APPENDIX G

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN
OU-3 BIOSPARGE REMEDY

HOOKER/RUCO SITE
HICKSVILLE, NEW YORK

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1.0 INTRODUCTION

The Quality Assurance Project Plan (QAPP) defines all quality assurance/quality control (QA/QC) procedures which will be used during collection and analysis of samples in support of the performance monitoring of the biosparge remedy to be constructed for Operable Unit-3 (OU-3) at the Hooker Chemicals/Ruco Polymer Superfund Site (Hooker/Ruco Site) located in Hicksville, New York. The QAPP has been prepared following specifications and definitions described in "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations", EPA QA/R-5, October 1997; "Region II CERCLA Quality Assurance Manual", Revision 1, EPA Region II, October 1989; and "Guidelines for the Data Quality Objectives Process", EPA QA/G-4, EPA/600/R-96/055, September 1994.

2.0 PROJECT DESCRIPTION

As detailed in the report entitled "Off-Site Groundwater Predesign Information Report" submitted to the United States Environmental Protection Agency (USEPA) on November 22, 2002, as revised by the responses submitted March 27, 2003 to USEPA comments, and USEPA comments received June 25, 2003, the biosparge remedy will involve the collection and chemical analysis of groundwater, liquid supplements, and soil vapor samples to monitor the performance of the OU-3 biosparge remedy.

The Data Quality Objectives (DQOs) are to obtain data of acceptable quality for use in meeting the overall project objectives. The quality of the data will be determined based on the results of various quality control measurements described in these protocols. Data will be usable if the quality control requirements outlined herein are met.

Any deviations to the QAPP protocols must be approved by the Project QA Officer and the Project Manager. The USEPA program QA/QC representative will be notified of any such changes.

The objective of this QAPP is to provide sufficiently thorough and concise descriptions of the measures to be applied during this program such that the data generated will be of a known and acceptable level of precision and accuracy. The QAPP has been prepared to identify procedures for sample preparation and handling, sample Chain of Custody, laboratory analyses, and data reporting to be implemented during this investigation to ensure the accuracy and integrity of the data generated.

3.0 PROJECT MANAGEMENT

Monitoring activities will be conducted by Conestoga-Rovers & Associates (CRA) and various subcontractors. The project management structure for QA/QC activities associated with the program is discussed below, along with a brief description of the duties of the key personnel.

Project Manager - Steve Whyte – Miller Springs Remediation Management, Inc. (MSRMI)

- provides overall project management
- ensures professional services provided are cost effective and of the highest quality
- ensures all necessary resources are available on an as-required basis
- participates in key technical negotiations with the agencies involved
- provides managerial and technical guidance to the Project Coordinator

Project Coordinator – Jim Kay - CRA

- provides day-to-day project management
- provides managerial guidance to the project technical group
- provides technical representation at meetings as appropriate
- acts as liaison between the technical group and the client
- acts as liaison with the agencies involved
- prepares and reviews reports
- conducts preliminary chemical data interpretation

QA/QC Officer - Analytical Activities –Denise R. Anderson - CRA

- overviews and reviews laboratory activities
- determines laboratory data corrective action
- performs analytical data validation and assessment
- reviews laboratory QA/QC
- assists in preparation and review of final report
- provides technical representation for analytical activities

QA/QC Officer - Field Activities

- provides immediate supervision of all on-site activities
- provides field management of sample collection and field QA/QC

- assists in preparation and review of final report
- provides technical representation for field activities
- is responsible for maintenance of the field equipment
- the individual designated to be Site Coordinator will be specified prior to commencement of field activities

Laboratory Project Manager - Analytical Contractor

- ensures resources of laboratory are available on an as-required basis
- coordinates laboratory analyses
- supervises laboratory's in-house Chain of Custody
- schedules analyses of samples
- oversees review of data
- oversees preparation of analytical reports
- approves final analytical reports prior to submission to the client

Laboratory QA/QC- Analytical Contractor

- overviews laboratory QA/QC
- overviews QA/QC documentation
- conducts detailed data review
- decides laboratory corrective actions, if required
- provides technical representation for laboratory QA/QC procedures

Laboratory Sample Custodian - Analytical Contractor

- receives and inspects the sample containers
- records the condition of the sample containers
- signs appropriate documents
- verifies Chains of Custody and their correctness
- notifies laboratory project manager and laboratory QA Officer of sample receipt and inspection
- assigns a unique laboratory identification number correlated to the field sample identification number, and enters each into the sample receiving log

- initiates transfer of the samples to the appropriate lab sections with assistance from the laboratory project manager
- controls and monitors access to and storage of samples and extracts

Primary responsibility for data quality rests with the QA Officers. Ultimate responsibility for project quality rests with MSRMI's Project Manager. Independent quality assurance will be provided by the laboratory's Project Manager and QA Officer prior to release of the data to CRA.

The analytical laboratory chosen to perform the analyses will be certified by the New York State Department of Health (NYSDOH) through the environmental laboratory approval program for the appropriate Contract Laboratory Program (CLP) categories of analysis. The name of the analytical laboratory and the laboratory QA/QC manual will be submitted to USEPA for review and approval prior to sample collection.

4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for sample collection and analyses which will provide data with an acceptable level of accuracy and precision.

The purpose of this Section is to define the QA goals required to meet the DQOs of the project. QA goals for accuracy, precision and sensitivity of analyses; and completeness, representativeness, and comparability of measurement data are established in the following sections. The sampling and analysis program is summarized in Table 1.

4.1 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSES

The fundamental QA objective with respect to the accuracy, precision and sensitivity of analytical data is to meet the QC acceptance criteria of each analytical protocol. The following analytical methods and targeted detection limits have been specified to meet the analytical objectives of the biosparge remedy program:

i) groundwater samples will be collected from monitoring wells and analyzed for volatiles (including TICs), total organic carbon (TOC), nitrate/nitrite (as N), and phosphorus as specified in Table 1. VOC TICs will be analyzed and reported for the groundwater samples collected from the first sampling event of each new well installed and the next sampling event from any existing well. If TICs are present in a well, TICs will continue to be analyzed/reported for the subsequent samples from such well until they are no longer present. For wells in which no TICs are present, no future analysis/reporting will be performed;

ii) groundwater samples will be collected from monitoring wells and analyzed for microbial counts by CRA's in-house laboratory as specified in Table 1;

iii) groundwater samples will be collected from monitoring wells and analyzed in the field for dissolved oxygen, oxidation/reduction (redox) reaction potential (Eh), pH, temperature, conductivity, and ferrous iron (Fe^{+2});

iv) soil vapor from monitoring wells will be analyzed for volatile organic compounds (VOCs) and methane as shown in Table 1;

v) soil vapor from monitoring wells will be monitored using a photoionization detector (PID) meter. If elevated PID readings are obtained, additional samples will be collected for VOCs and methane; and

vi) liquid supplement samples will be collected from the supplemental tank and analyzed for TOC, N, and P.

Analytical methods are listed in Table 2 and targeted quantitation limits are listed in Table 3. To meet these limits for laboratory analyses, the analytical laboratory's calibration curve must include a calibration standard at the targeted quantitation levels specified in Table 3.

The method accuracy (percent recovery) for water samples analyzed in the laboratory will be determined by spiking selected samples (matrix spikes) with representative spiking compounds as specified in the analytical methods. Accuracy will be reported as the percent recovery of the spiking compound(s) and will be compared to the criteria specified in the appropriate methods. If the analytical methods used do not specify acceptance criteria for spike recoveries, laboratory-generated limits will be used. If laboratory-generated limits are not available, control limits of 75 to 125 percent will be used to assess the recoveries.

The method(s) precision (reproducibility between duplicate analyses) will be determined based on the analysis of field duplicate samples, the duplicate analysis of matrix spike samples for organic parameters and duplicate sample analyses for inorganic parameters. Precision will be reported as relative percent differences (RPDs) between duplicate analyses; acceptance criteria will be as specified in the appropriate analytical methods. If the analytical methods used do not specify acceptance criteria for duplicate results, laboratory-generated limits will be used. If laboratory-generated limits are not available, a control limit of 25 percent will be used to assess the RPDs.

4.2 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

A completeness requirement of 90 percent will be targeted for the biosparge remedy program (see Section 13.1.3 for a definition of completeness).

The quantity of samples to be collected has been determined in an effort to effectively represent the population being studied.

Analytical methods selected for this study are consistent with those used for previous studies (if applicable) to assure comparability of the data. All standards used by the laboratory will be traceable to reliable sources and will be checked with an independent standard.

4.3 FIELD MEASUREMENTS

Measurement data will be generated during field activities. These activities include, but are not limited to, the following:

i) pH measurement;

ii) specific conductivity measurement;

iii) temperature measurement;

iv) oxidation/reduction reaction potential measurement;

v) dissolved oxygen measurement;

vii) ferrous iron (Fe^{+2}) measurement;

viii) well depth measurement;

ix) verifying well development and pre-sampling purge volumes; and

x) measuring groundwater elevations in wells.

These parameters will be measured using standardized operating procedures as specified in the document entitled "Predesign Work Plan for Operable Unit-1, Revision 2 (PDWP-Rev. 2)". The general QA objective for measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the use of standardized procedures.

5.0 SAMPLING PROCEDURES

All sampling activities will be performed in accordance with the protocols specified in the PDWP-Rev. 2 and the USEPA Region II Ground Water Sampling Procedure-Low Stress (Low Flow) Purging and Sampling protocol (see Attachment G1). The protocols for sample collection through reporting have been selected to meet the project objectives. Phthalate-free gloves will be worn by field personnel during sampling activities.

Sampling equipment will be decontaminated as specified in the PDWP-Rev. 2. Required sample containers, sample preservation methods, maximum holding times, and filling instructions are summarized in Table 2. Sample containers will be purchased from a USEPA-certified manufacturer and will be prepared in accordance with OSWER Directive #9240.0-05A, Specifications and Guidance for Contaminant-Free Sample Containers.

6.0 SAMPLE CUSTODY AND DOCUMENT CONTROL

The following documentation procedures will be used during sampling and analysis to provide Chain of Custody control during transfer of samples from collection through storage. Recordkeeping documentation will include use of the following:

i) field log books (bound with numbered pages) to document sampling activities in the field;

ii) labels to identify individual samples;

iii) Chain of Custody record sheets to document sample IDs and analyses to be performed;

iv) laboratory sample custody log books; and

v) evidentiary files.

6.1 FIELD LOG BOOK

Log books will be used in the field to record information. The field log book will be bound and the information will be entered in indelible ink. Each field log book page will be signed by the sampler. Field measurements and observations will assist in the interpretation of analytical results obtained and it is important that these measurements and observations be as complete as possible.

For each sample collected, the following shall be recorded in indelible ink in the field log book if applicable:

i) Site location identification;

ii) depth interval of sample;

iii) unique sample identification number;

iv) date and time (in 2400 hour time format) of sample collection;

v) weather conditions;

vi) designation as to the type of sample (groundwater, soil, sediment, etc.);

vii) designation as to the means of collection (split spoon, etc.);

viii) brief description of the sample;

ix) name of sampler;

x) analyses to be performed on sample;

xi) departure from established QA/QC field procedures;

xii) instrument problems; and

xiii) any other relevant comments such as odor, staining, texture, size of area sampled, etc.

6.2 SAMPLE LABELS

Sample labels are necessary to identify and prevent misidentification of the samples The labels shall be affixed to the sample container (not the caps) prior to the time of sampling. The labels shall be filled out in waterproof ink at the time of collection. The labels will include the following information:

i) sample number/identification code;

ii) name of collector;

iii) date and time of collection;

iv) client and geographic location;

v) project number;

vi) required analysis; and

vii) type of preservation.

A unique sample numbering system will be used to identify each collected sample. This system will provide a tracking number to allow retrieval and cross-referencing of sample information. The sample numbering system to be used is described as follows:

Example:	G-041693 - AA-XXX
where:	G - Designates sample type
	(G - Groundwater, S - Surface Water)
041693	date of collection (mm,dd,yy)
AA	sampler initials
xxx	unique sample number

Field duplicate samples are to be "blind" to the laboratory and will be identified with sample IDs similar to the investigative samples.

6.3 FIELD INSTRUMENT CALIBRATION AND USE LOGS

Standardized instrument calibration records for each field instrument will be maintained during all sampling activities to demonstrate properly functioning equipment. Included in the log will be documentation of time of instrument use, operator, and any maintenance performed.

6.4 CHAIN OF CUSTODY RECORDS

Chain of Custody forms will be completed for all samples collected during the program. Chain of Custody forms will be completed to document the transfer of sample containers (see Attachment G.2).

The Chain of Custody record, completed at the time of sampling, will contain, but not be limited to, the sample number, date and time of sampling, and the name of the sampler. The Chain of Custody document will be signed, timed, and dated by the sampler when transferring the samples.

The Chain of Custody form will consist of four copies which will be distributed to the shipper, the receiving laboratory, and two copies to CRA. The shipper will keep one copy while the other three copies will be enclosed in a waterproof envelope within the cooler with the samples. The laboratory, upon receiving the samples, will complete the three remaining copies. The laboratory will maintain one copy for their records; one copy will be returned to CRA upon receipt of the samples by the laboratory; one copy will be submitted to the client with the data deliverables package.

6.5 SAMPLE SHIPMENT

Sample bottles will be sealed with custody tape, wrapped with bubble wrap and packed carefully in coolers with adequate bubble wrap to prevent sample breakage. The samples will be refrigerated using wet ice immediately after collection and will be maintained at 4°C (±2°C) during transport and storage. Custody seals will be placed around each cooler and the coolers will be sealed with packing tape for shipment to the analytical laboratory typically within 24 hours of collection by either commercial courier or Contractor personnel.

6.6 LABORATORY SAMPLE CUSTODY LOG BOOKS

Upon receipt at the laboratory, the shipping cooler and the custody seal will be inspected by the designated sample custodian. The condition of the cooler and the custody seal will be noted on the Chain of Custody record sheet by the sample custodian.

The sample custodian will record the temperature of one sample (or temperature blank) from each cooler and the temperature will be noted on the Chain of Custody. If the shipping cooler seal is intact, the sample containers will be accepted for analyses. The sample custodian will document the date and time of receipt of the container, and sign the form.

If damage or discrepancies are noticed (including sample temperature exceedances), they will be recorded in the remarks column of the record sheet, dated and signed. Any damage or discrepancies will be reported to the lab supervisor who will inform the lab manager and the project QA Officer before samples are processed.

6.7 EVIDENTIARY FILES

The laboratory will be responsible for maintaining analytical log books and laboratory data as well as a sample (on hand) inventory for submittal to CRA on an "as required" basis. Raw laboratory data produced from the analysis of samples submitted for this program will be inventoried and maintained by the laboratory for a period of 5 years at which time CRA will advise the laboratory regarding the need for additional storage.

Evidentiary files for the entire project shall be inventoried and maintained by CRA and shall consist of the following:

i) project related plans;

ii) project log books;

iii) field data records;

iv) sample identification documents;

v) Chain of Custody records;

vi) report notes, calculations, etc.;

vii) lab data, etc.;

viii) references, copies of pertinent literature; and

ix) miscellaneous - photos, maps, drawings, etc.; and

x) copies of all final reports pertaining to the project.

The evidentiary file materials shall be the responsibility of the project manager with respect to maintenance and document removal.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

7.1 INSTRUMENT CALIBRATION AND TUNING

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The frequency of calibration and the concentration of calibration standards is determined by the manufacturer's guidelines, the analytical method, or the requirements of special contracts.

A bound notebook will be kept with each instrument requiring calibration in which will be recorded activities associated with QA monitoring (e.g., QC outliers warranting corrective action and/or instrument maintenance) and repairs program. These records will be checked during periodic equipment review and internal and external QA/QC audits.

7.1.1 GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

It is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria prior to initiating any ongoing data collection. This is accomplished through the analyses of tuning compounds as specified in the analytical methods.

Calibration of the GC/MS system will be performed daily at the beginning of the day or with each 12 hours of instrument operating time. The calibration information is generally compiled by computer and printed out as standard forms.

All method-specified calibration criteria must be met prior to sample analyses. All calibrations must be performed using either average response factors or first-order linear regression (with a correlation coefficient requirement of 0.995). Higher order fits will not be allowed.

Quantification of samples that are analyzed by GC/MS will be performed by internal standard calibration. For quantitation, the nearest internal standard free of interferences must be used.

7.1.2 INSTRUMENTATION FOR INORGANIC ANALYSES

All method-specified calibration procedures will be performed and acceptance criteria will be met prior to sample analyses. Standard curves derived from data consisting of one reagent blank and a minimum of three concentrations (one reagent blank and one concentration for inductively coupled plasma [ICP]) will be prepared for each inorganic analyte. Instrument calibrations will be documented on either standardized forms or in bound logbooks. Calibrations will be performed using either average response factors, or first-order linear regression (with a correlation coefficient requirement of 0.995). Higher order fits will not be allowed unless the laboratory can demonstrate that the instrument is working properly, and that the instrument response over the concentration range of interest is second-order.

The standard curve will be used with each subsequent analysis provided the standard curve is verified by using at least one reagent blank and one standard at a level normally encountered or expected in such samples. If the results of the verification are not within ±10 percent of the original curve, a new standard will be prepared and analyzed. If the results of the second verification are not within ±10 percent of the original standard curve, a reference standard will be used to determine if the discrepancy is with the standard or with the instrument.

New standards will also be prepared on a quarterly basis at a minimum. All data used in drawing or describing the curve will be so indicated on the curve or its description. A record will be made of the verification.

7.1.3 FIELD INSTRUMENTATION

Field equipment used during this investigation will be calibrated both prior to and following the day's surveys in accordance with the manufacturer's instructions. The equipment will also be operated in accordance with the manufacturer's instructions. Records of calibrations of field equipment will be recorded in a bound field notebook.

Instrumentation for temperature, pH turbidity, and specific conductance will be calibrated as follows:

i) the pH meter will be checked against two known standard pH buffers (7 and 10) before and after each day's use;

ii) temperature measurements will be made with a digital Celsius thermometer. The thermometer will be checked periodically against a precision thermometer certified by the National Institute of Standards and Technology; and

iii) conductivity readings will be made with a portable specific conductance meter. The meter will be calibrated against a 0.010 N potassium chloride solution at least twice a day.

Calibration procedures for other applicable field measurement techniques will be performed in accordance with instrument or test kit manufacturer's instructions. The field kit for ferrous iron requires no calibration.

Field measurement instrumentation will be rinsed with deionized water between samples to avoid cross-contamination of the investigative samples.

8.0 ANALYTICAL PROCEDURES

8.1 ANALYTICAL METHODS

All investigative samples will be analyzed for the parameters listed in Table 3 using the methods cited in Table 2. These methods have been selected to meet the DQOs for each sampling activity. The TOC analysis will include the volatile fraction since the samples will be collected without headspace. To eliminate any effervescing, the samples will be collected unpreserved and analyzed within 7 days.

8.2 COMPOUND IDENTIFICATION

Compounds which will be analyzed by GC/MS will be identified by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). Mass spectra for standard references should be obtained on the user's GC/MS within the same 12 hours as the sample analysis. These standard reference spectra may be obtained through analysis of the calibration standards. The following criteria must be satisfied to verify identification:

i) elution of the sample component at the same GC relative retention time (RRT) as the standard component; and

ii) correspondence of the sample component and the standard component mass spectrum.

8.3 QUANTITATION

The procedures for quantitation of analytes are discussed in the appropriate analytical methods. Sample results are generally calculated using external standards with the exception of the samples analyzed by GC/MS; these methods employ the use of internal standards for analyte quantitation.

8.4 QUANTITATION LIMIT REQUIREMENTS

The analytical laboratory will target the quantitation limits specified in Table 3. When matrix interferences are noted during sample analysis, actions will be taken by the laboratory to achieve the specified detection limits. Samples will not be diluted by more than a factor of five to reduce matrix effects. The laboratory will re-extract and/or use

any of the cleanup techniques presented in the analytical methods to eliminate matrix interferences. Samples may be diluted to a greater extent if the concentrations of analytes of concern exceed the calibration range of the instrument. In such cases, the laboratory QA Officer will assure that the laboratory demonstrates good analytical practices and that such practices are documented in order to achieve the specified detection limits.

9.0 DATA REDUCTION, VALIDATION, ASSESSMENT, AND REPORTING

9.1 GENERAL

The contract laboratory will perform analytical data reduction and validation in-house under the direction of the laboratory QA Officer. The laboratory QA Officer will be responsible for assessing data quality and advising of any data which were rated "preliminary" or "unacceptable" or other qualifications based on the QC criteria outlined in the analytical methods, which would caution the data user of possible unreliability. Data reduction, validation, and reporting by the laboratory will be conducted as detailed in the following:

i) raw data produced and checked by the responsible analysts is turned over for independent review by another analyst;

ii) the area supervisor reviews the data for attainment of quality control criteria presented in the referenced analytical methods;

iii) upon completion of all reviews and acceptance of the raw data by the laboratory operations manager, a computerized report will be generated and sent to the laboratory quality assurance officer;

iv) the laboratory QA Officer will complete a thorough inspection of all reports;

v) the laboratory QA Officer and area supervisor will decide whether any sample reanalysis is required; and

vi) upon acceptance of the preliminary reports by the project QA Officer, final reports will be generated and signed by the laboratory manager.

Validation of the analytical data will be performed by the project QA Officer for analytical activities. The data validation will be performed in accordance with the latest revisions of the following documents: "Organic Data Review for Low Concentration Water (SOP #HW-13, Revision 3)", July 2001 and "Evaluation of Metals Data for the Contract Laboratory Program" (SOP #HW-2, Revision 11), January 1992. Data obtained using methods not covered in these documents will be validated using the general principles used in these documents, and the analytical requirements specified in the methods.

Assessment of analytical and in-house data will include checks on data consistency by looking for comparability of duplicate analyses, comparability to previous data from the same sampling location (if available), adherence to accuracy and precision control criteria detailed in this QAPP and anomalously high or low parameter values. The

results of these data validations will be reported to the project manager and the contract laboratory, noting any discrepancies and their effect upon acceptability of the data.

Data from field measurements and sample collection activities that are used in project reports will be appropriately identified and appended to the report. Where data have been reduced or summarized, the method of reduction will be documented in the report. Field data will be audited for anomalously high or low values that may appear to be inconsistent with other data.

9.2 LABORATORY REPORTING

Full CLP raw data deliverables will be provided for all samples including all items listed in Table 4. Electronic data deliverables (EDDs) will also be provided by the laboratory in the EQuIS format.

All sample data and corresponding QA/QC data as specified in the analytical methods shall be maintained accessible to CRA either in hard copy or on magnetic tape or disk.

10.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

10.1 QC FOR FIELD MEASUREMENTS

QC procedures for field measurements will be limited to checks in the reproducibility of field measurements by obtaining multiple readings and by calibrating the instrument (where appropriate).

10.2 QC FOR LABORATORY ANALYSES

Specific procedures related to internal laboratory QC samples are described in the following subsections.

10.2.1 REAGENT BLANKS

Reagent blanks will be analyzed by the laboratory at the frequency specified in the analytical methods. The reagent blank, an aliquot of analyte-free water or solvent, will be carried through the entire analytical procedure.

10.2.2 MS/MSD OR MS/DUP ANALYSES

An MS/MSD sample will be analyzed for organic parameters and a MS/Dup will be analyzed for inorganic parameters at the frequency specified in Table 1. Acceptable criteria and analytes that will be used for matrix spikes are identified in the analytical methods. Percent spike recoveries will be used to evaluate analytical accuracy while percent relative standard deviation or the RPD between duplicate analyses will be used to assess analytical precision.

10.2.3 SURROGATE ANALYSES

Surrogates are organic compounds which are similar to the analytes of interest, but which are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Every blank, standard, and environmental sample analyzed by GC or GC/MS, including MS/MSD samples, will be spiked with surrogate compounds prior to sample preparation.

The compounds that will be used as surrogates and the levels of recommended spiking are specified in the methods. Surrogate spike recoveries must fall within the control limits specified in the analytical methods. If surrogate recoveries are excessively low (<10 percent), the laboratory will contact the project QA Officer for further instructions.

Dilution of samples to bring the analyte concentration into the linear range of calibration may dilute the surrogates out of the quantification limit. Reanalysis of these samples is not required. Assessment of analytical quality in these cases will be based on the MS/MSD sample analysis results.

10.3 QC FOR SAMPLING PROTOCOL

To assess the quality of data resulting from the field sampling program, field duplicate and field blank samples will be collected (where appropriate) and submitted to the analytical laboratory as samples.

10.3.1 FIELD DUPLICATE SAMPLES

Field duplicate samples will be collected at the frequency specified in Table 1. These samples will be submitted "blind" to the laboratory for analysis and the results will be compared and RPD values will be assessed against a control limit of 50 percent.

10.3.2 FIELD BLANK SAMPLES

Trip blanks for VOCs will be prepared by the laboratory using analyte-free water and submitted with the sample collection containers. The trip blanks will be kept unopened in the field with sample bottles. One trip blank will be transported to the laboratory with each batch of aqueous VOC samples at the frequency specified in Table 1. The laboratory will analyze trip blanks as samples.

Rinse blanks will be used to assess decontamination procedures of collection equipment. The rinse blanks will be prepared using demonstrated analyte-free deionized water; the deionized water used to make the blanks will be analyzed prior to use the field using the analytical methods identified in Table 2. Rinse blanks will be collected and analyzed at the frequency specified Table 1. Rinse blanks will not be needed if dedicated sampling equipment is used.

11.0 PERFORMANCE AND SYSTEM AUDITS AND FREQUENCY

11.1 LABORATORY

For the purpose of external evaluation, performance evaluation check samples are analyzed periodically by the laboratory. Internally, the evaluation of data from these samples is done on a continuing basis over the duration of a given project.

The project QA Officer may carry out performance and/or systems audits to insure that data of known and defensible quality are consistently produced during this program.

Systems audits are qualitative evaluations of all components of laboratory quality control measurement systems. They determine if the measurement systems are being used appropriately. The audits may be carried out before all systems are operational, during the program, or after completion of the analytical report by the laboratory. Such audits typically involve a comparison of the activities given in the QA/QC plan described herein, with activities actually scheduled or performed. A special type of systems audit is the data management audit. This audit addresses only data collection and management activities, and can be used to track data generation and manipulation through the lab.

The performance audit is a quantitative evaluation of the measurement systems used for a monitoring program. It requires testing the measurement systems with samples of known composition or behavior to quantitatively evaluate precision and accuracy. A performance audit may be carried out by or under the auspices of the project QA Officer without the knowledge of the analyst during each sampling event for this program.

It should be noted, however, that any additional external QA audits will only be performed if deemed necessary.

11.2 FIELD

Audits of field techniques will be conducted by the Field QA Officer. These audits will include review of the sample collection and instrument calibration logbooks and Chain of Custody documents. Field inspections will also be performed to review sample collection and handling techniques, on-Site supplies of sampling equipment and standards, and availability of relevant project documents.

12.0 PREVENTIVE MAINTENANCE

All analytical instruments to be used in this project will be serviced by laboratory personnel at regularly scheduled intervals in accordance with the manufacturers' recommendations. Instruments may also be serviced at other times due to failure. Requisite servicing beyond the abilities of laboratory personnel will be performed by the equipment manufacturer or their designated representative.

Daily checks of each instrument will be performed by the analyst who has been assigned responsibility for that instrument. Manufacturers' recommended procedures will be followed in every case.

Maintenance procedures and schedules and instrument logbooks will be documented in bound notebooks and made available to the project QA Officer upon request.

13.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

13.1 QA MEASUREMENT QUALITY INDICATORS

13.1.1 PRECISION

Precision will be assessed by comparing the analytical results between duplicate spike or duplicate sample analyses. Precision as percent relative difference will be calculated as follows for values significantly greater than the associated detection limit:

Matrix Spike/Matrix Spike Duplicate

$$\text{Precision} = \left| \frac{\{D_2 - D_1\}}{\{D_1 + D_2/2\}} \right| \times 100$$

D_1 = matrix spike recovery

D_2 = matrix spike duplicate spike recovery

Sample Duplicates

$$\text{Precision} = \left| \frac{\{D_2 - D_1\}}{\{D_1 + D_2/2\}} \right| \times 100$$

D_1 = original sample result

D_2 = duplicate sample result

For results near the associated detection limits, precision will be assessed based on the following criteria:

$$\text{Precision} = |\text{original result - duplicate result}| < \text{CRDL}$$

13.1.2 ACCURACY

Accuracy will be assessed by comparing a set of analytical results to the accepted or "true" values that would be expected. In general, MS/MSD and check sample recoveries will be used to assess accuracy. Accuracy as percent recovery will be calculated as follows:

$$\text{Accuracy} = \frac{A-B}{C} \times 100$$

A = The analyte determined experimentally from the spike sample

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

C = The amount of spike added

13.1.3 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the database is sufficient.

When possible, the percent completeness for each set of samples will be calculated as follows:

$$\text{Completeness} = \frac{\text{valid data obtained}}{\text{total data planned}} \times 100 \text{ percent}$$

13.1.4 OUTLIERS

Procedures discussed previously will be followed for documenting deviations. As specified in the analytical methods, appropriate actions will be taken by the laboratory to correct any QC outliers caused by problems with analytical techniques. All QC outliers will be addressed in the data validation, and the data validator will use professional judgement to determine whether the data are usable to meet the project objectives.

14.0 CORRECTIVE ACTION

The need for corrective action may be identified by system or performance audits or by standard QC procedures. The essential steps in the corrective action system will be:

i) checking the predetermined limits for data acceptability beyond which corrective action is required;

ii) identifying and defining problems;

iii) assigning responsibility for investigating the problem;

iv) investigating and determining the cause of the problem;

v) determination of a corrective action to eliminate the problem (this may include reanalysis or resampling and analyses);

vi) assigning and accepting responsibility for implementing the corrective action;

vii) implementing the corrective action and evaluating the effectiveness;

viii) verifying that the corrective action has eliminated the problem; and

ix) documenting the corrective action taken.

For each measurement system, the Laboratory QA Officer will be responsible for initiating the corrective action and the laboratory supervisor will be responsible for implementing the corrective action. For field activities, the project manager or project coordinator will be responsible for initiating and implementing corrective action.

15.0 QUALITY ASSURANCE REPORT TO MANAGEMENT

The CRA QA Officer will receive reports on the performance of the measurement system and the data quality following each sampling round and at the conclusion of the project.

Minimally, these reports will include:

i) assessment of measurement quality indicator (i.e., data accuracy, precision, and completeness);

ii) results of system audits; and

iii) QA problems and recommended solutions.

The project QA Officer will be responsible within the organizational structure for preparing these periodic reports. The final report for the project will also include a separate QA section which will summarize data quality information contained in the periodic QA/QC reports to management, and present an overall data assessment and validation in accordance with the data quality objectives outlined in this QAPP.

REFERENCES

- "Test Methods for Evaluating Solid Waste" USEPA Office of Solid Waste, SW-846 Third Edition, November 1986 (with revisions).
- "USEPA Contract Laboratory Program Statement of Work For Organic Analysis", OLM03.2, EPA-540/R-94/073.
- "USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-media, Multi-Concentration", ILM 4.0 EPA/540/R95/121.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, March 1983.
- "Standard Methods of Examination of Water and Wastewater", 17th Edition.
- Method TO-14A from the "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air," EPA 625/R-96/010b, January 1999.
- "American Society for Testing and Materials (ASTM)", Vol. 5.06 (2000).
- "EPA Requirements for Quality Assurance Project Plans", EPA QA/R-5, EPA/240/B-01/003, March 2001.
- "Guidance for the Data Quality Objectives Process", EPA QA/G-4, EPA/600/R-96-055, August 2000.
- "Region II CERCLA Quality Assurance Manual", Revision 1, EPA Region II, October 1989.

TABLE 1

SAMPLING AND ANALYSIS SUMMARY
OU-3 BIOSPARGE REMEDY PERFORMANCE MONITORING
OCCIDENTAL CHEMICAL CORPORATION
HOOKER/RUCO SITE
HICKSVILLE, NEW YORK

Date	*Analytical Parameters*	*Estimated Number of Samples*	*Field Duplicates*	*Trip Blanks*	*Rinse Blanks*	*MS/MSD/Dup.*	*Comments*
Groundwater							
September 2005	VOC + TICs (1)	9	1	1/cooler	1	1/1/0	Background
	TOC, N, P	36	1	0	1	2/0/2	for
	Microbial Counts	9	1	0	0	0/0/0	Phase I
October 2005	VOC + TICs (1)	2	1	1/cooler	1	1/1/0	
	TOC, N, P	2	1	0	1	1/0/1	
November 2005	VOC + TICs (1)	2	1	1/cooler	1	1/1/0	
	TOC, N, P	2	1	0	1	1/0/1	
December 2005	VOC + TICs (1)	9	1	1/cooler	1	1/1/0	
	TOC, N, P	9	1	0	1	1/0/1	
March 2006	VOC + TICs (1)	9	1	1/cooler	1	1/1/0	
	TOC, N, P	9	1	0	1	1/0/1	
June 2006	VOC + TICs (1)	9	1	1/cooler	1	1/1/0	
	TOC, N, P	9	1	0	1	1/0/1	
September 2006	VOC + TICs (1)	9	1	1/cooler	1	1/1/0	
	TOC, N, P	9	1	0	1	1/0/1	
	Microbial Counts	9	1	0	0	0/0/0	
December 2006	VOC + TICs (1)	4	1	1/cooler	1	1/1/0	
	TOC, N, P	4	1	0	1	1/0/1	
March 2007	VOC + TICs (1)	9	1	1/cooler	1	1/1/0	
	TOC, N, P	9	1	0	1	1/0/1	
June 2007	VOC + TICs (1)	4	1	1/cooler	1	1/1/0	
	TOC, N, P	4	1	0	1	1/0/1	
August 2007	VOC + TICs (1)	3	1	1/cooler	1	1/1/0	Background
	TOC, N, P	12	1	0	1	1/0/1	for Rest of
	Microbial Counts	3	1	0	0	0/0/0	Middle Fence
September 2007	VOC + TICs (1)	12	1	1/cooler	1	1/1/0	
	TOC, N, P	12	1	0	1	1/0/1	
	Microbial Counts	9	1	0	0	0/0/0	
October 2007	VOC + TICs (1)	3	1	1/cooler	1	1/1/0	
	TOC, N, P	3	1	0	1	1/0/1	
November 2007	VOC + TICs (1)	3	1	1/cooler	1	1/1/0	
	TOC, N, P	3	1	0	1	1/0/1	
December 2007	VOC + TICs (1)	5	1	1/cooler	1	1/1/0	
	TOC, N, P	5	1	0	1	1/0/1	
March 2008	VOC + TICs (1)	12	1	1/cooler	1	1/1/0	
	TOC, N, P	12	1	0	1	1/0/1	
June 2008	VOC + TICs (1)	5	1	1/cooler	1	1/1/0	
	TOC, N, P	5	1	0	1	1/0/1	
September 2008	VOC + TICs (1)	12	1	1/cooler	1	1/1/0	
	TOC, N, P	12	1	0	1	1/0/1	
	Microbial Counts	12	1	0	0	0/0/0	

TABLE 1

SAMPLING AND ANALYSIS SUMMARY
OU-3 BIOSPARGE REMEDY PERFORMANCE MONITORING
OCCIDENTAL CHEMICAL CORPORATION
HOOKER/RUCO SITE
HICKSVILLE, NEW YORK

Date	Analytical Parameters	Estimated Number of Samples	Field Duplicates	Trip Blanks	Rinse Blanks	MS/MSD/Dup.	Comments
Groundwater							
December 2008	VOC + TICs (1)	18	1	1/cooler	1	1/1/0	Includes
	TOC, N, P	57	3	0	1	3/0/3	Background for
	Microbial Counts	13	1	0	0	0/0/0	North Fence
January 2009	VOC + TICs (1)	2	1	1/cooler	1	1/1/0	
	TOC, N, P	2	1	0	1	1/0/1	
February 2009	VOC + TICs (1)	2	1	1/cooler	1	1/1/0	
	TOC, N, P	2	1	0	1	1/0/1	
March 2009	VOC + TICs (1)	18	1	1/cooler	2	1/1/0	
	TOC, N, P	18	1	0	2	1/0/1	
September 2009	VOC + TICs (1)	25	2	1/cooler	2	2/2/0	
	TOC, N, P	25	2	0	1	2/0/2	
	Microbial Count	25	2	0	0	0/0/0	
Soil Vapor/Ambient Air							
September 2005	VOCs, Methane	6	1	0	1	1/1/0	
March 2006	VOCs, Methane	6	1	0	1	1/1/0	
September 2006	VOCs, Methane	6	1	0	1	1/1/0	
March 2007	VOCs, Methane	10	1	0	1	1/1/0	
September 2007	VOCs, Methane	10	1	0	1	1/1/0	
March 2008	VOCs, Methane	10	1	0	1	1/1/0	
September 2008	VOCs, Methane	20	1	0	1	1/1/0	
Liquid Supplement							
September 2005	TOC, N, P	1	0	0	0	0/0/0	
September 2006	TOC, N, P	1	0	0	0	0/0/0	
September 2007	TOC, N, P	1	0	0	0	0/0/0	

Notes:
Dup. Duplicate.
MS Matrix Spike.
MSD Matrix Spike Duplicate.
N Nitrate/Nitrite (as N).
P Total Phosphorus.
TOC Total Organic Carbon.
VOCs Volatile Organic Compounds.
Rinse blanks will not be collected if dedicated sampling equipment is used.
(1) TICs will be analyzed/reported for first sampling event of each new well and next sampling event ofany existing well. If TICs are not present in a well, no future analysis/reporting of TICs in such wellwill be performed. If TICs are present in a well, TIC anlaysis/reporting will continue until TICs are nolonger present.

TABLE 2

SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME PERIODS
OU-3 BIOSPARGE REMEDY - PERFORMANCE MONITORING
OCCIDENTAL CHEMICAL CORPORATION
HOOKER/RUCO SITE
HICKSVILLE, NEW YORK

Analyses	*Method*	*Sample Containers*	*Preservation*	*Maximum Holding Time*	*Notes*
Groundwater/Liquid Supplement					
VOC + TICs	CLP SOW OLM03.2 [1]	Four 40-mL teflon lined septum vials	Cool 4°C HCl to pH <2	14 days from collection to analysis	Fill completely, no air bubbles
TOC	EPA 415 [2]	250 mL septum top bottle	Cool 4°C	7 days from collection to analysis	Fill completely, no air bubbles
Nitrite/Nitrate (as N)	EPA 300 [2]	One 250 mL glass bottle	Cool 4°C H_2SO_4 to pH <2	28 days from collection to analysis	Fill to neck of bottle
Phosphorus	EPA 365 [2]	One 150 mL glass bottle	Cool 4°C H_2SO_4 to pH <2	28 days from collection to analysis	Fill to neck of bottle
Microbial Count	Method 9215B [3]	40-mL glass vial	Cool 4°C	48 hours from collection to analysis	Fill completely, no air bubbles
Soil Vapor					
VOCs	TO-14A [4]	6 liter summa canister	None	N/A	Fill Completely
Methane	ASTM D-1946 [5]	1 liter summa canister	None	N/A	Fill Completely

Notes:

VOCs Volatile Organic Compounds.

TOC Total Organic Carbon.

(1) Methods referenced from: "USEPA Contract Laboratory Program Statement of Work for Organic Analysis", OLM03.2, EPA 540/R-94/073; and "USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration", ILM4.0 EPA/540/R95/121.

(2) Referenced from "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, March 1983.

(3) Adapted from Standard Methods of Examination of Water and Wastewater, 17th Edition.

(4) Method TO-14A from the "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air," EPA 625/R-96/010b, January 1999.

(5) Referenced from American Society for Testing and Materials (ASTM), Vol. 5.06 (2000)

TABLE 3

TARGETED REPORTING LIMITS - WATER AND SOIL VAPOR
OU-3 BIOSPARGE REMEDY - PERFORMANCE MONITORING
OCCIDENTAL CHEMICAL CORPORATION
HOOKER/RUCO SITE
HICKSVILLE, NEW YORK

	Groundwater Samples *Minimum ARAR Cleanup Level* [1] *(µg/L)*	*Method PQL (µg/L)*	*Soil Vapor (ppbv)*
TCL Volatiles			
Chloromethane	5	0.5	2.0
Bromomethane	10	0.5	0.5
Vinyl chloride	2	0.5	0.5
Chloroethane	10	0.5	0.5
Methylene chloride	10	0.5	0.5
Acetone	50	5	2.0
Carbon disulfide	50	0.5	2.0
1,1-Dichloroethene	10	0.5	0.5
1,1-Dichloroethane	10	0.5	0.5
1,2-Dichloroethene (total)	5	0.5	0.5
Chloroform	7	0.5	0.5
1,2-Dichloroethane	10	0.5	0.5
2-Butanone	50	5	2.0
1,1,1-Trichloroethane	10	0.5	0.5
Carbon tetrachloride	10	0.5	0.5
Bromodichloromethane	10	0.5	0.5
1,2-Dichloropropane	10	0.5	0.5
cis-1,3-Dichloropropene	10	0.5	0.5
Trichloroethene	5	0.5	0.5
Dibromochloromethane	10	0.5	0.5
1,1,2-Trichloroethane	10	0.5	0.5
Benzene	0.7	0.5	0.5
trans-1,3-Dichloropropene	10	0.5	0.5
Bromoform	10	0.5	2.0
4-Methyl-2-pentanone	10	5	2.0
2-Hexanone	10	5	2.0
Tetrachloroethene	5	0.5	0.5
Toluene	10	0.5	0.5
1,1,2,2-Tetrachloroethane	10	0.5	0.5
Chlorobenzene	5	0.5	0.5
Ethyl benzene	5	0.5	0.5
Styrene	10	0.5	0.5
Total Xylenes	5	0.5	0.5
Methane (%)	NA	NA	0.00010

TABLE 3

TARGETED REPORTING LIMITS - WATER AND SOIL VAPOR
OU-3 BIOSPARGE REMEDY - PERFORMANCE MONITORING
OCCIDENTAL CHEMICAL CORPORATION
HOOKER/RUCO SITE
HICKSVILLE, NEW YORK

	Groundwater Samples *Method* *PQL*
Natural Attenuation Parameters	
Dissolved Oxygen (DO) (mg/L)	0.4 - 19.9
Oxidation/Reduction (redox) Reaction Potential (Eh) (mV)	-999 to +999
Nitrate/Nitrite (as N) (mg/L)	0.100
Ammonia (as N) (mg/L)	0.100
TOC (mg/L)	1
Phosphorus, Total (mg/L)	0.05
Fe^{+2} (Hach Kit)	NA

Notes:
(1)

ARAR	Applicable or Relevant and Appropriate Requirements.
ppb	Parts Per Billion.
ppm	Parts Per Million.
PQL	Practical Quantitation Limit.
TCL	Target Compound List.
TOC	Total Organic Carbon.
NA	Not Applicable.

TABLE 4

LABORATORY REPORTING DELIVERABLES - FULL DATA PACKAGE

A detailed report narrative should accompany each submission, summarizing the contents, and results.

A. Chain of Custody Documentation and Detailed Narrative (1)

B. Sample Information
- i) date collected
- ii) date extracted or digested
- iii) date analyzed
- iv) analytical method and reference

C. Data (including all raw data and CLP-like summary forms)
- i) samples
- ii) method blanks
- iii) spikes; spike duplicates (2), (3)
- iv) surrogate recoveries (2)
- v) calibration

D. Miscellaneous
- i) method detection limits and/or instrument detection limits
- ii) percent solids (where applicable)
- iii) run logs
- iv) standard preparation logs
- v) sample preparation logs

All sample data and its corresponding QA/QC data shall be maintained accessible to CRA either in hard copy or on magnetic tape or disc (computer data files).

Notes:

(1) Any quality control outliers must be addressed and corrective action taken must be specified.
(2) Laboratory must specify applicable control limits for all quality control sample results.
(3) A blank spike must be prepared and analyzed with each sample batch.

ATTACHMENT G-1

USEPA REGION II GROUNDWATER SAMPLING PROCEDURE - LOW STRESS (LOW FLOW) PURGING AND SAMPLING

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an

additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump's intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of four options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain

pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough "daily" decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

- Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

- Well construction data, location map, field data from last sampling event.

- Polyethylene sheeting.

- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).

- Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.

- Interface probe or equivalent device for determining the presence or absence of NAPL.

- Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.

- Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

- Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).
- Power source (generator, nitrogen tank, etc.).
- Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.

- Decontamination supplies (see Section VII, below).

- Logbook (see Section VIII, below).

- Sample bottles.

- Sample preservation supplies (as required by the analytical methods).

- Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow

rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    ±0.1 for pH
    ±3% for specific conductance (conductivity)
    ±10 mv for redox potential
    ±10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

    Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded

or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits

inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see #18 below).

17. **Daily Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley ress, Boca Raton, Florida.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures, EPA/540/S-95/504.

U.S. EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

U.S. EPA Region II, 1989, CERCLA Quality Assurance Manual.

ATTACHMENT G-2

CHAIN OF CUSTODY FORM

CHAIN OF CUSTODY RECORD

CRA
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive
Waterloo, Ont. N2V 1C2 (519)884-0510

SHIPPED TO (Laboratory Name):

REFERENCE NUMBER:

SAMPLER'S SIGNATURE: _____ PRINTED NAME: _____

SEQ. No.	DATE	TIME	SAMPLE No.	SAMPLE TYPE	No. OF CONTAINERS	PARAMETERS	REMARKS
TOTAL NUMBER OF CONTAINERS						HEALTH/CHEMICAL HAZARDS	

RELINQUISHED BY: ① _____	DATE: TIME:	RECEIVED BY: ② _____	DATE: TIME:
RELINQUISHED BY: ② _____	DATE: TIME:	RECEIVED BY: ③ _____	DATE: TIME:
RELINQUISHED BY: ③ _____	DATE: TIME:	RECEIVED BY: ④ _____	DATE: TIME:

METHOD OF SHIPMENT: WAY BILL No.

White –Fully Executed Copy
Yellow –Receiving Laboratory Copy
Pink –Shipper Copy
Goldenrod –Sampler Copy

SAMPLE TEAM:

RECEIVED FOR LABORATORY BY:

DATE: _____ TIME: _____

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