prior to well sampling to determine whether the well water has "stabilized." These types of data include those generated on-site through the use of HNu, pH, conductivity, and other real-time monitoring equipment at the site such as analysis for dissolved oxygen content and turbidity in groundwater samples prior to sampling. The field data requirements are summarized in Table X.X of the Field Sampling Plan. Groundwater may be sampled using the geoprobe without applying well water stability criteria identified in the Field Sampling Plan. However, in the case of geoprobe groundwater sampling, the groundwater field parameters will be determined to assess the condition of groundwater at the time of sampling.

In order to accomplish the primary objectives, a confirmational level of analytical quality is needed. This provides the highest level of data quality and includes, but is not limited to, the purposes of risk assessment, evaluation of remedial alternatives and establishing cleanup levels. These analyses require full documentation of SW-846 analytical methods, sample preparation steps, data packages and data validation procedures necessary to provide defensible data. QC must be sufficient to define the precision and accuracy of these procedures at every step.

If the data generated during Phase I does not support the case for the "No Further Action" alternative, then Phase II data will be collected and analyzed in detailed ecological and human health risk assessments.

1.4.1 Project Target Parameters

This section must provide a thorough rationale for the elimination of any constituents included in Appendix IX. The rationale must address, at a minimum, each type of constituent (i.e, volatile organic compounds (VOCs), herbicides, etc.). In addition, the rationale must include specific references to earlier studies or other sources of information supporting the decision. A matrix or tabular presentation is recommended. See Instructions Section 3.5.

The list of target parameters for this project is limited to analysis of PCBs, lead and other "RCRA metals", as specifically indicated in Tables 1.1 and 1.2 through 1.5 for both field and fixed laboratory determinations, respectively.

1.4.2 Field Parameters

The Field Parameters are listed in Table 1.1. The intended field soil parameters include lead to be measured by x-ray fluorescence and PCBs to be measured by immunoassay. The rationale for choosing these soil parameters is **[PROVIDE RATIONALE, ADDRESSING CHOICE OF PARAMETERS AND SPECIFIC METHOD CAPABILITIES]**. Groundwater field parameters include turbidity, dissolved oxygen, specific conductance, temperature and pH in order to **[PROVIDE RATIONALE AND/OR PURPOSE OF GROUNDWATER PARAMETERS]**.

1.4.3 Laboratory Parameters

The project-specific laboratory parameters are presented in Tables 1.2 through 1.5. The basis for the chosen parameters list is provided in Sections X.X and X.X of the Field Sampling Plan. The rationale for the exclusion of all other RCRA Appendix IX constituents is as follows. **[PROVIDE RATIONALE FOR EACH EXCLUDED APPENDIX IX CONSTITUENT. NOTE THAT RESULTS FOR ALL METHOD TARGET COMPOUNDS SHOULD ORDINARILY BE REPORTED.]**

1.5 Sampling Locations

Maps showing intended soil, sediment and surface water sampling locations are provided on Figures X.X and X.X in the Field Sampling Plan, which is fully incorporated into this QAPP through reference. It is possible, however, that depending on the nature of encountered field conditions, sampling locations may be changed. The person who shall be responsible for making such decisions will be the Site Field Manager whose responsibilities are described in Section 2 of this QAPP. Locations of monitoring and residential wells to be sampled, with associated screen depths, are indicated on Figures X.X and X.X of the Field Sampling Plan. Any changes to this sampling strategy will only be implemented after receipt of approval from the U.S. EPA RCRA Project Manager.

1.5.1 Rationale for Selected Sampling Locations

The rationale for the selected sampling locations (and depths) at each solid waste management unit and area of concern are fully described in Section X.X and Table X.X of the Field Sampling Plan. The statistical arguments supporting the number of samples to be taken for a given matrix (e.g. a total of seven background soil samples shall be taken to fully characterize background conditions with respect to each parameter, at a statistically high level of confidence) are also provided in Section X.X of the Field Sampling Plan.

1.6 Project Schedule

1.6.1 Anticipated Date of Project Mobilization

The earliest date for which samples are planned to be collected is **[DATE]**. However, as indicated in Figure X.X, the Task Bar Chart, some activities, such as installation of monitoring wells, are scheduled to begin **[DATE]**.

1.6.2 Task Bar Chart and Associated Time Frames

The dates of projected milestones are indicated on Figure X.X, the Task Bar Chart.

TABLE 1.1 - FIELD PARAMETERS

Constituents	Human Health Target Decision Level	Reporting Limit	Matrix
Lead	100 ppm	100 ppm	soil
PCBs	2 ppm	2 ppm	soil

Note: The analytical reporting limit is equal to the target decision level.

Table 1.2 - Soil Laboratory Parameters

Constituent	Human Health Target Decision Level	Ecological Target Decision Level	Reporting Limit
PCBs (as aroclors)*	2,000 g/kg	1.58 g/kg**	500 g/kg
Arsenic*	320 g/kg	0.796 g/kg**	100 g/kg
Barium*	5.3×10^6 g/kg	5.62 g/kg**	200 g/kg
Cadmium*	3.8×10^4 g/kg	0.519 g/kg**	10 g/kg
Chromium (total)	2.1×10^5 g/kg	336 g/kg**	100 g/kg
Copper*	2.8×10^6 g/kg	3.73 g/kg**	600 g/kg
Lead*	2.5×10^5 g/kg	0.00862 g/kg**	100 g/kg
Mercury*	23,000 g/kg	1.08 g/kg**	100 g/kg
Nickel*	1.5×10^6 g/kg	50.5 g/kg**	1,500 g/kg

*For these parameters, analytical sensitivity is inadequate to meet target decision level(s). Therefore, for risk assessment purposes, non-detect data shall be considered as equal to one-half the reporting limit.

**These ecological target decision levels are based on masked shrew toxicity.

Table 1.3 - Sediment Laboratory Parameters

Constituent	Human Health Target Decision Level	Ecological Target Decision Level	Reporting Limit
PCBs (as aroclors)*	None applicable	34.1 g/kg	500 g/kg
Arsenic	None applicable	5,900 g/kg	100 g/kg
Barium	None applicable	None applicable	200 g/kg
Cadmium	None applicable	596 g/kg	10 g/kg
Chromium (total)	None applicable	26,000 g/kg	100 g/kg
Copper	None applicable	16,000 g/kg	600 g/kg
Lead	None applicable	31,000 g/kg	100 g/kg
Mercury	None applicable	174 g/kg	100 g/kg
Nickel	None applicable	16,000 g/kg	1,500 g/kg

*For this parameter, analytical sensitivity is inadequate to meet target decision level(s). Therefore, for risk assessment purposes, non-detect data shall be considered as equal to one-half the reporting limit.

Table 1.4 - Groundwater Laboratory Parameters

Constituent	Human Health Target Decision Level	Ecological Target Decision Level	Reporting Limit
PCBs (as aroclors)*	0.0087 g/L	None applicable	5 g/L
Arsenic*	0.038 g/L	None applicable	10 g/L
Barium	2,600 g/L	None applicable	20 g/L
Cadmium	18 g/L	None applicable	1 g/L
Chromium (total)	180 g/L	None applicable	10 g/L
Copper	1,400 g/L	None applicable	60 g/L
Lead*	4 g/L	None applicable	10 g/L
Mercury	11 g/L	None applicable	2 g/L
Nickel	730 g/L	None applicable	50 g/L

*For these parameters, analytical sensitivity is inadequate to meet target decision level(s). Therefore, for risk assessment purposes, non-detect data shall be considered as equal to one-half the reporting limit.

Table 1.5 - Surface Water Laboratory Parameters

Constituent	Human Health Target Decision Level	Ecological Target Decision Level	Reporting Limit
PCBs (as aroclors)*	None applicable	2.9×10^{-5} g/L	5.4 g/L
Arsenic	None applicable	53 g/L	10 g/L
Barium	None applicable	None applicable	20 g/L
Cadmium*	None applicable	0.0216 g/L	1 g/L
Chromium (total)	None applicable	11 g/L	10 g/L
Copper*	None applicable	2.41 g/L	60 g/L
Lead*	None applicable	1.3 g/L	10 g/L
Mercury*	None applicable	9.74×10^{-4} g/L	2 g/L
Nickel	None applicable	36.8 g/L	50 g/L

*For these parameters, analytical sensitivity is inadequate to meet target decision level(s). Therefore, for risk assessment purposes, non-detect data shall be considered as equal to one-half the reporting limit.

ELEMENT 3 CHECKLIST

- **G** Have you determined the purpose of investigation? (Instructions Sections 3.0 and 3.4)
- **G** Have you identified the project-specific objectives? (Instructions Sections 3.0 and 3.4)
- **G** Are the project-specific objectives quantitative? (Instructions Section 3.4)
- **G** Have you provided a thorough site history? (Instructions Section 3.3)
- **G** Have you developed a well-supported Target Parameter List? (Instructions Sections 3.4 and 3.5)
- **G** Have you determined Human Health and Ecological Risk Decision Levels for all Target Parameters? (Instructions Section 3.6)

PROJECT ORGANIZATION AND RESPONSIBILITY

The example language for this element includes a variety of types of individual responsibilities. In writing your QAPP, you should use or modify for use only those portions of the example applicable to your project.

2.0 Project Organization and Responsibility

At the direction of the **[U.S. EPA RCRA PERMIT WRITER/RCRA PROJECT MANAGER(RPM)/STATE PROJECT MANAGER], [CONTRACTOR]** has responsibility for all phases of the investigation. **[CONTRACTOR/FACILITY]** will perform the field investigation, prepare the Report, and perform any subsequent studies. Project management will also be provided by **[CONTRACTOR/FACILITY]**. The various quality assurance, field, laboratory and management responsibilities of key project personnel are defined below.

2.1 Project Organization Chart

It is important to ensure that the titles and responsibilities presented in the text and figure in this element are consistent with those provided in Elements 1, 11, 12 and 15 of the QAPP.

The lines of authority specific to this investigation are presented in Figure 2-1. This chart includes all individuals discussed below.

2.2 Management Responsibilities

U.S. EPA RCRA Permit Writer/RCRA Project Manager/State Project Manager

The **[U.S. EPA RCRA PERMIT WRITER (RPW)/RCRA PROJECT MANAGER (RPM), NAME]** has the overall responsibility for all phases of the investigation. The State Project Manager has overall responsibility for all phases of the investigation with oversight by the U.S. EPA **[RPM/RPW].**

[FACILITY] Project Manager

The **[FACILITY]** project manager is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The **[FACILITY]** project manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. The **[FACILITY]** project manager will report directly to

the **[U.S. EPA REGION 5 RPW/RPM/STATE PROJECT MANAGER]** and will provide the major point of contact and control for matters concerning the project. The **[FACILITY]** project manager will:

- Define project objectives and develop a detailed work plan schedule;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- Orient all field leaders and support staff concerning the project's special considerations;
- Monitor and direct the field leaders;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Approve all reports (deliverables) before their submission to U.S. EPA Region 5;
- Ultimately be responsible for the preparation and quality of interim and final reports; and
- Represent the project team at meetings and public hearings.

[CONTRACTOR] Project Manager

The **[CONTRACTOR]** project manager has responsibility for ensuring that the project meets U.S. EPA's objectives and **[CONTRACTOR]** quality standards. The **[CONTRACTOR]** project manager will provide assistance to the **[FACILITY]** project manager in terms of writing and distributing the QAPP to all those parties connected with the project (including the laboratory). The **[CONTRACTOR]** project manager will report directly to the **[FACILITY]** project manager and is responsible for technical QC and project oversight.

2.3 Quality Assurance Responsibilities

The QA personnel responsibilities discussed in this section must include (but certainly not be limited to) data validation, data assessment and internal performance and system audits. See Instructions Section 4.2.

[FACILITY] QA Manager

The **[FACILITY]** QA manager will remain independent of direct job involvement and day-to-day operations, and have direct access to corporate executive staff as necessary, to resolve any QA dispute. He/she is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations, **[CONTRACTOR'S]** policies, and U.S. EPA requirements. The **[FACILITY]** QA manager has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA/QC issues. Specific functions and duties include:

- Performing QA audits on various phases of the field operations;
- Reviewing and approving QA plans and procedures;
- Providing QA technical assistance to project staff;
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the program manager and executive vice president for technical operations.

[CONTRACTOR] QA Manager

The **[CONTRACTOR]** QA manager reports directly to the **[CONTRACTOR]** project manager and will be responsible for ensuring that all **[CONTRACTOR]** procedures for this project are being followed. In addition, the **[CONTRACTOR]** QA manager will be responsible for the data validation of all sample results from the analytical laboratory.

U.S. EPA RCRA Quality Assurance Coordinator (RQAC)

The U.S. EPA RQAC has the responsibility to review and approve all QAPPs. Additional U.S. EPA responsibilities for the project include:

- Conducting external Performance and System Audits of **[PROJECT LABORATORY]**.
- Evaluating results of performance evaluation sample data.
- Reviewing and evaluating analytical field and laboratory procedures.

2.4 Laboratory Responsibilities

The laboratory tasked with responsibility for analytical work is **[NAME AND ADDRESS].**

[LABORATORY] Project Manager

The **[LABORATORY]** project manager will report directly to the **[CONTRACTOR]** project manager and will be responsible for the following:

- Ensuring all resources of the laboratory are available on an as-required basis.
- Overseeing production and final review of analytical reports.

[LABORATORY] Operations Manager

The **[LABORATORY]** operations manager will report to the **[LABORATORY]** Project Manager and will be responsible for:

- Coordinating laboratory analyses.
- Supervising in-house chain-of-custody.
- Scheduling sample analyses.
- Overseeing data review.
- Overseeing preparation of analytical reports.
- Approving final analytical reports prior to submission to **[CONTRACTOR/FACILITY].**

[LABORATORY] Quality Assurance Officer

The **[LABORATORY]** QA officer has the overall responsibility for data after it leaves the laboratory. The **[LABORATORY]** QA officer will be independent of the laboratory but will communicate data issues through the **[LABORATORY]** project manager. In addition, the **[LABORATORY]** QA officer will:

- Oversee laboratory QA.
- Oversee QA/QC documentation.
- Conduct detailed data review.
- Determine whether to implement laboratory corrective actions, if required.

- Define appropriate laboratory QA procedures.
- Prepare laboratory SOPs.
- Sign the title page of the QAPP.

Final responsibility for project quality rests with **[CONTRACTOR'S]** Project Manager. Independent QA will be provided by the **[LABORATORY]** Project Manager and QA Officer prior to release of all data to **[CONTRACTOR/FACILITY]**.

[LABORATORY] Sample Custodian

The **[LABORATORY]** sample custodian will report to the **[LABORATORY]** operations manager. Responsibilities of the **[LABORATORY]** sample custodian will include:

- Receiving and inspecting the incoming sample containers.
- Recording the condition of the incoming sample containers.
- Signing appropriate documents.
- Verifying chain-of-custody.
- Notifying laboratory manager and laboratory supervisor of sample receipt and inspection.
- Assigning a unique identification number and customer number, and entering each into the sample receiving log.
- With the help of the laboratory manager, initiating transfer of the samples to appropriate lab sections.
- Controlling and monitoring access/storage of samples and extracts.

[LABORATORY] Technical Staff

The **[LABORATORY]** technical staff will be responsible for sample analysis and identification of corrective actions. The staff will report directly to the **[LABORATORY]** operations manager.

2.5 Field Responsibilities

[CONTRACTOR/FACILITY] Field Leader

The **[FACILITY]** project manager will be supported by the **[FACILITY/CONTRACTOr]** field team leader. He/she is responsible for leading and coordinating the day-to-day activities of the various resource specialists under his/her supervision. The **[FACILITY/CONTRACT]** field team leader is a highly experienced environmental professional and will report directly to the **[FACILITY]** project manager. Specific field team leader responsibilities include:

- Provision of day-to-day coordination with the **[FACILITY]** project manager on technical issues in specific areas of expertise;
- Developing and implementing of field-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements;
- Coordinating and managing field staff including sampling and drilling, and supervising field laboratory staff;
- Implementing QC for technical data provided by the field staff including field measurement data;
- Adhering to work schedules provided by the project manager;
- Authoring, writing, and approving of text and graphics required for field team efforts;
- Coordinating and overseeing technical efforts of subcontractors assisting the field team;
- Identifying problems at the field team level, resolving difficulties in consultation with the **[FACILITY]** project manager, implementing and documenting corrective action procedures, and provision of communication between team and upper management; and
- Participating in preparation of the final report.

[LABORATORY] On-Site Laboratory Manager

The on-site laboratory manager is responsible for leading and coordinating the day-to-day laboratory activities. Specific on-site laboratory manager responsibilities include:

- Providing day-to-day coordination with the field team leader on technical issues in specific areas of expertise;

- Implementing QC for analytical data;

- Identifying problems at the laboratory level and discussing and documenting resolutions with the field team leader.

[CONTRACTOR] Field Technical Staff

The technical staff for this project will be drawn from **[CONTRACTOR'S]** pool of corporate resources. The technical staff will be utilized to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

[LABORATORY] On-Site Lab Staff

The on-site laboratory staff will be responsible for maintaining all aspects of the laboratory to meet the requirements outlined in this QAPP. They will also be responsible for notifying the field team leader when nonconformances are noted and in any other instance where corrective action may be warranted.

2.6 Special Training Requirements and Certifications

The purpose of this section is to address any specialized or nonroutine training requirements necessary for completion of the subject investigation. Sufficient information shall be provided to ensure that special training skills can be verified, documented and updated as necessary. See Instructions Section 4.6.

2.6.1 Training

Training for non-standard procedures and/or procedures requiring special expertise, such as performing field XRF screening, should be addressed. Means of demonstrating appropriate training include, but are not limited to, in-house training courses, manufacturer sponsored courses and certifications from organizations such as the National Institute for Certification in Engineering Technologies (NICET).

Requirements for specialized training for nonroutine field sampling techniques, field analyses, laboratory analyses, and data validation are specified below. Training for these activities has already been established and documented for the following individuals. **[PROVIDE LIST]** The list identifies and describes specialized training or certification requirements needed by

personnel to successfully complete the project or task. Training will be provided and scheduled as indicated below to assure that individuals have acquired the necessary skills. Documentation of training will be maintained **[PROVIDE A BRIEF DESCRIPTION OF THE PROCEDURE FOR DOCUMENTING THE REQUIRED SPECIALIZED TRAINING].**

2.6.2 Certification

Certifications required for implementing this plan have already been attained for the following individuals, with respect to certain required tasks. **[PROVIDE LIST.]**

ELEMENT 4 CHECKLIST

- **G** Have facility and contractor management duties been defined and personnel identified? (Instructions Section 4.1)
- **G** Have facility, contractor and laboratory QA duties been defined and personnel identified? (Instructions Section 4.2)
- **G** Have all appropriate field responsibilities been defined and personnel identified? (Instructions Section 4.3)
- **G** Are the titles, names and responsibilities presented here consistent with the titles and names on the Cover/Signature page?
- **G** Are the titles and responsibilities presented here consistent with the information provided for Elements 1, 11, 12 and 15?

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The information provided in this section must be developed in conjunction with the project objectives as described in QAPP Element 3. The QA objectives should ensure that the data obtained is of appropriate quality to support the project objectives. See Instructions Section 5.0.

3.0 Quality Assurance Objectives

The overall QA objective for this project is to develop and implement procedures for field sampling, laboratory analysis, chain-of-custody, and reporting that will provide results which are legally defensible in a court of law. This section will provide in greater detail specific project objectives and intended data usages mentioned in Section 1 of this QAPP. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP.

3.1 Precision

This section must address precision objectives for all field and laboratory parameters. The objectives should be provided in a tabular format. See Instructions Section 5.3.2.

3.1.1 Definition

Precision is a measure of the degree to which two or more measurements are in agreement.

3.1.2 Field Precision Objectives

Field precision is assessed through the collection and measurement of field duplicates at a rate of 1 duplicate per 10 analytical samples. The total number of duplicates for this project is found in Table X.X of the RFI Workplan.

3.1.3 Laboratory Precision Objectives

Precision in the laboratory is assessed through the calculation of relative percent differences (RPD) and relative standard deviations (RSD) for three or more replicate samples. The equations to be used for precision in this project can be found in Section 12 of this QAPP. Precision control limits are provided in Table 3.X **[PROVIDE TABLE IN QAPP WHICH**

SUMMARIZES ALL APPLICABLE PRECISION CONTROL LIMITS FOR EACH PARAMETER AND EACH MATRIX] and also in the applicable SOPs as referenced in Section 7 of this QAPP.

For inorganic analyses, laboratory precision shall be assessed through the analysis of a sample/sample duplicate pair and field duplicate pairs. For organic analyses, laboratory precision shall be assessed through the analysis of matrix spike/matrix spike duplicate (MS/MSD) and field duplicate samples. Note that all parameters of concern listed in Tables 1.2 through 1.5 of this QAPP are included in method spiking solutions for MS and MS/MSD analyses.

3.2 Accuracy

This section must address accuracy objectives for all field and laboratory parameters. The objectives should be provided in a tabular format. See Instructions Section 5.3.2

3.2.1 Definition

Accuracy is the degree of agreement between an observed value and an accepted reference or true value.

3.2.2 Field Accuracy Objectives

Accuracy in the field is assessed through the use of field and trip blanks and through the adherence to all sample handling, preservation and holding times.

3.2.3 Laboratory Accuracy Objectives

Laboratory accuracy is assessed through the analysis of MS/MSD, standard reference materials (SRM), laboratory control samples (LCS) and surrogate compounds, and the determination of percent recoveries. The equation to be used for accuracy in this project can be found in Section 12 of this QAPP. Accuracy control limits are given in Table 3.X **[PROVIDE TABLE IN QAPP WHICH SUMMARIZES ALL APPLICABLE ACCURACY CONTROL LIMITS FOR EACH PARAMETER AND EACH MATRIX]** and also in the applicable SOPs as referenced in Section 7 of this QAPP. Note that all parameters of concern included in Tables 1.2 through 1.5 of this QAPP are included in method spiking solutions for the LCS and MS/MSD samples. Also, in the case of sampling for VOCs in soil, use of the Encore sampler will ensure data tint is both accurate and representative of on-site conditions.

3.3 Completeness

3.3.1 Definition

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

3.3.2 Field Completeness Objectives

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in Section 12 of this QAPP. The field completeness objective for this project will be greater than 90 percent.

3.3.3 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in Section 12 of this QAPP. The laboratory completeness objective for this project, with respect to critical measurement parameters identified in Tables 1.2 through 1.5 of this QAPP, will be greater than 95 percent.

3.4 Representativeness

3.4.1 Definition

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary.

3.4.2 Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the RFI Workplan is followed and that proper sampling techniques are used. In designing the sampling program, media of concern have been specified.

3.4.3 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, meeting sample holding times and analyzing and assessing field duplicate samples. The sampling network was designed to provide data representative of facility conditions. During development of this network, consideration was given to past waste

disposal practices, existing analytical data, physical setting and processes, and constraints inherent to the RCRA program. The rationale of the sampling network is discussed in detail in Section X.X of the RFI Workplan.

3.5 Decision Rules

The decision rules presented in this section of the QAPP must be in agreement with those cited in Section 1, Project Description. The development of well-founded, quantitative decision rules is critical to the preparation of an acceptable QAPP. See Instructions Section 5.1.

3.5.1 Definition

A Decision Rule is a statement which allows for a course of action or non-action to be taken, based on assumptions made to draw out and test its logical or empirical consequences.

3.5.2 Decision Rule Objectives

The decision rule objectives address the following.

- Define statistical parameter(s) characterizing the population (e.g., mean, maximum, percentile) and incorporate the scale of decision-making (e.g., residential lot size). For this project, samples shall be collected discretely without compositing to provide greater indication of locally contaminated zones and hot spots. Given the limited number of samples to be collected in this preliminary phase, this will provide adequate characterization of the site for present project purposes. **[NOTE THAT IN LATTER PHASES OF THE PROJECT, AFTER THE KEY INDICATOR PARAMETER DRIVING CLEANUP IS DETERMINED, OR FOLLOWING EXCAVATION OF CONTAMINATED SOIL, THEN IT MAY BE POSSIBLE TO RELY ON A MEAN RESULT FOUNDED ON A STATISTICALLY VALID SET OF COMPOSITED SAMPLES. IN EARLIER PHASES OF THE INVESTIGATION, USE OF DISCRETE, UNCOMPOSITED SAMPLES WOULD BE MOST APPROPRIATE FOR HOT-SPOT SCREENING OR DETERMINING MAXIMUM LEVELS OF CONTAMINATION IN A GIVEN LOCATION.]**

- Identify action level(s) (e.g., Soil Screening Level; Maximum Contaminant Level for drinking water; Ecological Data Quality Levels (EDQL) or a reference-based standard).

- Develop “if/then” statements defining conditions that would cause the decision maker to choose among alternative actions (e.g., remediation or no remediation).

Decision levels, expressed as human health or ecological target decision levels, for each critical measurement parameter are specified in the Tables 1.1 through 1.5 of this QAPP.

The decision rules for this facility can be stated as follows.

1. If detectable concentrations of Table 1.1 field contaminants are detected at any discrete location or soil depth using field tests, no further sampling shall be performed in the immediate vicinity. In this event, the sampling team will relocate to the next node of the grid (as explained in Section X.X of the Field Sampling Plan). This step shall be performed iteratively until no further concentrations of PCBs or lead are found using the field tests.

2. For fixed laboratory analysis of "RCRA metals" and PCBs, the decision rule associated with this sampling activity is that if any constituents listed in Table 1.2 through 1.5 are identified in discrete soil samples at concentrations exceeding the human health target decision levels indicated in the tables then all collected data will be subjected to a baseline human health risk assessment. If any Table 1.2 through 1.5 constituents are identified at concentrations exceeding the ecological target decision levels indicated in Tables 1.2 through 1.5, all collected data will be subject to a preliminary ecological risk assessment. If the statistically derived soil background levels are determined to be above the target decision levels, then a statistical comparison shall be made to the investigational areas.

   If, on the basis of immunoassay and x-ray fluorescence field screening, no potentially "clean" areas can be determined, samples will be collected for fixed laboratory testing as indicated in Figure X.X of the Field Investigation Plan. These data will be utilized in a baseline human health risk assessment and preliminary ecological risk assessment, unless the facility proposes to implement a voluntary remediation program.

3. In order to determine the existence or extent of a plume with respect to the constituents of site interest, groundwater samples shall first be taken on a quarterly basis from existing upgradient groundwater monitoring wells according to procedures specified in Section X.X of the Field Sampling Plan. Groundwater shall be analyzed at a fixed laboratory, **[LABORATORY NAME]** for parameters identified in Table 1.4.

   The decision rules associated with the groundwater sampling are that if any Table 1.4 constituents are identified above the human health or ecological targeted levels in any monitoring wells in any of the quarterly sampling events, then the data will be used to map the plume boundaries and all generated data will be subjected to a baseline human health risk assessment and preliminary ecological risk assessment. In the case of constituents for which the groundwater reporting limit exceeds the target decision level, statistically valid comparisons shall initially be made to the

upgradient monitoring well data. If no Table 1.4 constituents are detected above the targeted decision levels in any monitoring event and monitoring well data suggests that SWMUs have not contributed contamination, then the baseline human health cumulative risk assessment and preliminary ecological risk assessments shall be performed using one-half the reporting limit values for Table 1.4 constituents for which analytical sensitivity was inadequate (i.e. arsenic, PCBs and lead). If the risks are deemed "not unreasonable" and there is no evidence of soil contamination per procedures described previously, then the facility may qualify for the "No Further Action" alternative as indicated below.

4. The mean concentrations of PCBs and RCRA metals will be used to identify SMWUs with contaminated soils in the facility that pose a health threat.

As more information from the investigation is gathered, the planning team will use the decision rule(s) for this facility to statistically set the acceptable level of confidence in the data or the amount of uncertainty needed to optimize the design of the data collection.

3.6 Comparability

3.6.1 Definition

Comparability is an expression of the confidence with which one data set can be compared to another.

3.6.2 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Field Sampling Plan is followed and that proper sampling techniques are used. **[THE DESIGN OF THE SAMPLING PROGRAM SHOULD ADDRESS THE RATIONALE BEHIND THE SAMPLING TYPE CHOSEN (E.G., SIMPLE RANDOM SAMPLING, COMPOSITE SAMPLING OR SEQUENTIAL SAMPLING).]**

3.6.3 Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented in the QAPP. Comparability is also dependent on similar QA objectives.

3.7 Level of Quality Control Effort

Field blank, trip blank, method blank, field duplicate, laboratory duplicate, laboratory control, standard reference materials (SRM) and matrix spike samples will be analyzed to assess the

quality of the data resulting from the field sampling and analytical programs. **[IT IS STRONGLY RECOMMENDED THAT A TABLE SUMMARIZING THE TYPE AND FREQUENCY OF QC SAMPLES BE PROVIDED WITHIN THE QAPP WHICH ADDRESSES ALL FIELD AND LABORATORY ANALYTICAL PARAMETERS TO BE DETERMINED DURING THE INVESTIGATION.]**

- Field and trip blanks consisting of distilled water will be submitted to the analytical laboratories to provide the means to assess the quality of the data resulting from the field sampling program.

- Field blank samples are analyzed to check for procedural contamination at the facility which may cause sample contamination.

- Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.

- Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures.

- Duplicate samples are analyzed to check for sampling and analytical reproducibility.

- MS/MSDs provide information about the effect of the sample matrix on the digestion and measurement methodology. Depending on site specific circumstances, one MS/MSD should be collected for every 20 or fewer investigative samples of a given matrix. MS/MSD samples are designated/collected for organic analyses only.

[MS/MSD SAMPLES ARE QC SAMPLES. SOIL MS/MSD SAMPLES REQUIRE NO EXTRA VOLUME FOR EXTRACTABLE ORGANICS. HOWEVER, ADDITIONAL SOIL VOLUME IS REQUIRED FOR VOC ANALYSES, AS OUTLINED IN SW-846, METHODS 5021 AND 5035. AQUEOUS MS/MSD SAMPLES MUST BE COLLECTED AT TRIPLE THE VOLUME FOR VOCS AND DOUBLE THE VOLUME FOR EXTRACTABLE ORGANICS.]

U.S. EPA Region 5 requires the collection of one field duplicate and one field blank for every 10 investigative samples of a given matrix.

The general level of the QC effort will be one field duplicate and one field blank for every 10 or fewer investigative samples. One trip blank consisting of distilled deionized ultra pure water will be included along with each shipment of aqueous VOC samples.

The number of duplicate and field blank samples to be collected are listed in Table X.X of the Field Investigation Plan. Sampling procedures are specified in Sections X.X through X.X of the Field Sampling Plan.

ELEMENT 5 CHECKLIST

- **G** Have field precision objectives been appropriately developed? (Instructions Section 5.3.2)
- **G** Have laboratory precision objectives been appropriately developed? (Instructions Section 5.3.2)
- **G** Have field accuracy objectives been appropriately developed? (Instructions Section 5.3.2)
- **G** Have laboratory accuracy objectives been appropriately developed? (Instructions Section 5.3.2)
- **G** Have field completeness objectives been appropriately developed? (Instructions Section 5.3.1)
- **G** Have laboratory completeness objectives been appropriately developed? (Instructions Section 5.3.1)
- **G** Have representativeness objectives been appropriately developed? (Instructions Section 5.3.1)
- **G** Have comparability objectives been appropriately developed? (Instructions Section 5.3.1)
- **G** Are the analytical objectives consistent with the proposed set of decision rules? (Instructions Sections 5.1, 5.2, 5.3.1, and 5.3.2)

SAMPLING PROCEDURES

The following is an example of a sampling procedures section where a Field Sampling Plan (FSP) has been prepared. If a FSP or similar plan has not been prepared, the required information must be stated in this section of the QAPP or an appendix to the QAPP. See Instructions Section 6.1.

4.0 Sampling Procedures

The sampling procedures to be used in this site investigation will be consistent for the objectives of this project. The **[SPECIFIC TITLE OF FIELD INVESTIGATION PLAN ASSOCIATED WITH THE QAPP]** provides the SOPs for all sampling activities to be conducted during this investigation. The SOPs are presented in Section X.X of the **[ASSOCIATED FIELD INVESTIGATION PLAN].**

The specific field SOPs to be used are listed below. **[PROVIDE A TABULAR LISTING OF ALL SOPS, BY NUMBER, THE FIELD ACTIVITY ADDRESSED IN THE SOP, AND A PAGE-SPECIFIC REFERENCE TO THE LOCATION OF THE SOP IN THE ASSOCIATED FIELD INVESTIGATION PLAN.]**

Examples of the type of procedures for which SOPs should be provided are listed below. Only those procedures specifically applicable to the subject field investigation should be included. The examples below are not meant to be an all-inclusive list. The requirements of a given field investigation must be carefully evaluated against the RCRA QAPP Instructions to fully determine all necessary SOPs. See Instructions Section 6.1.

- Groundwater Sampling Procedures
- Groundwater Monitoring Well Installation
- Well Drilling Methods
- Direct-Push Methods
- Groundwater Sampling Equipment
- Field Analytical Procedures
- Groundwater Sampling Procedures for Existing Wells
- Groundwater Sampling Procedures for Temporary Sampling Points
- Groundwater Sampling Order
- Obtaining Contaminant-Free Sample Containers
- QC Sample Collection Procedures
- Sampling Equipment Decontamination
- Investigation-derived Waste Management
- Soil Sample Field Screening Procedures Using Immunoassay Test Kits

- Discrete Soil Sampling Equipment
- Field Procedures
- Surficial Soil Sampling Procedures
- Subsoil Sampling Procedures
- Confirmatory Sampling Procedures For Laboratory Analysis
- Soil Sampling Order
- Establishing a grid based sampling network (required for soil, sediment, or waste sampling)

ELEMENT 6 CHECKLIST

G Have all field sampling procedures been identified and appropriate SOPs provided? (Instructions Sections 6.1 and 6.2)

G Have all field analytical procedures been identified and appropriate SOPs provided? (Instructions Sections 6.1 and 6.2)

G Have all ancillary field procedures (sample containers, decontamination, etc.) been identified and appropriate SOPs provided? (Instructions Section 6.1)

G Have all SOPs been prepared according to *Guidelines for the Preparation of Standard Operating Procedures (SOPs) of Field and Laboratory Measurements*? (Instructions Appendix M)

CUSTODY PROCEDURES

Portions of the text below may be generally applicable to the custody requirements of most investigations. While in most cases, it may be useful as presented, all text must be carefully reviewed for any investigation-specific modifications required prior to inclusion in a QAPP. See Instructions Section 7.0.

5.0 Custody Procedures

Custody is one of several factors which are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including originals of all laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under your custody if:

- the item is in actual possession of a person.
- the item is in the view of the person after being in actual possession of the person.
- the item was in actual physical possession but is locked up to prevent tampering.
- the item is in a designated and identified secure area.

5.1 FIELD CUSTODY PROCEDURES

Field logbooks will provide the means of recording data collecting activities performed during the investigation. As such, entries will be described in as much detail as possible so that persons going to the facility could reconstruct a particular situation without reliance on memory.

Field log books will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned.
- Logbook number.
- Project name.

- Project start date.

- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection equipment being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed, and dated and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark which is signed and dated by the sampler. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station, which includes compass and distance measurements, or, latitude and longitude information (e.g., obtained by using a global positioning system) shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in Section 4.0 of this QAPP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample numbering and other sample designations are included in Section X.X of this QAPP. Examples of field custody documents and instructions for completion are presented in Appendix X.X of this QAPP.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. Field procedures have been designed such that as few people as possible will handle the samples.

Sample tags MUST be used for all samples for which chain-of-custody is to be maintained. See Instructions Section 7.1 and Appendix O.

- All bottles will be identified by the use of sample tags with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented in Section X.X of this QAPP.

- Sample tags will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather.

See Instructions Appendix N for example chain-of-custody sequence.

- Samples will be accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

- Samples will be properly packaged on ice at 4 C for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by the field team leader. The cooler will be strapped shut with strapping tape in at least two locations.

Whenever split samples are collocated with a government agency, a separate sample receipt will be prepared for those samples and marked to indicate with whom the samples are being collocated. The person relinquishing the samples to the facility or agency should request the following:

- The representative's signature acknowledging sample receipt. If the representative is unavailable or refuses to sign, this is noted in the "Received By" space.

- All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment, and the pink and yellow copies will be retained by the sampler for returning to the sampling office.

- If the samples are sent by common carrier, a bill of lading will be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.

- Samples will be transported to the laboratory the same day the samples are collected in the field by overnight carrier.

5.2 LABORATORY CUSTODY PROCEDURES

Laboratory custody procedures for sample receiving and log-in; sample storage and numbering; tracking during sample preparation and analysis; and storage of data are described in SOP No. XX-XX, provided in Appendix X of this QAPP. Examples of laboratory chain-of-custody traffic reports along with instructions for completion are included in Appendix X of this QAPP. **[THE USE OF AN EXISTING LABORATORY SOP IS ACCEPTABLE HERE. ALTERNATIVELY, THE LABORATORY CHAIN-OF-CUSTODY PROCEDURES CAN BE DESCRIBED IN THIS ELEMENT OF THE QAPP.]**

5.3 FINAL EVIDENCE FILES

The final evidence file will be the central repository for all documents which constitute evidence relevant to sampling and analysis activities as described in this QAPP. **[CONTRACTOR]** is the custodian of the evidence file and maintains the contents of evidence files for the investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited access area and under custody of the **[CONTRACTOR]** facility manager.

The final evidence file will include at a minimum:

- Field logbooks.
- Field data and data deliverables.
- Photographs.
- Drawings.
- Soil boring logs.
- Laboratory data deliverables.
- Data validation reports.
- Data assessment reports.
- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (tags, forms, air bills, etc.)

ELEMENT 7 CHECKLIST

G Have all field custody procedures been developed and described? (Instructions Section 7.1)

G Has an SOP describing the laboratory custody procedures been provided? (Instructions Section 7.2)

G Has the use of sample tags been included in the QAPP? (Instructions Section 7.1 and Appendix O)

G Have the contents of the final evidence file been provided in the QAPP? (Instructions Section 7.3)

G Have example chain-of-custody forms been developed and included? (Instructions Section 7.1 and Appendix N)

CALIBRATION PROCEDURES AND FREQUENCY

Calibration procedures are required for all field analytical equipment and laboratory equipment. Field and laboratory SOPs developed according to *Guidelines for the Preparation of Standard Operating Procedures (SOPs) of Field and Laboratory Measurements* (Instructions Appendix M) will contain a section presenting the required calibration information. See Instructions Section 8.0.

6.0 Calibration Procedures and Frequency

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

6.1 Field Instrument Calibration

It must be remembered that the example provided below is simply that - an example. The material provided does not apply to all field investigations and should only be included in those cases where it is applicable. Calibration procedures must be provided for all field equipment to be used in the subject investigation. See Instructions Section 8.1 and Appendix R.

The field instruments will be calibrated as described in field SOPs presented in **[CITE EITHER THE FIELD INVESTIGATION PLAN OR QAPP APPENDIX WHERE THE FIELD SOPS ARE PRESENTED]**. Field instruments include the XRF for the determination of lead, **[LIST ALL FIELD INSTRUMENTATION TO BE USED IN THE SUBJECT INVESTIGATION, INCLUDING BUT NOT LIMITED TO THERMOMETERS, NEPHELOMETERS, CONDUCTIVITY METERS, FIELD GC SYSTEMS, ORGANIC VAPOR ANALYZERS (OVAS), OR ORGANIC VAPOR PHOTOIONIZATION DETECTORS (PIDS).]** As a rule, instruments will be calibrated daily prior to use and will be recalibrated every **[NUMBER]** samples. For specific instructions on the calibration frequency, the acceptance criteria and the conditions that will require more frequent recalibration, refer to the specific SOPs for each field analysis as list in Section 4.0 of this QAPP.

The linearity of the instruments will be checked by using a 2-point calibration with reference standards bracketing the expected measurement. All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, temperature at which readings were taken and the readings. Multiple readings on one sample or standard, as well as readings on replicate samples, will likewise be documented.

[THE SOPS FOR FIELD MEASUREMENTS SHOULD BE REFERENCED. FIELD INSTRUMENTS MAY VARY BY MANUFACTURER IN WHICH CASE THE INSTRUCTION OR OPERATING MANUAL

SHOULD SERVE AS A GUIDE IN PREPARING SOPS. HOWEVER, NOTE THAT AN INSTRUCTIONS MANUAL IS NOT A SUBSTITUTE FOR AN SOP.]

6.2 Laboratory Instrument Calibration

Calibration procedures for a specific laboratory instrument will consist of initial calibrations (3 or 5-points), initial calibration verifications and continuing calibration verification. For a description of the calibration procedures for a specific laboratory instrument, refer to Section X.X.X of the applicable SOPs in Appendix X of this QAPP. The SOP for each analysis performed in the laboratory describes the calibration procedures, their frequency, acceptance criteria and the conditions that will require recalibration. In all cases, the initial calibration will be verified using an independently prepared calibration verification solution.

The laboratory maintains a sample logbook for each instrument which will contain the following information: instrument identification, serial number, date of calibration, analyst, calibration solutions run and the samples associated with these calibrations.

ELEMENT 8 CHECKLIST

G Have all field instruments been identified and calibration procedures, preferably as SOPs, developed? (Instructions Section 8.1 and Appendices J, M and R)

G Have all laboratory instruments been identified and calibration procedures in the form of laboratory-specific SOPs been developed? (Instructions Section 8.2 and Appendices J and M)

G Have all required initial, verification and continuing calibrations been included in the SOPs? (Instructions Section 8.2 and Appendices J and M)

ANALYTICAL PROCEDURES

STOP! Before preparing this section of the QAPP, a specific laboratory must be identified to ensure that the project objectives can be met. In addition, see Section 9 and Appendices B, E, F, G, H, I, J and M of the Region 5 QAPP Instructions.

7.0 Analytical Procedures

Groundwater, surface water, soil and sediment samples collected during field sampling activities for the **[FACILITY]** investigation will be analyzed by the **[LABORATORY NAME, ADDRESS AND TELEPHONE NUMBER]**. **[ALL LABORATORIES TO BE USED FOR THE INVESTIGATION, REGARDLESS OF THE NUMBER OF SAMPLES OR ANALYTICAL PARAMETERS, MUST BE IDENTIFIED HERE.]**

7.1 Field Analytical Procedures

The procedures for field analytical determinations using XRF and immunoassay techniques for metals and PCBs respectively are provided in the SOPs provided in **[REFERENCE EITHER THE ASSOCIATED FIELD INVESTIGATION PLAN OR AN APPENDIX TO THE QAPP WHICH INCLUDES FULLY DEVELOPED SOPS FOR EACH FIELD ANALYTICAL PROCEDURE]** and included in Table 7.X below. The standardization and QA criteria for these parameters are provided in Table 3.X of this QAPP. **[REFERENCE THE APPROPRIATE TABLE IN ELEMENT 5 OF THE QAPP WHERE SPECIFIC QA/QC CRITERIA ARE PROVIDED FOR EACH FIELD ANALYTICAL PROCEDURE TO BE USED IN THE INVESTIGATION.]**

7.2 Laboratory Analytical Procedures

Any deviation from the SOP must be explained and justified in this section. It must be specified whether the deviation to the SOP is only temporary for the purpose of this investigation. Otherwise, if the deviation is permanent, then the SOP will have to be revised and resubmitted to U.S. EPA. See Instructions Sections 9.3 and 9.5.

The laboratory(ies) named above will implement the project required SOPs. These laboratory SOPs for sample preparation, cleanup and analysis are based on SW-846 Revision **[REVISION NUMBER AND DATE]** and **[OTHER U.S. EPA METHODS, SUCH AS 600 SERIES OR 500 SERIES METHODS]**. These SOPs provide sufficient details and are specific to this investigation.

For confirmatory analysis of **[COMPOUNDS OF INTEREST],** SOP number **[LABORATORY SOP NUMBER]** based on **[SW-846 METHOD NUMBER]** will be performed.

The documentation of appropriate method validation for the project target compounds is submitted in Appendix X of this QAPP. It includes the criteria for acceptance, rejection or qualification of data.

Tables 7.1 and 7.2 summarize the analyte groups of interest, appropriate laboratory SOP numbers and U.S. EPA reference method for the organic and inorganic analytes, respectively, to be evaluated in this investigation. The **[LABORATORY]** SOPs to be used in this investigation are included in Appendix X of this QAPP.

A table summarizing the SOP numbers, specific location of the SOP within an attachment to the QAPP, the analyte group and the U.S. EPA method on which the SOP is based must be provided for all sample preparation, clean-up, digestion, and determinative methods to be used in the investigation. See Instructions Sections 9.2, 9.3, 9.4 and 9.5.

7.2.1 List of Project Target Compounds and Laboratory Detection Limits

If the required information has already been provided (usually in Element 3 or 5) it should not be repeated here. A specific reference to the table is sufficient.

A complete listing of project target compounds, project quantitation limits, and current laboratory determined detection limits for each analyte group listed in Table X.X can be found in Section X of this QAPP. Method detection limits (MDLs) shown have been experimentally determined using the method found in FR vol. 49, no. 209, page 198-199.

7.2.2 List of Associated Quality Control Samples

The laboratory SOPs listed in Table 7.X above include a QC section which addresses the minimum QC requirements for the analysis of specific analyte groups. Since **[ANALYTE 1, ANALYTE 2, ETC.]** have been found in a **[PREVIOUS INVESTIGATION TYPE]** at **[CONCENTRATIONS]**, these compounds will be added to the spiking solution, in compliance with project requirements. Section X of this QAPP contains a complete listing of the associated QC samples for every analyte group and matrix.

The following tables are examples only and do not bear any relation to the tables presented in Section 1. The SOPs are examples of a naming convention which includes the basis for the SOP.

TABLE 7.1
SUMMARY OF ORGANIC ANALYTICAL PROCEDURES

Analyte Group*	Lab. SOP No.	Equivalent EPA Method Number[a]
Matrix: Water		
Volatile Organics	SOP.01B8260/86 (Analysis)	8260
Semivolatiles	SOP.02B3510/86 (Sample Prep)	3510
	SOP.03B3640/86 (Cleanup/GPC)	3640
	SOP.04B8270/86 (Analysis)	8270
Matrix: Soil		
Pesticides/PCBs	SOP.05B3540/86 (Sample Prep/Soxhlet)	3540
	SOP.06B3640/86 (Cleanup/GPC)	3640
	SOP.07B3620/86 (Cleanup/Florisil)	3620
	SOP.08B3660/86 (Cleanup/Sulfur**)	3660
	SOP.09B8080/86 (Analysis***)	8080
Volatile Organics	SOP.01B8260/97 (Extraction/ Analysis)	5035/8260

* See 7.2.1 for compounds in each analyte group.
** Sulfur cleanup will be done using mercury.
*** Pesticide/PCB analysis using dual, dissimilar megabore columns.
[a]SW-846, Third Edition.

TABLE 7.2

SUMMARY OF INORGANIC ANALYTICAL PROCEDURES

Analyte*	Lab. SOP No.	Equivalent EPA Method Number[a]
Matrix: Water		
Arsenic	SOP.01B3020/86 (Digestion) SOP.01B7060/86 (Analysis)	3020 7060
Antimony	SOP.02B3005/86 (Digestion) SOP.03B7041/86 (Analysis)	3005 7041
Lead	SOP.04B3010/86 (Digestion) SOP.05B6010/88 (Analysis)	3010 6010
Sulfide	SOP.06B9030/88 (Analysis)	9030
Matrix: Soil		
Arsenic	SOP.01B3050/86 (Digestion) SOP.01B7060/86 (Analysis)	3050 7060
Antimony	SOP.02B3050/86 (Digestion) SOP.03B7041/86 (Analysis)	3050 7041
Lead	SOP.04B3050/86 (Digestion) SOP.05B6010/88 (Analysis)	3050 6010
Sulfide	SOP.06B9030/88 (Analysis)	9030

* See 7.2.1 for compounds in each analyte group.
[a]SW-846, Third Edition.

ELEMENT 9 CHECKLIST

G Have all field analytical procedures been identified and SOPs developed? (Instructions Section 9.3 and Appendices M and R)

G Have all laboratory analytical procedures been identified and laboratory-specific SOPs been developed? (Instructions Section 9.1 through 9.6 and Appendix M)

G Have the special issues associated with soil/sediment VOC sampling been addressed? (Instructions Section 9.7)

G Have the special issues associated with metals analysis of groundwater samples been addressed? (Instructions Section 9.8)

G Have the appropriate number and type of QC samples for each field and laboratory analytical parameter been determined? (Instructions Section 9.9)

INTERNAL QUALITY CONTROL CHECKS

QC checks are required for all field analytical equipment and laboratory equipment. Field and laboratory SOPs developed according to *Guidelines for the Preparation of Standard Operating Procedures (SOPs) of Field and Laboratory Measurements* (Instructions Appendices M and R) will address the required information. See Instructions Section 10.0.

8.0 Internal Quality Control Checks

8.1 Field Quality Control Checks

QC procedures for XRF determination of metals and immunoassay determination of PCBs will include calibrations as described in Section 6.0 of the QAPP, measuring duplicate samples and checking the reproducibility of the measurements by taking multiple readings on a single sample or reference standard. The QC criteria for each field measurement are provided in Table 3.X of this QAPP. Assessment of field sampling precision and bias will be made by collecting field duplicates and field blanks for laboratory analysis. Collection of the samples will be in accordance with the applicable SOPs in **[REFERENCE THE FIELD INVESTIGATION PLAN HERE]** as referenced in Section 4.X at the frequency indicated in Table 3.X of this QAPP.

8.2 Laboratory Quality Control Checks

The laboratory identified in Section 7 of this QAPP has a QC program in place to ensure the reliability and validity of the analysis performed at the laboratory. All analytical procedures are documented in writing as SOPs and each SOP includes a QC section which addresses the minimum QC requirements for the procedure. The internal QC checks differ slightly for each individual procedure but in general the QC requirements include the following: **[TABULATE THE SOURCE OF THE RELEVANT INFORMATION IN EACH SOP FOR ALL QC CHECKS INDICATED BELOW.]**

- Method blanks
- Reagent/preparation blanks (applicable to inorganic analysis)
- Instrument blanks
- MS/MSDs
- Surrogate spikes
- Analytical spikes (Graphite furnace)
- Laboratory duplicates
- Laboratory control standards
- Internal standard areas for GC/MS analysis
- Mass tuning for GC/MS analysis
- Endrin/DDT degradation checks for GC/EC analysis
- Second, dissimilar column confirmation for GC/EC analysis

All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC criteria. Any samples analyzed in nonconformance with the QC criteria will be reanalyzed by the laboratory, if sufficient volume is available. It is expected that sufficient volumes/weights of samples will be collected to allow for reanalysis when necessary.

ELEMENT 10 CHECKLIST

G Have all field analytical procedure internal QC checks been developed and included in the appropriate SOPs? (Instructions Section 10.1 and Appendices M and R)

G Have all laboratory analytical procedure internal QC checks been developed and included in the appropriate SOPs? (Instructions Section 10.2 and Appendix M)

G Have the appropriate number and type of QC samples for each field and laboratory analytical parameter been determined?

DATA REDUCTION, VALIDATION, AND REPORTING

All data must be evaluated according to the procedures presented in this element prior to use for decision making purposes based on the project objectives developed in Element 3. Therefore, these procedures must be specifically developed to ensure that the project-specific QC objectives presented in Element 5 are met prior to use of the data. See Instructions Section 11.0.

9.0 Data Reduction, Validation and Reporting

All data generated through field activities, or by the laboratory operation shall be reduced and validated prior to reporting. No data shall be disseminated by the laboratory until it has been subjected to these procedures which are summarized in subsections below.

9.1 Data Reduction

9.1.1 Field Data Reduction Procedures

Field data reduction procedures for the XRF determination of metals and immunoassay determination of PCBs in the field are provided in Section X.X.X of the associated SOPs presented in Appendix X of the **[FIELD INVESTIGATION PLAN]**. All field data will be written into field log books immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. Later, when the results calculation forms required for this study are being filled out, the Field Manager, identified in Section 2 of this QAPP, will review the forms to determine whether any errors have been made by the field crew.

9.1.2 Laboratory Data Reduction Procedures

Laboratory data reduction procedures will be performed according to the following protocol. All raw analytical data will be recorded in numerically identified laboratory notebooks. These notebooks will be issued only by the Laboratory QA Manager. Data are recorded in this notebook along with other pertinent information, such as the sample identification number and the sample tag number. Other details will also be recorded in the lab notebook, such as the analytical method used (SOP#), name of analyst, the date of analysis, matrix sampled, reagent concentrations, instrument settings, and the raw data. Each page of the notebook shall be signed and dated by the analyst. Copies of any strip chart printouts (such as gas chromatograms) will be maintained on file. Periodic review of these notebooks by the Lab QA Manager takes place prior to final data reporting. (Records of notebook entry inspections are maintained by the Lab QA Manager.)

For this project, the equations that will be employed in reducing data are presented in Section X.X.X of the associated SOPs identified in Table 7.X of this QAPP. The formulae included in the SOPs make pertinent allowances for matrix type. All calculations are checked by the Laboratory QA Manager at the conclusion of each operating day. Errors are noted, corrections are made, but the original notations are crossed out legibly. Analytical results for soil samples shall be calculated and reported on a dry weight basis.

QC data (e.g. laboratory duplicates, surrogates, MS/MSDs) will be compared to the method acceptance criteria. Data considered to be acceptable will be entered into the laboratory computer system. Data summaries will be sent to the Laboratory QA Manager for review. If approved, data are logged into the project database format. Unacceptable data shall be appropriately qualified in the project report. Case narratives will be prepared which will include information concerning data that fell outside acceptance limits, and any other anomalous conditions encountered during sample analysis. After the Laboratory QA Manager approves these data, they are considered ready for third party data validation.

9.2 Data Validation

One hundred percent of all critical analytical data generated should be validated unless a very strong rationale, consistent with the nature of project objectives presented in Element 3, can be provided. See Instructions Section 11.2.2.

Data validation procedures shall be performed for both field and laboratory operations as described below.

9.2.1 Procedures Used to Validate Field Data

Procedures to validate field data for this project are provided in the project-specific validation protocols provided in Appendix X of this QAPP. Validation of the analytical data obtained in the field will be performed by **[DATA VALIDATION CONTRACTOR]** under the supervision of the **[CONTRACTOR]** QA officer. One hundred percent of the field analytical data will be validated. **[FOR INVESTIGATIONS WHICH INVOLVE MINIMAL FIELD ANALYTICAL ACTIVITIES LIMITED TO RECORDING OF RESULTS FROM DIRECT READ INSTRUMENTATION, THE FOLLOWING EXAMPLE LANGUAGE SHOULD PROVIDE A TEMPLATE FOR DEVELOPING APPROPRIATE INVESTIGATION-SPECIFIC PROCEDURES.]** The procedures to evaluate field data for this investigation include checking for transcription errors and review of field log books, on the part of field crew members. This task will be the responsibility of the Field Manager, who will otherwise not participate in making any of the field measurements, or in adding notes, data or other information to the log book.

9.2.2 Procedures Used to Validate Laboratory Data

The CLP National Functional Guidelines directly apply only to analyses performed according to the CLP SOWs. For all other analyses, project-specific data validation protocols should be developed based on project-specific QC objectives presented in Element 5 and using the Functional Guidelines as a framework when appropriate. See Instructions Section 11.2.2.

Procedures to validate laboratory data will be derived from the U.S. EPA's *Contract Laboratory Program, National Functional Guidelines For Organic Data Review*, and *Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review*. The project-specific data validation protocols are presented in Appendix X of this QAPP. Essentially, all technical holding times shall be reviewed, instrument performance check sample results shall be evaluated, results of initial and continuing calibration will be reviewed and evaluated by trained reviewers independent of the laboratory. **[THE ROLE OF THE DATA VALIDATORS IS INDICATED IN THE PROJECT ORGANIZATION (SECTION 2) OF THIS QAPP.]** Also, results of all blanks, surrogate spikes, MS/MSDs, laboratory control samples, and target compound identification and quantitation will be reviewed/evaluated by the Data Validator. One hundred percent of the analytical data shall be validated.

Additionally, a method detection limit study will be performed, at the request of the U.S. EPA, per the provisions of Federal Register, Vol. 49, no. 209, October 26, 1984, pp.198-199. The results shall also be validated.

The overall completeness of the data package will also be evaluated by the Data Validator. Completeness checks will be administered on all data to determine whether deliverables specified in the QAPP are present. At a minimum, deliverables will include sample chain-of-custody forms, analytical results, QC summaries, and supporting raw data from instrument printouts. The reviewer will determine whether all required items are present and request copies of missing deliverables.

9.3 Data Reporting

At least one complete hard copy of each analytical data package must be obtained by the facility from the laboratory. This data package must be sufficiently detailed to allow for full validation of the data. See Instructions Section 11.2.3.

Data reporting procedures shall be carried out for field and laboratory operations as indicated below.

9.3.1 Field Data Reporting

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field, and documentation of all field calibration activities.

9.3.2 Laboratory Data Reporting

The task of reporting laboratory data (to the U.S. EPA) begins after the independent validation activity has been concluded. The **[CONTRACTOR]** QA Manager must perform a final review of the report summaries and case narratives to determine whether the report meets project requirements. In addition to the record of chain-of-custody, the report format shall consist of the following:

1. Case Narrative:
   - i. Date of issuance
   - ii. Laboratory analysis performed
   - iii. Any deviations from intended analytical strategy
   - iv. Laboratory batch number
   - v. Numbers of samples and respective matrices
   - vi. QC procedures utilized and also references to the acceptance criteria
   - vii. Laboratory report contents
   - viii. Project name and number
   - ix. Condition of samples 'as-received'
   - x. Discussion of whether or not sample holding times were met
   - xi. Discussion of technical problems or other observations which may have created analytical difficulties
   - xii. Discussion of any laboratory QC checks which failed to meet project criteria
   - xiii. Signature of the Laboratory QA Manager

2. Chemistry Data Package
   - i. Case narrative for each analyzed batch of samples
   - ii. Summary page indicating dates of analyses for samples and laboratory QC checks
   - iii. Cross referencing of laboratory sample to project sample identification numbers
   - iv. Description of data qualifiers to be used
   - v. Sample preparation and analyses for samples
   - vi. Sample results
   - vii. Raw data for sample results and laboratory QC samples
   - viii. Results of (dated) initial and continuing calibration checks, and GC/MS tuning results

ix. MS/MSD recoveries, laboratory control samples, method blank results, calibration check compounds, and system performance check compound results

x. Labeled (and dated) chromatograms/spectra of sample results and laboratory QC checks

xi. Results of tentatively identified compounds

The data package submitted will be a "CLP-like" data package consisting of all the information presented in a CLP data package (but without the CLP forms).

9.4 Data Acquisition Requirements and Data Quality Management

[PROVIDE PROCEDURES TO BE FOLLOWED TO MAINTAIN ADEQUATE DATA ACQUISITION AND AN APPROPRIATE LEVEL OF DATA MANAGEMENT AS OUTLINED IN THE INSTRUCTIONS SECTION 11.2.4 AND 11.2.5.]

ELEMENT 11 CHECKLIST

G Have data reduction and validation protocols been developed for all project field analytical activities? (Instructions Section 11.1)

G Have data reduction and validation protocols been developed for all project laboratory analytical activities which take into account the project-specific QC objectives presented in Element 5? (Instructions Section 11.2)

G Has a procedure been developed which allows for 100% validation of the critical analytical results by a party independent of the field samplers, laboratory and facility? (Instructions Section 11.2.2)

G Have arrangements been made by the facility to obtain hard copies of complete data packages for all laboratory analytical results? (Instructions Section 11.2.3)

PERFORMANCE AND SYSTEM AUDITS

Limited portions of the text below may be generally applicable to the audit requirements of some investigations. While in most cases it can be used as presented, all text must be carefully reviewed for any investigation-specific modifications required prior to inclusion in a QAPP. See Instructions Section 12.0.

10.0 Performance and System Audits and Frequency

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and QAPP. The audits of field and laboratory activities include two independent parts: internal and external audits.

10.1 Field Performance and System Audits

10.1.1 Internal Field Audits

10.1.1.1 Internal Field Audit Responsibilities

Internal audits of field activities including sampling, and field measurements will be conducted by the **[CONTRACTOR]** QA Officer. These audits will verify that all established procedures are being followed.

10.1.1.2 Internal Field Audit Frequency

Internal field audits will be conducted at least once at the beginning of the site sample collection activities. **[IF THE PROJECT DURATION IS LONG (E.G., GREATER THAN ONE YEAR), A PERIODIC FREQUENCY SHOULD BE STATED (E.G., SEMI-ANNUALLY).]**

10.1.1.3 Internal Field Audit Procedures

The audits will include examination of field sampling records, field screening analytical results, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain-of-custody, etc. Follow-up audits will be conducted to correct deficiencies, and to verify that QA procedures are maintained throughout the investigation. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation. The field audit checklist to be used for this project is provided as Figure 10.X of this QAPP.

10.1.2 External Field Audits

10.1.2.1 External Field Audit Responsibilities

External field audits may be conducted by the U.S. EPA RCRA Permit Writer/Project Manager.

10.1.2.2 External Field Audit Frequency

External field audits may be conducted any time during the field operations. These audits may or may not be announced and are at the discretion of U.S. EPA.

10.1.2.3 External Field Audit Process

External field audits will be conducted according to the field activity information presented in the QAPP. The external field audit process can include (but not be limited to): sampling equipment decontamination procedures, sample bottle preparation procedures, sampling procedures, examination of field sampling and safety plans, sample vessel cleanliness and QA procedures, procedures for verification of field duplicates, sample preservation and preparation for shipment, as well as field screening practices.

10.2 Laboratory Performance and Systems Audits

10.2.1 Internal Laboratory Audits

10.2.1.1 Internal Laboratory Audit Responsibilities

The internal laboratory audit will be conducted by the **[CONTRACTOR]** QA Officer.

10.2.1.2 Internal Laboratory Audit Frequency

The internal system audits will be done on an annual basis while the internal performance audits will be conducted on a quarterly basis.

10.2.1.3 Internal Laboratory Audit Procedures

The internal system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, instrument operating records, etc.

The performance audits will involve preparing blind QC samples and submitting them along with project samples to the laboratory for analysis throughout the project. The

[CONTRACTOR] QA Officer will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance. The laboratory audit checklist is included in this QAPP as Figure 10.X.

10.2.2 External Laboratory Audits

10.2.2.1 External Laboratory Audit Responsibilities

An external audit will be conducted as required, by appropriate QA staff of the Waste, Pesticides and Toxics Division, U.S. EPA Region 5.

10.2.2.2 External Laboratory Audit Frequency

An external audit will be conducted at least once prior to the initiation of the sampling and analysis activities. These audits may or may not be announced and are at the discretion of the U.S. EPA.

10.2.2.3 Overview of the External Laboratory Audit Process

External audits may include any or all of: review of laboratory analytical procedures, laboratory on-site visits, and/or submission of performance evaluation samples to the laboratory for analysis. Failure of any or all audit procedures chosen can lead to laboratory disqualification, and the requirement that another suitable laboratory be chosen.

An external on-site review can consist of: sample receipt procedures, custody and sample security and log in procedures, sample through put tracking procedure, review of instrument calibration records, instrument logs and statistics (number and type), review of QA procedures, log books, sample prep procedures, sample analytical SOP review, instrument (normal or extends quantitation report) reviews, personnel interviews, review of deadlines and glassware prep, and a close out to offer potential corrective action.

It is common practice when conducting an external laboratory audit to review one or more data packages from sample lots recently analyzed by the laboratory. This review will most likely include but not be limited to;

- Comparison of resulting data to the SOP or method, including coding for deviations.
- Verification of initial and continuing calibrations within control limits.
- Verification of surrogate recoveries and instrument timing results where applicable.
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable.

- Recoveries on control standard runs.
- Review of run logs with run times, ensuring proper order of runs.
- Review of spike recoveries/QC sample data.
- Review of suspected manually integrated GC data and its cause (where applicable).
- Review of GC peak resolution for isolated compounds as compared to reference spectra (where applicable).
- Assurance that samples are run within holding times.

Ideally, the data should be reviewed while on the premises, so that any data called into question can be discussed with the staff.

ELEMENT 12 CHECKLIST

G Have appropriate internal field audit procedures been developed and included in the QAPP? (Instructions Section 12.1)

G Have the frequency of field audits and responsible personnel responsible for conducting the audits been determined and presented? (Instructions Section 12.1)

G Have appropriate internal laboratory audit procedures been developed and included in the QAPP? (Instructions Sections 12.2)

G Have the frequency of laboratory audits and personnel responsible for conducting the audits been determined and presented? (Instructions Section 12.2)

G Has the information presented in this element been compared to Element 4 to ensure consistency in titles and responsibilities?

PREVENTATIVE MAINTENANCE

11.0 Preventative Maintenance

Additional guidance on developing this element can be found in Instructions Appendices K and L, Example Preventative Maintenance for Laboratories and Example Preventative Maintenance for Field Instrumentation, respectively. See Instructions Section 13.0.

11.1 Field Instrument Preventative Maintenance

The field equipment for this project includes an XRF field screening system and immunoassay test kits. Specific preventative maintenance procedures to be followed for field equipment are based on those recommended by the manufacturer. Field instruments will be checked and calibrated daily before use. Calibration checks will be documented on the Field Calibration log sheets (as indicated on Table 11.X of this QAPP). The maintenance schedule and trouble-shooting procedures for field instruments are indicated in Table 11.X as well. Critical spare parts such as tape and batteries will be kept on-site to reduce potential downtime. Backup instruments and equipment will be available on-site or within 1-day shipment to avoid delays in the field schedule.

11.2 Laboratory Instrument Preventative Maintenance

As part of the QA Program Plan, a routine preventative maintenance program is conducted by **[LABORATORY NAME]** to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees regularly perform routine scheduled maintenance and repair of [or coordinate with the vendor for the repair of] all instruments. All maintenance that is performed is documented in the laboratory's operating record. All laboratory instruments are maintained in accordance with manufacturer's specifications. Table 11.X provides the frequency with which components of key analytical instruments or equipment will be serviced.

11.3 Inspection/Acceptance Requirements for Supplies and Consumables

For this project, critical supplies will be tracked through **[CONTRACTOR'S]** management system in the following manner. **[PROVIDE TABLE OR OTHER SUMMARY INFORMATION. AN EXAMPLE FORMAT IS PROVIDED BELOW.]**

Critical Supplies and Consumables	Inspection/ Acceptance Testing Requirements	Acceptance Criteria	Testing method	Frequency	Responsible Individual	Handling/ Storage Conditions

Labels indicating the following information on receipt and testing are to be used for critical supplies and consumables.

- Unique identification number (if not clearly shown).
- Date received.
- Date opened.
- Date tested (if performed).
- Date to be retested (if applicable).
- Expiration date.

ELEMENT 13 CHECKLIST

- **G** Have preventative maintenance procedures been developed for all field instrumentation? (Instructions Section 13.1 and Appendix L)

- **G** Have preventative maintenance procedures been developed for all laboratory instrumentation? (Instructions Section 13.2 and Appendix K)

- **G** Has a procedure been developed and presented in the QAPP for the inspection and acceptance of supplies and consumables? (Instructions Section 13.3)

SPECIFIC ROUTINE PROCEDURES USED TO EVALUATE DATA PRECISION, ACCURACY AND COMPLETENESS

This Element must address the procedures and equations to be used to determine accuracy, precision and completeness in order to determine if the project objectives have been met through the assessment of QC data in relation to the QA objectives. See Instructions Section 14.

12.0 Specific Routine Procedures Used to Evaluate Data Precision, Accuracy and Completeness

The purpose of this section is to indicate the methods by which it will be ensured that the data collected for this investigation falls in line with the data quality objectives (DQOs) for the site.

Factors considered in this assessment include, but are not limited to:

- The risk assessment parameters chosen based on conditions and possible receptors involved in a project (i.e. ecological data quality levels, human health data quality levels, soil screening guidance, and the like).

- The contaminants known and/or suspected to be of concern on a project, as they relate to the data quality level parameters chosen.

- The choice of analytical and sample preparation methods for contaminants of concern, whose method detection limits will meet or exceed the data quality level concentrations for those contaminants.

Once these goals and objectives are evaluated and chosen, analytical data quality will be assessed to determine if the objectives have been met. In addition, the data will be reviewed for indications of interferences to results caused by sample matrices, cross contamination during sampling, cross contamination in the laboratory, and sample preservation and storage anomalies (i.e. samples holding time or analytical instrument problems).

12.1 Accuracy Assessment

In order to assure the accuracy of the analytical procedures, an environmental sample shall be spiked with a known amount of the analytes included in Tables 1.2 through 1.5. At a minimum, one sample spike should be included in every set of 20 samples tested on each instrument, for each sample matrix to be tested (i.e., soil, sediment, groundwater and surface water). The increase in concentration of the analyte observed in the spiked sample, due to the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the unspiked sample determines the percent recovery.

Accuracy is similarly assessed by determining percent recoveries for surrogate compounds added to each field and QC sample to be analyzed for PCBs. Accuracy for the metals analysis will also be further assessed through determination of percent recoveries for laboratory control samples, (as well as MS samples).

Percent recovery for MS/MSD results is determined according to the following equation:

$$\%\ R = \frac{\text{(Amount in Spiked Sample - Amount in Sample)}}{\text{Known amount added}} \times 100$$

Percent recovery for LCS and surrogate compound results is determined according to the following equation:

$$\%\ R = \frac{\text{Experimental Concentration}}{\text{Known amount added}} \times 100$$

12.2 Precision Assessment

The relative percent difference (RPD) between the spike and matrix spike, or matrix spike and sample duplicate in the case of metals, and field duplicate pair or laboratory duplicate pair is calculated to compare to precision DQOs and plotted. The RPD is calculated according to the following formula.

$$RPD = \frac{\text{(Amount in Sample 1 - Amount in Sample 2)}}{0.5\text{(Amount is Sample 1 + Amount in Sample 2)}} \times 100$$

12.3 Completeness Assessment

Completeness is the ratio of the number of valid sample results to the total number of samples analyzed with a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\textbf{Completeness} = \frac{\textbf{(number of valid measurements)}}{\textbf{(number of measurements planned)}} \textbf{ X 100}$$

[NOTE, IT IS IMPERATIVE THAT 95% OF EXPLOSIVES DATA AND ASSOCIATED QC DATA BE VALID IN ENTRY LEVEL AND FINAL DAY COMPOSITE SAMPLES CONFIRMED BY THE PROPOSED LABORATORY FOR EACH INDIVIDUAL COMPOSITE PILE.]

12.4 Assessment of Data

The assessment of the data obtained from the investigation is a critical part of determining what the next step in the RCRA Corrective Action process should be. It must be determined if the data are of the appropriate quality, quantity and representativeness to support the project objectives. The affect of the loss of data deemed unacceptable for use, for whatever reason, on the project objectives must be discussed.

The field and laboratory data collected during this investigation will be used to evaluate the nature and extent of contamination at the site. The QC results associated with each analytical parameter for each matrix will be compared to the objectives presented in Sections 3.X, 3.X and 3.X of this QAPP. Only data generated in association with QC results meeting these objectives will be considered useable for decision making purposes.

In addition, the data obtained will be both qualitatively and quantitatively assessed on a project-wide, matrix-specific, parameter-specific and unit-specific basis. This assessment will be performed by the **[FACILITY]** QA Manager and the results presented and discussed in detail in the final investigation report. Factors to be considered in this assessment of field and laboratory data will include, but not necessarily be limited to, the following.

- Were all samples obtained using the methodologies and SOPs proposed in the QAPP?
- Were all proposed analyses performed according to the SOPs provided in the QAPP?
- Were samples obtained from all proposed sampling locations and depths?
- Do any analytical results exhibit elevated detection limits due to matrix interferences or contaminants present at high concentrations?
- Were any analytes not expected to be present at the facility, or a given unit, identified as either target parameters or Tentatively Identified Compounds (TICs)?
- Were all field and laboratory data validated according to the validation protocols, including project-specific QC objectives, proposed in the QAPP?
- Which data sets were found to be unusable (qualified as “R”) based on the data validation results?
- Which data sets were found to be usable for limited purposes (qualified as “J”) based on the data validation results?

- What affect do qualifiers applied as a result of data validation have on the ability to implement the project decision rules?

- Has sufficient data of appropriate quality been generated to support a human health and/or ecological screening risk assessment?

- Were the human health and/or ecological screening risk assessments conducted properly?

- Can valid conclusions be drawn for all matrices at each unit and/or area under investigation?

- Were all issues requiring corrective action, as presented in the monthly QA Reports to management fully resolved?

- Were the project-specific decision rules used as proposed during the actual investigation?

- For any cases where the proposed procedures and/or requirements have not been met, has the affect of these issues on the project objectives been evaluated?

- Have any remaining data gaps been identified and summarized in the final investigation report?

- Based on the overall findings of the investigation and this assessment, were the original project objectives appropriately defined? If not, have revised project objectives been developed?

[IF STATISTICAL ANALYSIS OF RESULTS IS REQUIRED TO SUPPORT THE PROJECT AND QA OBJECTIVES IDENTIFIED IN SECTIONS 1 AND 3 RESPECTIVELY, THE STRATEGY FOR THE ASSESSMENT MUST BE PROVIDED HERE. SUFFICIENT INFORMATION TO DEMONSTRATE THE APPROPRIATENESS AND VALIDITY OF THE STATISTICAL ASSESSMENT, INCLUDING REFERENCES AS NECESSARY, MUST BE PROVIDED.]

The planned number of background samples, by media, are listed in Table X.X and were determined using the guidance document *Soil Sampling Quality Assurance User's Guide* (EPA 600/8-89/046, March 1989). The following assumptions have been made:

[FACILITY SPECIFIC ASSUMPTIONS, TESTS AND PROTOCOLS SHOULD BE PROVIDED AS APPROPRIATE. SUPPORTING RATIONALES SHOULD ALSO BE INCLUDED.]

ELEMENT 14 CHECKLIST

- **G** Has the procedure for assessing accuracy been appropriately developed? (Instructions Section 14.1)
- **G** Has the procedure for assessing precision been appropriately developed? (Instructions Section 14.2)
- **G** Has the procedure for assessing completeness been appropriately developed? (Instructions Section 14.3)
- **G** Has a detailed plan for an assessment of the project data been developed? (Instructions Section 14.4)
- **G** Have all required statistical assessment strategies been developed and supported? (Instructions Section 14.4)

CORRECTIVE ACTION

Portions of the text below may be generally applicable to the corrective action requirements of many investigations. While in some cases it can be used as presented, all text must be carefully reviewed for any investigation-specific modifications required prior to inclusion in a QAPP. See Instructions Section 15.0.

13.0 Corrective Action

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out of QC performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All corrective action proposed and implemented should be documented in the regular QA reports to management. Corrective action should only be implemented after approval by the **[FACILITY]** project manager, or his designee. If immediate corrective action is required, approvals secured by telephone from the **[FACILITY]** project manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the **[FACILITY]** project manager, who in turn will notify the U.S. EPA RCRA Permit Writer/Project Manager. If the problem is analytical in nature, information on these problems will be promptly communicated to the **[U.S. EPA RCRA PERMIT WRITER/PROJECT MANAGER.]** Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established QC procedures in the QAPP or Field Sampling Plan will be identified and corrected in accordance with the QAPP. The **[FACILITY]** project manager, or his designee, will issue a nonconformance report for each nonconformance condition. **[IF THE ACTIVITY IS BEING PERFORMED IN ACCORDANCE WITH A LEGAL AGREEMENT, THIS, AS WELL AS ANY OTHER SECTIONS OF THE QAPP, MUST COMPLY WITH THE LEGAL AGREEMENT.]**

Ensure that all personnel and responsibilities identified in this element are consistent with the information provided in Element 4!

13.1 Field Corrective Action

Corrective action in the field may be needed when the sample network is changed (i.e. more/less samples, sampling locations other than those specified in the QAPP, etc.), sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. In

general, the field team (technician, **[FACILITY]** project manager, and **[FACILITY]** QA officer) may identify the need for corrective action. The field staff in consultation with the field team leader will recommend a corrective action. The **[FACILITY]** project manager will approve the corrective measure which will be implemented by the field team. It will be the responsibility of the **[FACILITY]** project manager to ensure the corrective action has been implemented.

If the corrective action will supplement the existing sampling plan (i.e., additional soil borings) using existing and approved procedures in the QAPP, corrective action approved by the **[FACILITY]** project manager will be documented. If corrective actions result in less samples (or analytical fractions), alternate locations, etc., which may cause project QA objectives not to be achieved, it will be necessary that all levels of project management, including the **[U.S. EPA RCRA PERMIT WRITER/PROJECT MANAGER]**, concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The **[FACILITY]** QA officer will identify deficiencies and recommend corrective action to the **[FACILITY]** project manager. Implementation of corrective actions will be performed by the **[FACILITY]** field operations manager and field team. Corrective action will be documented in QA reports to the entire project management.

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the U.S. EPA RCRA Permit Writer/Project Manager.

If at any time a corrective action issue is identified which directly impacts project DQOs, the U.S. EPA RCRA Permit Writer/Project Manager and/or the U.S. EPA RCRA Enforcement/Permitting QA Coordinator will be notified immediately.

13.2 Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, potentially high concentration samples may be identified during sample log-in or just prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the **[LABORATORY]** QC manager to approve the implementation of corrective action. The SOPs included in Appendix X of this QAPP specify some conditions during or after analysis that may automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, automatic reinjection/reanalysis when certain QC criteria are not met, etc. A summary of method-specific corrective actions are found in Section X.X.X of the SOPs in Appendix X.

The bench chemist will identify the need for corrective action. The **[LABORATORY]** manager, in consultation with the staff, will approve the required corrective action to be implemented by the laboratory staff. The **[LABORATORY]** QA manager will ensure implementation and documentation of the corrective action. If the nonconformance causes project objectives not to be achieved, it will be necessary to inform all levels of project management, including the U.S. EPA RCRA Permit Writer/Project Manager, to concur with the corrective action.

These corrective actions are performed prior to release of the data from the laboratory. The corrective action will be documented in both the **[LABORATORY]**'s corrective action log (signed by analyst, section leader and QC coordinator), and the narrative data report sent from the laboratory to the **[CONTRACTOR]** data validator. If corrective action does not rectify the situation, the laboratory will contact the **[FACILITY]** project manager.

13.3 Corrective Action During Data Validation and Data Assessment

The facility may identify the need for corrective action during either the data validation or data assessment. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded, etc.). If the **[CONTRACTOR]** data assessor identifies a corrective action situation, it is the **[FACILITY]** project manager who will be responsible for approving the implementation of corrective action, including resampling, during data assessment. All corrective actions of this type will be documented by the **[FACILITY]** QA manager.

ELEMENT 15 CHECKLIST

- **G** Have the procedures to be used to ensure that corrective actions are carried out as required to meet the QC objectives of the investigation been developed? (Instructions Section 15.0)

- **G** Is it clearly indicated in the QAPP that U.S. EPA will be immediately notified of any issues which could affect project DQOs? (Instructions Section 15.0)

QUALITY ASSURANCE REPORTS TO MANAGEMENT

Portions of the text below may be generally applicable to the QA reporting requirements of many investigations. While in some cases it can be used as presented, all text must be carefully reviewed for any investigation-specific modifications required prior to inclusion in a QAPP. See Instructions Section 16.0

14.0 Quality Assurance Reports to Management

The deliverables associated with the tasks identified in the Work Plan and monthly progress reports will contain separate QA sections in which data quality information collected during the task is summarized. Those reports will be the responsibility of the **[FACILITY]** project manager and will include the **[FACILITY]** QA officer report on the accuracy, precision, and completeness of the data, as well as the results of the performance and system audits, and any corrective action needed or taken during the project.

14.1 Contents of Project QA Reports

The QA reports will contain on a routine basis, all results of field and laboratory audits, all information generated during the past month reflecting on the achievement of specific DQOs, and a summary of corrective action that was implemented, and its immediate results on the project. The status of the project with respect to the Project Schedule included in the QAPP will be determined. Whenever necessary, updates on training provided, changes in key personnel, anticipated problems in the field or laboratory for the coming month that could bear on data quality along with proposed solutions, will be reported. Detailed references to QAPP modifications will also be highlighted. All QA reports will be prepared in written, final format by the **[FACILITY]** project manager or his designee. To the extent possible, assessment of the project should also be performed on the basis of available QC data and overall results in relation to originally targeted objectives.

In the event of an emergency, or in case it is essential to implement corrective action immediately, QA reports can be made by telephone to the appropriate individuals, as identified in the Project Organization and Corrective Action sections of this QAPP. However, these events, and their resolution will be addressed thoroughly in the next issue of the monthly QA report.

14.2 Frequency of QA Reports

The QA Reports must be generated and submitted, at a minimum, on a monthly basis until reporting requirements of the investigation have been completed. See Instructions Section 16.0.

The QA Reports will be prepared on a monthly basis and will be delivered to all recipients by the end of the first full week of the month. The reports will continue without interruption, until the project has been completed. The frequency of any emergency reports that must be delivered verbally cannot be estimated at the present time.

14.3 Individuals Receiving/Reviewing QA Reports

All individuals identified in the Project Organization chart will receive copies of the monthly QA Report.

ELEMENT 16 CHECKLIST

- **G** Have the minimum content requirements for the QA reports to management been determined and included in the QAPP? (Instructions Section 16.0)

- **G** Is it clearly indicated in the QAPP that QA reports will be submitted to, at a minimum, all individuals listed on the project organization chart on a monthly basis? (Instructions Section 16.0)