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**UNIVERSITY OF CALIFORNIA
LOS ALAMOS NATIONAL LABORATORY (LANL)**

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Statement of Work
for Analytical Laboratories**

December 2000



STATEMENT OF WORK Revision 1

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**LOS ALAMOS NATIONAL LABORATORY
GENERAL INORGANIC, ORGANIC, RADIOCHEMICAL, AND ASBESTOS
ANALYTICAL LABORATORY SERVICES
December, 2000**

Scope and Introduction

The Los Alamos National Laboratory (LANL) Field Support Facility (FSF) is responsible for acquiring analytical services in support of the Environmental Restoration (ER) Project. This work is coordinated by the LANL Sample Management Organization (SMO), which is part of the FSF. This statement of work (SOW) outlines the requirements for analytical services.

Samples obtained for chemical analysis in support of LANL activities may consist of, but not be limited to, soil, waste, groundwater, surface water, domestic supply water, air filters, demolition debris, biota, sludge, organic liquids, swipes, gas canisters, and bioassay samples. Samples may also be acquired for airborne asbestos and bulk asbestos testing. The sections below detail specific quality assurance (QA) protocols, analytical practices and procedures, analytical quality control (QC) requirements, deliverable formats, and schedule requirements. Collectively, these conventions have been established to ensure that LANL data quality objectives (DQOs) are met and that data obtained from different Subcontract Laboratories are comparable. A Subcontract Laboratory must be prepared to handle radioactive samples (many samples will contain low levels of radioactivity). Expected isotopes are Pu, Am, U, Th, ⁹⁰Sr, and ³H, although others are occasionally present. The maximum level of radioactivity expected is 100 nCi/gram, although most levels are much lower than 2 nCi/gram.

Background

The DOE Albuquerque Operations Office (DOE-AL) developed a generic SOW for use by Albuquerque DOE facilities in an effort to standardize analytical laboratory services procurements. This SOW has been developed by LANL from the DOE-AL generic SOW to meet the specific needs of the LANL ER project.

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GLOSSARY

1.0 ANALYSIS REQUESTS AND SAMPLE SHIPMENT

1.1 Work Orders

The LANL SMO representative will schedule the shipment and analysis of samples with the Subcontract Laboratory representative. The Analytical Request Form that accompanies the samples will include the LANL request number and other information which detail the samples submitted and the analyses requested. On the day of shipment, LANL will fax to the Subcontract Laboratory a copy of the analytical request. If the Subcontract Laboratory does not receive the samples on the next business day, if any discrepancies are found between the samples received and the analytical request, if any samples containers are broken, if the chain of custody seal has been broken, or if there is insufficient sample for analysis, the Subcontract Laboratory will notify the LANL SMO immediately, by phone, of any such occurrences.

1.2 Sample Custody

Sample custody is transferred to the Subcontract Laboratory at the time of sample receipt, after which the Subcontract Laboratory is responsible for maintenance of unbroken chain of custody (COC). By definition, a sample is in custody if it is 1) in one's possession, 2) in view, or 3) in a controlled access area. Section 2.9 of this document provides additional detail regarding sample receipt and storage procedures.

1.3 Shipping Charges

Sample shipping charges will normally be paid by LANL. However, it may become necessary on occasion to ship samples collect. In such cases, the Subcontract Laboratory will be reimbursed for the shipping charges. Such collect shipping charges shall be included in the invoice for the associated request number.

1.4 Itemized Analytical Charges

Unit prices provided by Subcontract Laboratories shall include the cost of quality assurance, quality control, handling, preparation, cleanup, analytical, reporting, storage, and disposal requirements specified in this SOW. Analysis performed under conditions of accelerated turn around times are discussed in section 4.2.1 of this SOW and may be invoiced at increased costs.

1.5 Analyte Definitions

For analyses performed under this SOW, the term "general inorganic" refers to the analytes listed in Attachment 1, the term "radiochemical" refers to the analytes listed in Attachment 2, and the term "organic" refers to the analytes listed in Attachment 3.

1.6 Time Definitions

Turnaround times shall be considered as business days and shall exclude Saturdays, Sundays, and all national holidays. If a due date falls on a Saturday, Sunday, national holidays, or days that LANL is closed (New Years Day, Martin Luther King's Birthday, President's Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Thanksgiving Day and the Day after Thanksgiving, Christmas Shutdown (December 25 – 31)) the next business day will be considered the due date. Data package delivery schedules are discussed in Section 4.0 of this SOW.

1.7 Request for Reanalysis

1.7.1 Incomplete Reports and Errors

If a suspected analytical error is identified after comparison with historical data, if QC data are either missing or outside the control limits, or if the data are unusable for any reason, the LANL SMO reserves the right to request the missing documentation or the reanalysis of any or all samples. Reanalysis requests will be for the affected parameters only (rather than the entire analytical suite) where some results in the suite have met the acceptance criteria.

1.7.2 Reimbursement for Reanalysis Costs

Reanalysis will be requested by telephone and will be confirmed in writing (email) by the LANL SMO. Payment for reanalysis requested by the LANL SMO shall be made according to the following guidelines:

- a) Reanalysis that are requested because of a suspected significant error, and that confirm the original results within reasonable analytical error, shall be paid for by LANL. The LANL SMO will seek input from the Subcontract Laboratory regarding reanalysis confirmation due to sample inhomogeneity or other special considerations.
- b) Reanalysis requested because failed QC data were reported to the LANL SMO shall not be paid for by LANL.
- c) Reanalysis that are requested because of a suspected significant error, and that indicate that an analytical or reporting error was made in the first analysis, shall not be paid for by LANL.

1.8 Non-Standard Analyses

1.8.1 Proposals for Non-Standard Analyses

LANL may occasionally find it necessary to request an analysis that is not explicitly covered in this SOW. When this occurs, requests for quote will be submitted, by fax, to Subcontract Laboratories with a description of the needed work. If one or more of the Subcontract Laboratories holding current subcontracts can perform the analysis, the laboratory selection will be made based upon the following criteria:

1. LANL SMO assessment of the Subcontract Laboratory's ability to meet the technical specifications;

2. LANL SMO assessment of the Subcontract Laboratory's ability to meet the sample turnaround times based on laboratory capacity; and
3. The prices submitted.

The subcontracts for laboratories having the needed capability will then be amended by letter to include the new analysis.

1.8.2 Secondary Laboratory Capabilities

Subcontract Laboratories are allowed to propose secondary laboratories outside the current subcontract structure to meet the analytical needs expressed by LANL. The Subcontract Laboratory shall be solely responsible for contracting with the proposed laboratory for the work. A determination of the need to perform an audit of the proposed laboratory prior to submitting samples will be made by the LANL SMO. When an audit is deemed necessary, failure to submit to or pass the audit will disqualify the proposed secondary laboratory.

1.8.3 Using Secondary Laboratories

The Subcontract Laboratory shall not be permitted to send LANL samples to laboratories outside the original contract structure unless the conditions described in sections 1.8.1 and 1.8.2 have been met. If a Subcontract Laboratory sends work to a secondary laboratory, it is the responsibility of the original laboratory to ensure that all requirements of this SOW are met.

2.0 QUALITY ASSURANCE REQUIREMENTS

2.1 General Data Quality Objectives

2.1.1 Methods, Quality Control, and Documentation

- a) LANL will sometimes find, through application of the DQO process, that the quality control or other requirements in this document should be relaxed or tightened to suit particular project needs. Individual project needs that necessitate requirements different from those discussed in this SOW will be negotiated by this subcontract's contracting authority with the Subcontract Laboratory on a case-by-case basis.
- b) DQOs are developed by the specific LANL project. However, a general requirement is that industry-standard methods, such as United States Environmental Protection Agency (USEPA) SW-846 (Third Edition), USEPA 600 series methods, Occupational Safety and Health Administration (OSHA) methods, American Society for Testing and Materials (ASTM) methods, and American Public Health Association (APHA) methods (Standard Methods) be used where possible. The default methods are those listed in the analysis price table supplied by LANL. The analytical requests submitted to a laboratory specify which methods apply. In the absence of specific direction given in the SOW, Subcontract Laboratories may elect to use any industry-standard set of methods. Where industry-

standard methods do not address particular analytes, performance-based methods may be utilized with prior approval from the LANL SMO (written or e-mail).

- c) The Subcontract Laboratory must prepare complete documentation for every activity in order to facilitate review and enhance defensibility of the data. Documentation requirements include records for sample receipt/login, handling, preparation, sample or extract cleanup, standards preparation, sample analysis, data review, data reporting and records retention.
- d) In cases for which the specific QA and QC protocols found in the Environmental Protection Agency (EPA) (or other industry-standard) methods cannot be extended to requested parameters, professional judgment shall be employed in adhering as closely as possible to the spirit of those protocols. This means that the Subcontract Laboratory should extend all standard documentation and quality control practices to parameters, methods, and analytical techniques that are not covered in SW-846 or the CLP SOWs where possible. The Subcontract Laboratory shall formulate an approach to performance and documentation of analytical procedures that meet the requirements of this Statement of Work. Specific QC and analytical requirements are discussed in Section 3.0 of this SOW.

2.2 Subcontract Laboratory Quality Assurance Plan

2.2.1 Specific Requirements

The Subcontract Laboratory, and any secondary laboratory accepted for participation in the subcontract, shall have a Laboratory Quality Assurance Plan (LQAP) which contains sections addressing all of the items listed below.

- a) Title page with provision for approval signatures and dates of revision.
- b) Table of contents.
- c) Subcontract Laboratory organizational structure and key personnel responsibilities.
- d) Personnel training, with required training, frequency, and methods of records maintenance specified.
- e) Sample receipt, custody, storage and management practices. This section shall specify a formal vehicle for notifying the analytical group of holding times near expiration in order to minimize occurrences of expiration prior to analysis.
- f) Facilities and equipment, including a description of security procedures, sample storage practices, and a list of equipment available at the Subcontract Laboratory. Equipment lists shall include acquisition dates and maintenance schedules.
- g) List of all Subcontract Laboratory analytical procedures by method number and matrix. Subcontract Laboratory policy shall require that controlled copies of analytical procedures be available to the analysts.
- h) Instrument calibration procedures, including documentation of calibration standards, coefficients resulting from linear or higher order polynomial regression calculations, and calibration curve

correlation coefficients. The issues below shall be addressed as applicable to the type of analyses being performed.

- i. Procedures shall require that linear regression calibration curve correlation coefficients for general inorganic chemistry be ≥ 0.995 . The results generated for the calibration shall be representative of the calibration range.
 - ii. Conformance with organic chemistry method calibration requirements shall be required.
 - iii. Calibration frequency, methodologies, and documentation practices for radiochemistry counting instruments shall be discussed.
-
- i) Method detection limits (MDL) for inorganic and organic chemistry. The section addressing MDLs shall specify detection limit determination methodologies. Minimum MDL study requirements are discussed in greater detail in section 3.3.1. Minimum detectable concentration (MDC) calculation requirements for radiochemistry are given in section 3.3.4.
 - j) The LQAP shall specify default criteria for QC sample type, number, and data acceptance in daily QC practices. This section shall also discuss the QC data review processes employed by the Subcontract Laboratory. Any Subcontract Laboratory performing a radiochemical analysis shall specify default minimum tracer and carrier recovery criteria in the LQAP. QC data requirements and acceptance criteria for LANL work are discussed in detail in Section 3.0.
 - k) The corrective action report (CAR) process shall be described and a copy of a CAR form shall be provided in the LQAP.
 - l) The Subcontract Laboratory document-control procedures shall be described. In addition, the LQAP shall outline document flow, including review steps, from COC to the final analytical report.
 - m) The process for data review and approval shall be outlined in the LQAP. Provision shall be made for peer, supervisory, or QA review of all chemist worksheets.
 - n) The Subcontract Laboratory's holding time policies and processes for pre-preservation of sample bottles, sample preservation checks, and documentation of preservation checks shall be discussed in the LQAP. Holding times and preservation techniques for LANL samples are outlined in Attachment 4.
 - o) The frequency and method of documentation for internal audits shall be discussed. In addition, the LQAP shall specify the frequency and contents of QA reports to management.
 - p) The LQAP shall list approvals and certifications from states and external agencies.
 - q) The LQAP shall specify the Subcontract Laboratory policy regarding the number of significant figures to be used in reporting analytical results. Also, the LQAP or a Standard Operating Procedure (SOP) shall require the use of leading zeros for numbers less than one, and that units accompany all numbers that are not dimensionless. The significant figures requirements for this SOW are found in section 4.1.12.
 - r) The LQAP shall describe procedures for material procurement, quality inspection, inventory, and storage.

- s) Methods for verification of Electronic Data Deliverable (EDD) and hard copy agreement for sample identifiers, results, detection limits, uncertainties, and QC data.

2.2.2 SOP Support for the LQAP

The LQAP sections addressing some of the issues listed above may refer to detailed SOPs. Complete and comprehensive descriptions of all the listed processes are not required in the LQAP when the specific process details are outlined in SOPs. However, the supporting SOPs should be referenced in the LQAP.

2.3 Performance Evaluation Sample Analysis Requirement

2.3.1 Schedule

Chemical analysis laboratories shall perform the analysis of performance evaluation (PE) samples provided to the Subcontract Laboratory by the LANL SMO. The analytical and deliverable requirements for these PE samples are the same as for all LANL samples. Payment for the analysis of PE samples shall be made according to the fees specified in the subcontract. LANL will not pay for the analysis of Performance Evaluation Materials ("known" samples and reference materials) provided as a courtesy to any Subcontract Laboratory for investigations or method development. LANL will identify such shipments as "Performance Evaluation Materials". These are provided as a courtesy to the Subcontract Laboratory. LANL will not pay for the analysis of these "Performance Evaluation" samples.

2.3.2 PE Sample Analysis

The analytical techniques and SOPs used in the analysis of PE samples shall be the same as those used in routine analysis of LANL samples.

2.3.3 Proficiency

- a) A summary of analytical results and theoretical values for each PE round will be provided to each Subcontract Laboratory by the LANL SMO after all the data for that round are in. Any requests for CARs necessitated by Subcontract Laboratory PE sample failures will accompany the summary report. Initial responses to CAR requests, including the projected schedule for completion, shall be due no later than two weeks from the date of the request. The LANL SMO reserves the right to request accelerated delivery of CARs if circumstances make this necessary. Failure to respond promptly to a request for corrective action may result in temporary suspension of the Subcontract Laboratory from the LANL chemical analysis program.
- b) Subcontract Laboratory performance information may be shared among DOE-AL facilities and entities supporting DOE-AL site activities. The DOE-AL Characterization Management Program policy governing the sharing of subcontractor performance information is provided as Attachment 5.

2.4 Systems and Internal Audit Requirements

2.4.1 Annual Systems Audits

The Subcontract Laboratory may be audited by a LANL representative at least once per year. The purpose of this audit is to verify Subcontract Laboratory compliance with the Subcontract Laboratory LQAP and the specifications of this SOW. In addition, recommendations may be made to Subcontract Laboratory personnel regarding possible quality improvements related to good laboratory practices and/or industry standards. A formal audit report will be issued following this activity. Written responses to audit reports will be due 30 days from the date of issue and receipt by the Subcontract Laboratory. Responses must include the Subcontract Laboratory's plan of action to close out all findings documented in the audit report.

2.4.2 On-Site Data Package Review

Data package reviews may be conducted at the Subcontract Laboratory at the discretion of LANL. The focus of these reviews shall be to verify contract compliance and deliverable accuracy, ensure that raw data and supporting documentation are maintained in retrievable form, and review ancillary documentation not included in deliverables. The data package to be reviewed will be chosen at the time of the review activity.

2.4.3 Internal Audits

The Subcontract Laboratory shall perform internal QA audits at least annually. The results of the Subcontract Laboratory's internal QA audits shall be provided to the LANL SMO in the next quarterly progress reports discussed in section 2.14.

2.5 Participation in Inter-Laboratory Comparison Studies

2.5.1 Required intercomparison programs

The Subcontract Laboratory shall participate, where appropriate, in the inter-laboratory comparison studies administered by the agencies listed below. Costs of participation in these programs shall be paid for by the Subcontract Laboratory. Subcontract Laboratories performing chemical analyses of DOE-AL facility samples under an organic and general inorganic subcontract shall participate in (a) and (c), below. Subcontract Laboratories performing chemical analyses under a radiochemical subcontract shall participate in (b) and (c), below. Subcontract Laboratories performing airborne silica, asbestos, metals, and/or organics analyses shall participate in (d), below. Subcontract Laboratories performing lead in paint analyses shall participate in (e), below.

- a) The Subcontract Laboratory must use EPA issued list of approved Water Pollution and Water Supply (WP/WS) sample vendors.
- b) Inter-laboratory Quality Assurance Program (QAP), U.S. Department of Energy, Environmental Measurements Laboratory (EML), New York, New York.
- c) Mixed Analyte Performance Evaluation Program (MAPEP), U.S. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho.

- d) Proficiency Analytical Testing Program (PAT), American Industrial Hygiene Association.
- e) Environmental Lead Proficiency Analytical Testing Program (ELPAT), American Industrial Hygiene Association.

2.5.2 Reporting Inter-Comparison Results

The Subcontract Laboratory shall report results of the inter-comparisons specified in section 2.5.1 to the LANL SMO on a quarterly basis. This report is due on the 15th day of January, April, July, and October to coincide with the delivery dates for quarterly progress reports. All results received by the Subcontract Laboratory since the last quarterly report and more than one week before the due date shall be included in this deliverable. Results received less than one week before the due date may be held for inclusion in the next quarters deliverable. Failure to participate in and report the results for the applicable inter-comparisons may result in suspension of the Subcontract Laboratory from participation in this subcontract for Analytical Laboratory Services.

2.6 Employee Training and Documenting Employee Proficiency

The Subcontract Laboratory shall have an internal analyst proficiency evaluation policy that provides a vehicle to gauge and document the competence of its staff, as well as specifying additional training and documentation practices applicable to all personnel. Personnel that have not been trained and evaluated shall not be utilized in the handling or analysis of LANL samples under this subcontract.

2.7 Subcontract Laboratory Instrumentation, Equipment, and Reagent Maintenance

2.7.1 Instrument Logs and Response Checks

- a) The Subcontract Laboratory shall have a SOP that specifies the requirements for maintaining logbooks. These requirements shall specifically address QA protocols for error correction, as well as schedules for peer, supervisory, or QA review of logbooks. In addition, the use of indelible ink to make logbook entries shall be explicitly required.
- b) The Subcontract Laboratory shall maintain an instrument logbook for all instruments (excluding pH meters, conductivity meters, and other similar single analyte instruments) used to acquire data for LANL. Each instrument logbook shall be clearly labeled to indicate its' association with a particular laboratory instrument.
- c) Any Subcontract Laboratory performing general inorganic analysis of LANL samples shall have a SOP requiring that instrument response checks, or other appropriate instrument performance checks, be performed daily. The requirements shall include recording the results of such checks in the appropriate instrument maintenance log.
- d) Any Subcontract Laboratory performing organic analysis of LANL samples shall have a SOP requiring that instrument logs contain a brief description of analysis failures and the file names for analysis runs. Reanalysis entries shall reference the original analysis runs to facilitate review. Instrument logs for GC-MS volatiles shall reference the port used for each analysis run where multiple ports exist.
- e) Any Subcontract Laboratory performing radiochemical analysis of LANL samples shall record the data file names and dates for all calibration activities in the associated instrument

logs or cover worksheets. Procedures shall also require that the GFPC, alpha spectrometry, gamma spectroscopy, or alpha scintillation detector used to count each sample be logged.

2.7.2 Balances, Volumetric Pipettes, and Sample Storage Refrigerators

- a) Any Subcontract Laboratory performing chemical analysis shall have a calibration SOP for analytical balances. The SOP shall specify that balances be checked daily (on all business days) against certified standards and that balances not accurate to within at least \pm one percent be re-calibrated or removed from service. The Subcontract Laboratory shall maintain logbooks in which the analytical balance calibration checks are recorded.
- b) Any Subcontract Laboratory performing chemical analysis shall have an SOP that requires daily temperature monitoring (on all business days) for refrigerated sample storage areas and the corrective action that will be initiated if a measurement falls outside the range $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The Subcontract Laboratory shall maintain logbooks for sample storage refrigeration units in which the daily temperature checks are recorded.
- c) Any Subcontract Laboratory performing chemical analysis shall have a calibration SOP for volumetric pipettes, other than glass pipettes, that deliver 100 μL or more. This SOP shall specify that pipettes be checked daily by weighing deionized (DI) water, and that pipettes failing to deliver to within \pm one percent accuracy shall be recalibrated or removed from service.

2.7.3 Reagent Water Production

- a) Any Subcontract Laboratory performing chemical analysis shall have a written SOP for reagent water or DI water production and system maintenance. This SOP shall outline specific control criteria for determining reagent or de-ionized water quality, require daily water-quality measurement (on all business days), and give specific corrective actions to be taken for non-compliant and non-routine events. The control criteria shall result in water of sufficient purity that, upon analysis, no detectable analyte concentration is obtained for each analysis in which the water is used.
- b) The Subcontract Laboratory shall keep records of water quality in logbooks designated for that purpose.

2.7.4 Control of Standards and Stock Solutions

Any Subcontract Laboratory performing chemical analysis shall have a SOP outlining policy on shelf life, labeling, and stock maintenance for reagents, stock solutions, intermediate dilutions, and working standards. The Subcontract Laboratory shall maintain standard certificates of analysis in an orderly manner to facilitate retrieval. Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in calibration and quantitation of samples. Calibration standards shall be traceable to standard materials.

- a) The SOP shall specify a shelf life no greater than one year for stock solutions prepared in the laboratory from salts or metals.
- b) The SOP shall specify a shelf life of no greater than one year for intermediate dilutions and vendor-supplied stock solutions, other than radionuclide solutions, when the constituent concentrations are ten mg/L or higher. General inorganic analyte solutions with constituent concentrations less than ten mg/L shall be defined as working standards.

SOW – LANL
General Inorganic, Organic, Radiochemical,
and Asbestos Analysis

The one-year shelf life shall not apply to neat materials or unopened ampoules containing solutions of organic compounds. The manufacturer's expiration date, if any, shall apply to neat materials and unopened ampoules containing organic standard solutions.

- c) The SOP shall limit the shelf lives of opened ampoules and intermediate dilutions containing organic standard solutions to no greater than those given below. Shorter shelf lives given in the EPA methods shall supersede the specified guidelines.

Volatiles	30 days
Total petroleum hydrocarbons	30 days for purgeable (GRO) 365 days for extractable (DRO)
Pesticides/PCBs/herbicides	180 days
Semi-volatiles	365 days
High Explosives	365 days, $\geq 1,000$ ppm, stock 30 days, 2.5 – 1,000 ppm, int. daily prep, all working standards

- d) The SOP shall specify multi-element radial viewing ICP-AES working standards are prepared fresh at least once a month.
- e) The SOP shall specify working standards for volatiles and general inorganic analyses, other than multi-element radial viewing inductively coupled plasma-atomic emission spectroscopy (ICP-AES) working standards, be prepared fresh daily. The SOP shall require that axial viewing ICP-AES working standards be prepared fresh daily.
- f) The SOP shall specify anion and nutrient stock solutions be kept in refrigerated storage. Refrigerated storage for standards is subject to the requirements of 2.7.2 (b) of this SOW.
- g) For any Subcontract Laboratory performing radiochemical analysis, the SOP shall limit radionuclide solution shelf lives to a maximum of five years or five half lives, which ever is less. The SOP may allow verification of expired standards against NIST traceable standards or require that they be discarded. If verification is allowed, the methodology to be used, performance requirements, and documentation practices must be discussed in the SOP.
- h) The SOP shall specify stock solutions and intermediate dilutions prepared in the Subcontract Laboratory be logged in a standards preparation log. The SOP shall give specific guidelines on what information is to be included in log entries. Expiration dates for solutions prepared from multiple sources shall coincide with the earliest expiration date of the starting materials.
- i) The SOP shall specify minimum labeling requirements for stock solutions and intermediate dilutions that are intended for long-term use, and shall include the information listed below, at a minimum.
- Initials of preparer.
 - Date of preparation.
 - Matrix.
 - Concentration of constituents, unless too many are contained to be listed on the label.
 - Expiration date.
 - Unique standard name that is traceable to a standards preparation log.
- j) The SOP shall specify that organic analysis calibration standards be prepared using high purity solvents that were accompanied by manufacturer's certificates of analysis when purchased.

- k) The SOP shall require standards for atomic spectroscopy be prepared in ASTM Type I water. The applicable ASTM standard for Type I water is the older standard that specifies a 16.67 MΩ·cm resistivity control criterion. Preparation water need not meet the newer 18.0 MΩ·cm criterion.
- l) The SOP shall specify standards for radiochemistry and wet chemistry be prepared using ASTM Type II water, at minimum.
- m) The SOP shall specify expired standards be segregated and labeled as expired while awaiting disposal.
- n) Standard materials, including second source materials, used in calibration and to prepare samples shall be traceable to National Institute Standards and Technology (NIST), EPA, American Association of Laboratory Accreditation (A2LA) or other equivalent DOE approved source, if available. If an NIST, EPA or A2LA standard material is not available, the standard material proposed for use must be approved by LANL SMO before use.

2.7.5 Glassware

- a) The Subcontract Laboratory shall have a SOP for glassware cleaning.
- b) All volumetric glassware used to make standard and sample dilutions for this subcontract shall be ASTM Class A glassware. Dilutions may also be accomplished by automation or using pipettes and/or balances that are controlled in accordance with the applicable provisions of this SOW.

2.7.6 Incident Tracking

Subcontract Laboratories shall have a documented system for recording and tracking incidents involving breakage and spillage of reagents and client samples. This system must address the potential for sample contamination in samples that were analyzed during periods when the ambient air may have been contaminated. The tracking system may be implemented through facilities, H&S, QA, or other Subcontract Laboratory organizations.

2.8 Analytical and QA Standard Operating Procedures

2.8.1 Control of Standard Operating Procedures

The Subcontract Laboratory shall maintain controlled copies of approved SOPs for each analytical method or general procedure performed by Subcontract Laboratory personnel. The Subcontract Laboratory shall establish and demonstrably adhere to a schedule of periodic review for SOPs. Changes to the procedures documented in Subcontract Laboratory SOPs for any work performed under this subcontract shall be transmitted to the LANL SMO for approval prior to implementation. The Subcontract Laboratory may seek approval from the LANL SMO by telephone for minor SOP modifications. Editorial changes and changes not affecting how the procedure is performed or how the results are documented do not need prior approval. Geotechnical laboratories may use the most recent ASTM methods instead of SOPs, provided that, in practice, there are no deviations from the method.

2.8.2 Availability of SOPs

Controlled copies of SOPs shall be readily available to all personnel performing analytical work in support of this subcontract. This may be accomplished by issuing a copy to each analyst, by placing a library of SOPs in a place that is accessible to analysts, or making electronic versions available.

2.8.3 Analyst Familiarity with SOPs

Analyst familiarity with SOPs shall be documented to ensure that the contents of QA and analytical SOPs are effectively communicated to personnel performing any analysis under this subcontract. The Subcontract Laboratory shall require that method training and QA indoctrination be performed and documented in training files.

2.9 Sample Receipt and Storage Requirements

2.9.1 Chain of Custody/Request for Analysis Forms

LANL samples received by the Subcontract Laboratory will be accompanied by a COC form and a letter containing analysis required, turnaround time requested and other pertinent information. Examples of the COC and Request for Analysis forms are provided in Attachments 6 and 7, respectively.

- a) At the time of sample shipment, these forms will indicate the Subcontract Laboratory name, request number, sample IDs, sample matrix, bottle volume, collection dates and times, date shipped, and method of shipment. Special analysis requirements will be documented on the Request for Analysis form.
- b) Individual sample bottles will be labeled by LANL with the sample ID, sampling date and time, preservation method, sampler's identity, and comments. An example of a bottle label is provided in Attachment 8.
- c) The Subcontract Laboratory sample custodian receiving the samples shall verify that the information listed on the COC form is correct and accurately describes the contents of the shipment. Discrepancies will be communicated immediately by phone and fax to the LANL SMO.

2.9.2 Acknowledgment of sample receipt

At the time of receipt, the Subcontract Laboratory sample custodian shall sign and date the COC form in indelible ink to acknowledge sample receipt and accept custody. The sample custodian shall note on the COC form and sample login worksheets any discrepancies between the samples listed on the COC and those actually received.

Note: The laboratory shall include all air bills in the case file where possible, and shall record all freight-carrier tracking numbers on the login records when the air bills cannot be removed intact. (See section 4.1.1 and 4.1.2 of this SOW for reporting requirements.)

2.9.3 Documentation of anomalies

The Subcontract Laboratory sample custodian shall note on the COC form and sample login worksheets any irregularities observed with the shipment, temperature, preservation, condition, or custody seals of samples received.

- a) The pH of all aqueous sample fractions, preserved and unpreserved, shall be checked during sample login. (Exceptions to the pH check requirements are Rn-222, tritium, iodine, VOC, TOX, and urine samples. In other words, the pH for these exceptions that can't be checked at sample login must be checked at sample preparation or analysis, as appropriate)
- b) The allowable temperature range for samples requiring cooling for preservation is $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The actual temperature of sample shipments shall be noted on login worksheets.
- c) If no anomalies are encountered upon receipt of a sample, a brief statement of that fact shall be provided on login worksheets and in the case narrative.
- d) If samples requiring preservation with nitric acid arrive unpreserved or inadequately preserved, the laboratory must contact the SMO for instruction regarding whether to proceed with the analysis. If the laboratory is instructed to adjust the sample pH, metals samples must be held for 16 hours and radionuclide samples must be held for 24 hours prior to withdrawing an aliquot for analysis.

2.9.4 Communication of Anomalies

A Subcontract Laboratory representative shall notify the LANL SMO immediately by telephone and fax of any irregularities noted during the sample receiving process. Any such problems that adversely affect data quality will also be described in the case narrative that accompanies the report of analytical results for that delivery order.

2.9.5 Sample Retention

The Subcontract Laboratory shall retain and store all samples associated with a specific delivery order received under this subcontract for a period of 90 days after issuing the analytical report for that delivery order.

2.9.6 Sample Disposal

The Subcontract Laboratory is solely responsible for lawful disposal of all LANL samples after the 90-day sample storage requirement is fulfilled if the exception given in (a) below does not apply.

- a) If, due to the nature of the samples, the laboratory has no outlet for disposal, or disposal is prohibitively expensive, then samples may be returned to the LANL SMO.
- b) If samples are to be returned to the LANL SMO, the Subcontract Laboratory shall provide to the LANL SMO at least two weeks prior to shipping, notification that includes an inventory of samples.
- c) The Subcontract Laboratory shall not return extracts or digestates to the LANL SMO.

2.9.7 Return of Shipping Coolers

The Subcontract Laboratory shall initiate the shipment of sample coolers and blue ice back to the LANL SMO within five days of receipt. Sample coolers should be shipped to the address given below unless the LANL SMO provides different instructions. Sample coolers may be returned by Federal Express using the LANL SMO account number. Shipping charges for sample coolers shipped by other means without the prior approval of the LANL SMO will not be reimbursed.

Stephen Bolivar
Los Alamos National Laboratory
TA-3, Building 271,
Drop Point O1U
Los Alamos, NM 87545

2.9.8 Subcontract Laboratory-Supplied Sample Containers

The LANL SMO may use Subcontract Laboratory-supplied sample containers for some projects (e.g. SUMMA canisters). The schedule of prices provided in the Subcontract Laboratory's proposal shall include separate prices for pre-cleaned sample containers, having the appropriate preservative, for each analysis covered in the proposal. Container and preservative requirements are given in Attachment 4 of this SOW.

2.10 Holding Time Requirements

2.10.1 LANL Holding Times

Analytical holding times for LANL are specified in Attachment 4.

2.10.2 Definition

For all LANL analyses, the holding time interval is defined to begin at the time and date that the sample was collected. Holding times are calculated in days or hours, according to the time units used in the EPA holding time requirements. That is, if the EPA-specified holding time is given in hours, then the analysis must be complete before the end of the last hour of the holding time when calculated from the sampling time. When the holding time is given in days, the analysis must be complete before the end of the day on which the holding time would expire as calculated from the sampling day.

For organic analyses, the preparation holding time is calculated from the time of sample collection to the time of completion of the sample preparation process as described in the applicable method, prior to any necessary extract cleanup and/or volume reduction process. For organic methods requiring sample preparation prior to analysis, the analysis holding time is calculated from the time of preparation completion to the time of completion of all analytical runs, including dilutions, second column confirmations, and any required reanalysis. For all other analyses, the analysis holding time is calculated from the time of sample collection to the time of completion of all analytical runs, to include dilutions and any required re-analyses.

2.10.3 Matrix Types

Where matrix-specific holding times are not given in Attachment 4, the holding times specified apply to all sample matrix types. The holding time specified in the requested method shall be used when any non-standard analyses are requested under Section 1.8 of this subcontract.

2.10.4 Meeting Holding Times

It is crucial that the Subcontract Laboratory perform chemical analyses within the specified holding times. The Subcontract Laboratory shall promptly notify the LANL SMO if it determines, upon sample receipt or thereafter, that one or more analyses cannot be performed within the holding times. Payment will not be made for performance of analysis beyond the holding time that are reported without prior explanation and LANL SMO approval obtained. Holding times are always listed in calendar days (NOT business days).

- a) The LANL SMO will notify the Subcontract Laboratory when samples having less than 72 hours of the holding time remaining are to be shipped.
- b) For samples having holding times greater than 48 hours, shipments arriving at the laboratory with less than 72 hours of the holding time remaining will be invoiced at the appropriate accelerated turn around price. That is, when 48 to 72 hours remain, the three day turn around price applies, and when less than 48 hours remain, the one day turn around price applies. Any deliverable schedule that is at least as long as that covered by the premium price will be requested by the LANL SMO.

2.10.5 Violations

The Subcontract Laboratory shall provide an explanation for all holding time violations in the case narrative. The Subcontract Laboratory shall not allow sample analyses to be canceled because the holding times could or will be missed without prior notification of the LANL SMO. Cancellation of analyses without the notification of the LANL SMO, may result in suspension of the Subcontract Laboratory from participation in this subcontract.

2.11 Subcontract Laboratory Data Verification and Review Requirements

2.11.1 Worksheet Review

- a) All analyst worksheets describing analysis of samples performed under this subcontract shall undergo supervisory or peer review. A field shall be provided on each worksheet for the reviewer's initials. The reviewer need not sign each page of a submittal; only one signature per data submittal (per analytical batch) is required.
- b) Worksheet review signatures signify that the analyst has met the requirements of the method, Subcontract Laboratory QA policies, and this SOW.

2.11.2 Report Review

All data transmitted to the LANL SMO by the Subcontract Laboratory shall undergo data verification and completeness review by the Subcontract Laboratory's QA or technical staff. In addition, reviews shall include 100 percent verification of agreement between EDDs and hard copy reports, as defined in section 2.2.1 (s) of this SOW, until the efficacy of the EDD production process is demonstrated. Signature evidence of this review in the case narrative is required.

2.12 Subcontract Laboratory Record Maintenance Requirements

The Subcontract Laboratory shall maintain, a case file containing all documents and records associated with each specific delivery order. Alternatively, an effective system ensuring the ability to retrieve all associated records in a timely fashion may be utilized. All raw data, worksheets, analyzed logs, digestion logs, shipping and login records, custody forms, and communication records must be included in the case file or addressed by the retrieval system discussed above. This supporting documentation may be used to verify compliance with the requirements outlined in this document, or to support the data in a court of law. The supporting documentation shall be shipped to the LANL SMO or discarded, at the direction of the procurement specialist, when the contract base period and all exercised extensions expire. Freight charges for shipping supporting documentation will be the responsibility of LANL.

2.13 Corrective Action for Non-Compliant or Non-Routine Events

2.13.1 Requests for Corrective Action Report (CAR)

The Subcontract Laboratory may be required by LANL SMO to provide a response to a CAR for data not within control limits or associated non-routine events associated with analytical services provided to LANL under this subcontract.

2.13.2 Delivery of CARs

Initial responses to a LANL SMO request for a CAR, including the projected schedule for completion, shall be due no later than two weeks from the date of the request. The LANL SMO reserves the right to request delivery of CAR responses in less than two weeks if circumstances indicate that this is necessary. Failure to submit requested CARs may result in suspension of the Subcontract Laboratory from the LANL laboratory analysis program.

2.14 Quarterly Progress Report Requirement

2.14.1 Contents of Quarterly Progress Reports

The Subcontract Laboratory shall submit two copies of the quarterly progress reports (QPR) to the LANL SMO. Email distribution is acceptable. Quarterly progress reports shall address calendar quarters and are due by the 15th day of the month following the reporting period. In addition to the quarterly reporting requirement, the Subcontract Laboratory will notify the LANL SMO immediately for issues relating to items (d) and (e), below. Emphasis should be placed on the following for inclusion in QPRs:

- a) New analysis methods and changes in old methods.
- b) Summaries of non-routine incidents during the reporting period, and copies of the associated CARs.
- c) Descriptions of changes in the LQAP that affect the analysis of or documentation for LANL samples.

- d) Changes in QA and key technical personnel, including resumes of new personnel.
- e) Changes in certification status with any regulatory or certifying agencies.
- f) Loss of capability to perform any service that is specified in existing contracts with DOE-AL facilities.
- g) Results of any internal audits performed.

If no changes occurred concerning subsection a) through g) above during the reporting period, and if no CARs were generated, then a simple statement of these facts shall suffice to meet the QPR requirement.

2.14.2 Compliance

Failure to comply with the QPR requirement in this SOW may result in suspension of the Subcontract Laboratory from the LANL laboratory analysis program.

2.15 Primary Contact Person

2.15.1 Subcontract Laboratory Contact Person

The Subcontract Laboratory shall assign a project manager to be the primary contact person for issues relating to the analysis of LANL samples.

2.15.2 LANL SMO Contact Persons

The LANL SMO technical representative shall be:

Stephen L. Bolivar
Los Alamos National Laboratory
P.O. Box 1663 MS H865
Los Alamos NM 87545
phone (505) 667-1868
fax (505) 665-9972
e-mail bolivar@lanl.gov

Backup contact, Chemistry Team representative:

Bart J. Vanden Plas
Los Alamos National Laboratory
P.O. Box 1663 MS M992
Los Alamos NM 87545
phone (505) 667-0675
fax (505) 665-4747
e-mail bartvan@lanl.gov

Backup contact, SMO representative:

Stephanie I. Hagelberg
Los Alamos National Laboratory
P.O. Box 1663 MS H865
Los Alamos NM 87545
phone (505) 665-9966
fax (505) 665-9972
e-mail shagelbe@lanl.gov

2.15.3 Communication

Open communication between LANL and the Subcontract Laboratory is crucial to developing a mutually beneficial business relationship. The Subcontract Laboratory technical personnel are encouraged to seek guidance in advance of performing work when any questions arise and to comment on any analytical approach they may believe to be flawed.

2.16 Radioactive Materials License Requirements

The Subcontract Laboratory shall have a current radioactive materials license that is appropriate to the materials they anticipate receiving under this contract. If the radioactive materials license has expired, the Subcontract Laboratory shall have a letter of timely renewal on file. Photocopies of new or updated licenses shall be provided to the LANL SMO with the next quarterly progress report.

2.17 Good automated laboratory practices

Good Automated Laboratory Practices (GALP) must be used by the Subcontract Laboratory to ensure the reliability of data. GALP includes traceability, accountability, standardized procedures, adequate resources, and the availability of documentation of conformance to the requirements (including setting acceptance criteria where appropriate). Subcontract Laboratories performing chemical analyses, and as applicable, Subcontract Laboratories performing asbestos and geotechnical tests, must have procedures that address the issues listed below.

2.17.1 Laboratory Management

When electronic data are collected, analyzed, processed, or maintained under this subcontract, the Subcontract Laboratory management shall:

- a) Ensure that personnel clearly understand the functions they are to perform.
- b) Ensure that quality assurance staff members monitor computer activities.
- c) Ensure that personnel, resources, and facilities are adequate and available.
- d) Receive reports of audits of LIMS and computer systems and ensure that corrective actions are promptly taken in response to any deficiencies.

- e) Approve the SOPs setting forth the methods that ensure electronic data integrity, ensure that any deviations from SOPs and applicable GALP provisions are appropriately documented and that corrective actions are taken and documented, and approve subsequent changes to SOPs.

2.17.2 Personnel

The Subcontract Laboratory shall ensure that all computer support staff and users:

- a) Have adequate education, training, and experience to perform assigned functions.
- b) Have a current summary of their training, experience, and job description, including their knowledge relevant to LIMS design and operation, maintained at the facility.
- c) Are of sufficient number for timely and proper operation of the computer systems.

2.17.3 Quality Assurance

The Subcontract Laboratory shall designate QA staff to monitor computer functions and procedures. QA staff members shall:

- a) Audit the computer systems at intervals adequate to ensure the integrity of the electronic data and prepare audit reports. Reports shall include a description of the operation audited, the dates of the audit, the person performing the audit, findings and problems observed, action recommended and taken to resolve existing problems, and any scheduled dates for re-audit. QA staff shall report to the Subcontract Laboratory management any problems that may affect data integrity.
- b) Determine that no deviations from approved SOPs were made without proper authorization and adequate documentation.
- c) Ensure that the responsibilities and procedures applicable to QA, the records kept by QA, and the method of indexing such records are properly documented and maintained.
- d) Establish non-conformance and corrective action procedures for hardware and software failures.

2.17.4 Electronic Data

Electronic data shall be managed in such a way as to ensure and/or include:

- a) Electronic data storage media are identified and indexed. These processes shall be included in Subcontract Laboratory SOPs.
- b) The individuals responsible for entering and recording data are uniquely identified when the data are recorded, and the times and dates of entry are documented.
- c) The instrument transmitting electronic data is uniquely identified when the data are recorded, and the time and date of transfer are documented.
- d) Procedures and practices for verification of the accuracy of data are documented and included in laboratory SOPs.
- e) Procedures and practices for making changes to electronic data are documented and provide evidence of change. Such evidence should preserve the original data, include the date of the change, indicate the reason for the change, identify the person who made the change, and, if

different, identify the person who authorized the change. These procedures shall be included in laboratory SOPs.

- f) Procedures and practices for backing up electronic files are documented. These procedures shall include frequency, storage and the process for restoring files. These procedures shall be included in the Subcontract Laboratory's SOPs.

2.17.5 Software

Software shall be managed in such a way as to ensure and/or include:

- a) Approved SOPs exist for:
- i. Verification and validation procedures to verify that all software programs accurately perform the intended functions. These procedures should address software security (cell protection, for example). When indicated, change-control procedures shall include reporting and evaluating problems and implementing corrective actions.
 - ii. Version control procedures that document the software version currently used and its implementation date.
 - iii. Maintaining a historical file of software including dates of use, software operating procedures (manuals), software changes, and software version numbers.
- b) Documentation for the issues in section (a) above is maintained. Subcontract Laboratory management shall ensure that all documentation is readily available in the facility where the software is used.

2.17.6 Security

Subcontract Laboratory management shall ensure that the security practices to ensure the integrity of electronic data:

- a) Ensure that calculation routines are secure from inadvertent changes.
- b) Make login password necessary to access stored data, enter new data, and change existing data.
- c) Establish access categories (read only, read/write, read/write/change) as appropriate to the duties of staff members.

2.17.7 Hardware

Subcontract Laboratory management shall ensure that hardware and communications components are:

- a) Of adequate design and capacity, and that a written description is maintained.
- b) Installed and operated in accordance with manufacturer's recommendations and, at installation, undergo acceptance testing.

- c) Adequately inspected and maintained on an ongoing basis. Non-routine maintenance shall be documented, including a description of the problem, the corrective action, and the acceptance testing performed to ensure that the hardware or communications components have been properly repaired.

2.17.8 Records Retention

Subcontract Laboratory management shall ensure that SOPs for records retention are implemented and that the SOP specifications are followed by staff.

2.17.9 Facilities

With regard to facilities, Subcontract Laboratory management shall ensure that:

- a) The environmental conditions of the facility housing the hardware are appropriately regulated to protect against data loss.
- b) Environmentally adequate storage capacity is provided for retention of electronic data, storage media, and records pertaining to the computer systems.

2.17.10 Standard Operating Procedures (SOPs)

Subcontract Laboratory management shall ensure that:

- a) Each current SOP is readily available where the procedure is performed.
- b) SOPs are periodically reviewed at a frequency adequate to ensure that they accurately describe the current procedures.
- c) SOPs are approved and changed in accordance with QA policy.
- d) A historical file of SOPs is maintained.

2.18 Records for method development and initial demonstration of proficiency

The Subcontract Laboratory QAP or procedures must specify the records needed to document method development and initial demonstration of proficiency. A system for tracking and retrieval of these records must be in place.

3.0 ANALYTICAL AND QUALITY CONTROL REQUIREMENTS

3.1 Standard Preparation And Instrument Calibration Requirements

3.1.1 Working Standards

Preparation of standards shall be performed according to the specifications in (a) through (m) of section 2.7.4 of the SOW. Working standard preparation information accompanying daily analysis worksheets shall be

sufficiently detailed to demonstrate compliance. Initial calibration verification and laboratory control sample solutions, if applicable, shall be documented in sufficient detail to make clear that they derived from a source different from that used to prepare the initial calibration standards.

3.1.2 Calibration

Instrument calibration shall be performed according to the specifications of the SW-846, ASTM, or other method where applicable. Calibration for analytical techniques that are not addressed in industry-standard methods shall be performed according to the specifications of the analytical procedure adaptations used by the Subcontract Laboratory.

All analytes reported shall be present in the initial and continuing calibrations (with exceptions for multi-component analytes such as pesticides and PCBs), and these calibrations shall meet the acceptance criteria specified in the appropriate section of this SOW. All results reported shall be within the calibration range. Multipoint calibrations shall contain the minimum number of calibration points specified in that method with all points used for the calibrations being contiguous. This applies equally to multi-component analytes. If more than the minimum number of standards is analyzed for the initial calibration, all of the standards analyzed shall be included in the initial calibration. The only exception to this rule is a standard that has been statistically determined as being an outlier can be dropped from the calibration, providing the requirement for the minimum number of standards is met. For any multi-component analytes including toxaphene, chlordane, and PCBs, these multi-component analytes must be run as separate standards in a calibration sequence as required by the appropriate methods.

Minimum calibration requirements specific to this SOW are given below. The requirements in (a) apply only when instruments are in use.

- a) Instruments used to acquire general inorganic data shall be calibrated daily or once every 24 hours, and each time the instrument is set up. All analysis of As, Cd, Pb, Sb, Se, and Tl by axial-viewing ICP-AES {rather than Graphite Furnace - Atomic Absorption (GFAA)} shall, for each parameter, perform a four-point calibration of the instrument at concentrations appropriate for the GFAA method. Suggested standard concentrations are a blank, one standard in the 50-100 ppb range, one standard in the 250-500 ppb range, and a standard not exceeding 1 ppm. The Subcontract Laboratory may include an additional standard at a higher concentration if desired to extend the calibration range.
- b) Instruments used to acquire radiochemical data shall be calibrated at the frequency specified in section 3.6.9.
- c) Instruments used to acquire organic data shall be calibrated at the frequency specified in the applicable EPA method. Analyte concentrations are determined with either calibration curves or response factors (RFs). For gas chromatography (GC), high performance/liquid chromatography (HPLC) and gas chromatography/mass spectroscopy (GC/MS) methods, when using RFs to determine analyte concentrations, the average RF from the initial five point calibration shall be used. The continuing calibration shall not be used to update the RFs from the initial five point calibration. The continuing calibration verification can not be used as the laboratory control sample (LCS).

3.2 Sample Analysis Requirements

3.2.1 Worksheet Requirements

Analyst worksheets used to record analytical data shall present a complete record of all information pertinent to the analysis. A completed analyst worksheet that includes the information, either explicitly or by reference, listed below is required for each analysis. Analyst worksheets may be computer generated or hand written using indelible ink.

- a) The name of the person performing the analysis.
- b) The instrument used in the analysis. If the Subcontract Laboratory has more than one instrument of a particular model, a unique designation shall be given to each.
- c) The name or initials of the peer, supervisory, or QA reviewer. (See section 2.11.1 of this SOW for specific review requirements.)
- d) Calibration information as specified in section 2.2.1 (h). Radiochemistry counting instrument calibration information may be limited to calibration dates, computer data file names, and a statement certifying that calibrations were successfully performed on schedule.
- e) Standards information, including the name, preparation date, and expiration date of calibration and calibration verification standards, as applicable.
- f) The analytical procedure used. Include the identification of the laboratory SOP and revision number.
- g) The equations for calculations used to obtain results. If instrument readouts give results, without the need for further mathematical manipulation, the worksheets shall include the statement "result = instrument readout." Measurement units must be specified.
- h) The date and time (beginning) that the analysis was performed.

3.2.2 Sample Preparation

Sample preparation shall be conducted according to the specifications of the analytical methods, except as noted below.

- a) Unless different digestion procedures are specified in the analysis request, soil and water samples submitted for metals analysis shall be digested according to the procedures given in the appropriate SW-846 method.
- b) Subcontract Laboratories performing general inorganic sample analyses shall perform the SW-846 digestions, total dissolution digestions (HNO₃, HClO₄, HF), and toxicity characteristic leaching procedure (TCLP) extractions, as requested by the LANL SMO.
- c) Soil samples submitted for radiochemical parameter analysis by techniques other than gamma spectroscopy shall be dried, crushed to -200 mesh, and homogenized prior to analysis. The Subcontract Laboratory may use a timed grind if it can be shown that the Subcontract Laboratory routinely reaches 200 mesh within the time used for grinding all sample aliquots. Gamma spectroscopy samples shall be dried, crushed to -28 mesh, and homogenized prior to analysis. Tritium samples and samples for radionuclide determinations that are conducted by general inorganic analytical techniques are exempt from this sample preparation requirement.

- i. The entire sample shall be crushed and homogenized, up to a maximum of 200 grams, unless a portion is needed for another analysis that does not require this preparation.
 - ii. Extraneous material that cannot be crushed (such as metal debris and organic matter) should be removed from the samples unless directed otherwise by LANL.
 - iii. Solid samples that are submitted for radiochemical analysis (other than gamma spectroscopy and 3H) shall be subjected to a total dissolution digestion.
 - iv. The LANL SMO will specify the sample preparation techniques for radionuclide determinations that are conducted by general inorganic analytical techniques. This applies to any radionuclide determinations by column-extraction/flow-injection Inductively Coupled Plasma - Mass Spectrometry (ICP-MS).
- d) Percent moisture measurements shall be made and reported for all LANL soil samples submitted for analyses. Unless otherwise specified, soil or semi-solid sample results for all analyses shall be reported on a dry weight basis.
 - e) Percent moisture data shall be reported for 3H analysis.
 - f) Extraction procedures for soil samples submitted for anion analysis will be selected on a case-by-case basis. The contract-required quantitation limits (CRQL) presented in the attachments assume a nominal 1:20 dilution factor.
 - g) Industrial hygiene samples will be digested by the appropriate National Institute for Occupational Safety and Health (NIOSH) or OSHA method identified in the request for analysis.

3.2.3 Initial Dilution of Samples

Since some LANL samples have a high solids content, initial dilution of samples for analysis by GFAA, ICP-AES, and ICP-MS will be allowed according to the criterion specified in (a) below. Samples submitted for organic analyses may be initially diluted according to (b) below.

- a) Water samples having total dissolved solids (TDS) content greater than 2000 mg/L may be diluted, prior to analysis, by the smallest integer dilution factor required to reduce the solids content down to less than 2000 mg/L. If the LANL SMO did not request TDS analysis, a sample's specific conductance may be used to estimate TDS. For this purpose, the specific conductance of the unpreserved sample fraction in $\mu\text{S}/\text{cm}$, multiplied by the factor 0.7, shall be considered equivalent to the sample TDS in mg/L.
- b) VOC samples may be screened using the screening methods discussed in section 3.5.4 (a) in order to determine the need for initial dilution. Any screening analyses used to estimate organic compound concentrations must follow the appropriate quality control requirements for the methods used, including calibration and blank analyses. If initial dilution is indicated, the sample may be diluted prior to analysis only to the level indicated by the screening results.
- c) Samples diluted according to the criteria specified in (a) and (b) above shall be listed and discussed in the case narrative. The MDLs and Contract Required Quantitation Limits (CRQLs) reported for such samples shall be elevated accordingly, as discussed in section 3.3.3 (b) of this SOW. Corrective actions shall be taken for any samples analyzed at an initial dilution that do not contain target analytes within the calibration range of the diluted analyses. The corrective actions should proceed as follows: 1) if the concentration of any target analyte in any sample is not above the second contiguous initial calibration standard, the sample must be re-analyzed at a lower dilution

until the above criteria is met or 2) if the dilution is performed for non-target analytes in the sample, then some sort of sample cleanup must be performed (EPA SW-846 3600 series methods), and the sample re-analyzed.

3.2.4 Analytical Techniques and SOPs

The Subcontract Laboratory shall employ approved analytical techniques and SOPs in the analysis of LANL samples. If a non-standard technique is required to achieve a specific LANL objective, the Subcontract Laboratory will be asked to provide a schedule of charges for the work on a case-by-case basis.

- a) The Subcontract Laboratory shall perform routine sample analyses using the analytical techniques and methods specified in Attachments 1 through 4. Approved adaptations of EPA, APHA, ASTM, NIOSH, OSHA, or other methods that employ the specified analytical techniques shall be used. Written documentation of these adaptations of the listed methods, specific to the Subcontract Laboratory environment, shall refer to the parent procedures.
- b) For GFAA Analyses, The Subcontract Laboratory shall adhere to the analytical and data qualification procedures specified in exhibit E, Section V of the CLP SOW.
- c) If, due to catastrophic instrument failure, the specified technique(s) cannot be used, a Subcontract Laboratory representative shall contact the LANL SMO to obtain approval for the use of an alternate technique. If the LANL SMO does not approve the proposed alternate technique, the LANL SMO will provide instructions for shipment of samples or sample splits to another Subcontract Laboratory.
- d) In the event that samples or sample splits must be sent by the Subcontract Laboratory to another Subcontract Laboratory, the Subcontract Laboratory initiating the shipment shall be responsible for demonstrating unbroken COC up to the time of shipment, and for ensuring that the samples are properly packed for shipment.

3.3 Detection Limits, Reporting Requirements, and QC Exemptions

3.3.1 MDL Determination

The MDL for all inorganic and organic parameters shall be determined and the results submitted to the LANL SMO annually. MDLs from the most recent MDL study shall appear on the Analysis Results forms.

- a) The MDL is defined to be the point at which the observed signal can reliably be considered to be caused by the analyte being measured. MDL determinations shall be performed using standard solutions at approximately one to five times the estimated or laboratory MDL for each method. Preparation of the standard solutions shall include all preparation steps (digestion, filtration, extraction, distillation, etc.) that would be used in the preparation of environmental samples. MDLs shall be determined by analyzing the standard solutions seven to ten times on the same day or succeeding days (over a 24-hour period), determining the standard deviation of the results, and multiplying the standard deviation by the appropriate "t statistic" from Chapter 1, Section 5 of SW-846.

- i. A report of MDLs shall be due to the LANL SMO on the anniversary of the contract award date. The MDL studies shall be conducted during a time period not to exceed two months prior to the report date.
 - ii. VOC analysis of water samples does not involve sample preparation, and hence the IDLs are equivalent to MDLs, and should be reported as MDLs. Also, the VOC water IDL will be used for the VOC low-level soil analysis MDL.
 - iii. Soil sample MDL determinations for organics (including VOC analysis) may be performed using muffled sand, an appropriate salt, or other soil matrix substitute. The specific choice of soil substitute is left to the Subcontract Laboratory's discretion.
 - iv. Due to the precision (good or bad) that is attainable for low-level standards in certain organic methods, Subcontract Laboratories may believe that the MDL values obtained on any particular day are of little technical value. Subcontract Laboratories may suggest modified values to be used based upon the likelihood of producing false positive results. The LANL SMO must approve the use of alternate values for MDLs prior to their use.
- b) If any MDL result is greater than the corresponding LANL CRQL, a discussion of the problem and planned corrective action shall accompany the report deliverable. (This requirement is waived where a prior agreement exists that allows slightly elevated MDLs for some parameters.) Failure to implement effective corrective action may render the Subcontract Laboratory ineligible to receive samples for which determination of that parameter is requested. c) The reports for MDLs should be in tabular summary form. Raw data generated in the determination of MDLs shall not be included as part of the deliverable, but may be specifically requested for examination by the LANL SMO during audit and data package assessment activities. The format of the EPA CLP form X-IN, or equivalent, shall meet the MDL reporting requirements.

3.3.2 Contract Required Quantitation Limits (CRQL)

CRQLs will be required for some analyses. The CRQL is defined as the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operation conditions. The CRQL is generally 5 to 10 times the MDL. However, it may be nominally chosen within these guidelines to simplify data reporting. For many analytes the CRQL analyte concentration is selected as the lowest non-zero standard in the calibration curve.

The Subcontractor Laboratory shall compare the results of the MDL demonstrations to the CRQLs for each method that are listed in the appropriate attachment. The MDL may not be more than one-half the corresponding CRQL. The Subcontractor Laboratory shall also verify the CRQLs by including a standard at or below the CRQL as the lowest point on the calibration curve. The low standard concentrations may be nominally chosen within these guidelines to simplify data reporting. The low standard concentration is then considered the reporting limit (RL) for each analyte.

Note: The Subcontractor Laboratory may use the higher of the MDLs derived to set the RLs when multiple instruments are in use for a specific analysis.

3.3.3 Reporting Conventions

- a) Each analysis result for general inorganic parameters shall be accompanied by the MDL where applicable. Organic analysis results shall be accompanied by both the MDL and RL (when required).

- b) MDLs, and RLs shall be sample specific to reflect the conditions for that sample. That is, the MDLs, and RLs shall reflect dilution factors, moisture content, and sample aliquot sizes used in the analysis of each sample.
- c) Results less than the MDL shall be qualified with a "U" flag. General inorganic analysis results between the MDL and the RL shall be qualified with a "B" flag.

3.3.4 Radiochemistry Detection Limits

LANL requires a means by which to capture sample-specific information, such as sample weight/volume, counting time, and chemical recovery, that affects a laboratory's ability to detect radiochemical analytes. The detection limit calculations in this section incorporate data that are specific to both the sample and the detector it is counted on.

The calculations given in sections (a) and (b) below apply to detectors for which at least 35 background counts can be obtained. For low-background alpha spectrometry, it is very difficult to obtain a sufficient number of background counts to support the assumption of normal distribution. In that case, the assumptions underlying the equations in (a) and (b) break down, resulting in an inappropriately large number of false positives. If at least 35 background counts cannot be obtained, laboratories shall use the low-background detection limit calculation of section (c). However, should they wish to do so, laboratories are free to apply the low-background (blank population) approach of section (c) to alpha spectrometry detectors having backgrounds above 35 counts.

- a) Radiochemistry laboratories shall calculate a sample-specific minimum detectable concentration (MDC) for each radiochemical parameter. The MDC values shall be calculated according to the equation below and reported with each analytical result submitted to LANL. This calculation means that if we counted a sample containing net activity a large number of times, and if the mean result of those counts comes out equal to the MDC, then the result of a subsequent count would have a five-percent probability of coming out below the decision level concentration (DLC). This is the net concentration "which may be *a priori* expected to lead to detection" on a single measurement according to Curie ("Analytical Chemistry," Volume 40, Number 3, March 1968, pages 586 through 593).

$$\text{MDC} = \frac{4.65 \cdot (\text{TBC})^{1/2} + 2.71}{2.22 \cdot \text{D} \cdot \text{E} \cdot \text{I} \cdot \text{V} \cdot \text{T} \cdot \text{R} \cdot \text{A}}$$

Where:

TBC = total background counts
2.22 = DPM/pCi
D = decay correction factor
E = detector efficiency
I = ingrowth correction factor
V = sample volume or weight
T = sample count time
R = chemical recovery
A = emission abundance

- b) Radiochemistry laboratories shall also calculate a sample-specific DLC for each analytical result. A blank or sample will be considered to have activity above the applicable background only when the blank or sample concentration exceeds the DLC. DLC values shall be calculated according to the equation below and reported with each batch blank and sample result submitted to the DOE-AL facility SMO. This calculation gives the level at which there is a five-percent probability of reporting a false positive result for a sample containing no activity.

$$\text{DLC} = \frac{1.645 \cdot (2 \cdot \text{TBC})^{1/2}}{2.22 \cdot \text{D} \cdot \text{E} \cdot \text{I} \cdot \text{V} \cdot \text{T} \cdot \text{R} \cdot \text{A}}$$

Where, the variables are defined in the same way as those in the MDC calculation of section (a).

- c) Low background MDC and DLC

When at least 35 background counts cannot be obtained, laboratories shall use the equations given below to calculate MDC and DLC. These equations are based upon a blank population approach to determining signal variability, used in the case for which the standard Poisson distribution assumption in the Curie equations is inappropriate due to the low number of background counts.

Laboratories must accumulate data for each parameter, matrix, approximate count time, and digestion/separation procedure to develop blank populations. A single blank population may be used for any digestion/separation process that is common to multiple matrices, provided that reagent volumes and counting times are comparable. As noted in section 3.6.2 of this document, laboratories are not to use sand or any other matrix substitute in radiochemistry preparation blanks associated with DOE-AL facility work. As a consequence, the digestion reagents and separation processes involved in the method define the blank type.

$$\text{MDC} = \frac{4.65 \cdot S_g + 2.71}{2.22 \cdot \text{D} \cdot \text{E} \cdot \text{I} \cdot \text{V} \cdot \text{T} \cdot \text{R} \cdot \text{A}}$$

$$\text{DLC} = \frac{2.33 \cdot S_g}{2.22 \cdot \text{D} \cdot \text{E} \cdot \text{I} \cdot \text{V} \cdot \text{T} \cdot \text{R} \cdot \text{A}}$$

In these equations, the variables in the denominators are defined in the same way as those in the MDC calculation of section (a). S_g is the standard deviation of the blank counts, for which the equation is given below.

$$S_g = \sqrt{\frac{\sum_{i=1}^n (C_i - AC)^2}{n-1}}$$

Where:

C_i = blank counts – background counts
 AC = average of the C_i
 n = the number of blanks in the population

For the low background blank population MDC and DLC approach, laboratories shall count batch blanks on randomly chosen detectors. Each blank shall be subtracted for the current background of the detector it is counted on, with the resulting data (C_i) saved to a file that is specific to the parameter, matrix, approximate count time, and digestion/separation process. At approximately the beginning of each month, the data in those files will be used to calculate new S_g values, which in turn will be used to calculate the MDC and DLC values for that month. The C_i in the data files will be updated monthly to include only data for the 20 most recent blanks of each type.

- d) Radiochemical analytical results shall be reported as measured. That is, the laboratory shall report all results, regardless of concentration or sign, and shall not report any result as "less than the MDC."

3.3.5 Radiochemical Analytical Uncertainty

Radiochemical analytical results shall be accompanied by sample-specific uncertainty bounds that reflect the 67 percent confidence level (1 sigma). The uncertainty bounds shall include not only the measurement counting error, but also a technique-specific error term that includes uncertainty values for each contributing measurement process, and a sample-specific contribution reflecting specific chemical recoveries, detectors used, etc. The Subcontract Laboratory shall examine error contributions such as detector calibration, tracer standardization error, or weighing and pipetting errors, and calculate their contributions to uncertainty. All radiochemical result uncertainties shall incorporate terms for technique-related and sample-specific measurement errors.

3.3.6 QC Exemption for Filter Samples

Various filter samples may be submitted for analysis under this subcontract. The matrix spike and replicate sample analysis requirements in this SOW shall not apply to filter samples because representative splits of these types of samples are generally not obtainable. All other QC criteria shall apply to the analysis of filters unless an insufficient amount of sample remains. A detailed discussion of that condition shall be included in the case narrative when it is encountered.

3.3.7 QC Exemption for Physical Parameters

Acidity, alkalinity, BOD, color, corrosivity, DO, gravimetric oil and grease, hardness, ignitability, pH, titrimetric sulfide, specific conductance, all of the solids methods, and turbidity are exempt from the general inorganic QC requirements described in Section 3.4. These analyses shall be controlled according to the method QC and/or the Subcontract Laboratory's quality control policies.

3.3.8 Reporting for Batch QC

The replicate and spike requirements given in this SOW apply to samples submitted by the LANL SMO. The Subcontract Laboratory shall perform replicates and spikes on LANL samples.

3.3.9 Additional Requirements for the Analysis of Fluoride by IC

Laboratories that run fluoride by ion chromatography must add eluent to all standards and samples to smooth the baseline at the "water ditch" and/or use a column that separates the ditch from the fluoride peak.

3.4 General Inorganic Analytical QC Requirements

Inorganic analytical and quality control requirements are specified in this section of the SOW. The Subcontract Laboratory shall follow the requirements specified in the USEPA SW-846 or as requested by the LANL SMO. Additional general analytical and quality control criteria are specified in the sections 3.4.1 through 3.4.9. Some situations make meeting the quality control requirements given in this SOW difficult or impossible. One such example might be replicate or spike failures where a filtered water sample contains a precipitate that cannot be brought back into solution by warming to ambient temperature and agitation. A Subcontract Laboratory representative shall call the LANL SMO to request an exemption from the reanalysis requirement for quality control failures that are believed to result from unavoidable inhomogeneity or other factors.

3.4.1 Calibration Verification

Required calibration verification data are the initial calibration verification (ICV) and continuing calibration verifications (CCV).

- a) ICV for general inorganic analysis shall be conducted immediately after the instrument has been calibrated. The verification shall consist of analysis of a standard solution within the range of calibration. The ICV standard for general inorganic analysis shall be from a source different from that used to prepare the calibration standards.
- b) CCV for general inorganic analysis shall be conducted every two hours or after every tenth analytical sample, whichever is more frequent. The same standard shall be used for all CCVs. The CCV standard and a calibration blank shall be analyzed at the end of each analysis. (The term "analytical sample" refers to all samples analyzed other than calibration standards, calibration verifications, and calibration blanks. All method or preparation blanks, spiked samples, laboratory control samples,

and laboratory replicates are analytical samples. However, replicate burns in GFAA work are considered to be one analytical sample).

- c) ICV and CCV results shall be within \pm ten percent of the known value except for cyanide (\pm 15 percent) and mercury (\pm 20 percent).
- d) In the event that either the ICV or CCV data fall outside of these limits, the analyst shall initiate corrective actions. If necessary, the instrument shall be recalibrated and all of the samples analyzed since the last successful calibration verification shall be reanalyzed.
- e) No instrument calibration is employed in the methods exempted in section 3.3.7. These analyses are exempt from the instrument calibration verification requirements.
- f) The iodine solution used in sulfide analysis shall be standardized against a certified titrant of known normality at least once a week. The results of solution standardization shall be recorded on the chemist's worksheet, but need not be reported in the QC summary.

3.4.2 Calibration Blanks

Initial calibration blanks (ICB) and continuing calibration blanks (CCB) shall be analyzed immediately following the associated calibration verification samples. The calibration blank matrix shall be the same as that of the calibration verification sample; that is, if the calibration standards and verification samples are digested, then the calibration blanks are also digested.

- a) Calibration blanks shall be analyzed with the same frequency as calibration verifications.
- b) If the absolute value of the CCB result for general inorganic parameters exceeds the RL, the analysis shall be terminated and the problem corrected. Recalibration followed by calibration verification and CCB samples shall be performed prior to resuming the analysis.

3.4.3 Preparation Blanks

Preparation blanks (PB) consisting of DI water and the appropriate reagents shall be included as part of each batch of samples requiring digestion or distillation. A minimum of one preparation blank shall be included for every 20 samples or one per batch. A batch shall not exceed 20 samples.

- a) PB analysis is applicable to all analyses requiring sample preparation prior to analysis, except those cases for which reagents are automatically added to all samples by an autoanalyzer. In the latter case, the initial calibration blank is equivalent to a preparation blank.
- b) If any analyte concentration in the PB exceeds the MDL, the lowest reported concentration in the associated samples must be at least ten times the concentration in the blank. All samples having that analyte's concentration at a value less than ten times that of the blank but greater than the RL shall be redigested and reanalyzed.

3.4.4 Interference Check Samples

- a) Interference check samples (ICS) for ICP-AES analyses shall be analyzed a minimum of twice in each eight-hour shift or at the beginning and end of each analysis run, whichever is more frequent.

The constituent composition of the interference check samples is specified in the CLP SOW. The LANL analytes not covered by the CLP target analyte list (TAL) shall be spiked into the ICS at one mg/L. The true values for the additional analytes shall be calculated using diluted certified standards.

- b) The results for the analytes in the interference check sample (solution AB) shall agree within ± 20 percent of the true value. If this criterion is not met, the analyst shall terminate the analysis. The problem shall be corrected, and the instrument recalibrated before reanalyzing any samples and QC analyzed associated with the ICS not meeting the criterion.
- c) Interference check samples (ICS) for ICP-MS analyses shall be run at the beginning of each analysis run. The composition of interference check samples (solutions A and AB) is specified in Table II of method 6020. The DOE-AL facility analytes not covered in Table II shall be spiked into the ICS.

3.4.5 Serial Dilution

- a) One serial dilution analysis shall be performed for each matrix in every batch, with a minimum of one serial dilution analysis per 20 samples in ICP/AES work. The analysis is accomplished by diluting the sample(s) by a factor of five, and comparing the dilution-corrected results to those for the undiluted sample(s). The serial dilution results shall agree within \pm ten percent of the undiluted sample results where the undiluted results are greater than or equal to 50 times the MDL. Results that fail the acceptance criterion shall be qualified with an "E" when reported. No acceptance criterion applies when the undiluted sample results are less than 50 times the MDL.
- b) One serial dilution analysis shall be performed in ICP-MS work for each matrix in every batch. The analysis is accomplished by diluting the sample(s) by a factor of five, and comparing the dilution-corrected results to those for the undiluted sample(s). The serial dilution results shall agree within \pm ten percent of the undiluted sample results where the undiluted results are greater than or equal to 100 times the preparation blank concentration. Results that fail the acceptance criterion shall be qualified with an "E" when reported. No acceptance criterion applies when the undiluted sample results are less than 100 times the preparation blank concentration.

3.4.6 Linear Range Verification

Semi-annual linear range verification samples shall not be used to justify reporting ICP-AES or ICP-MS analytical results that exceed the calibration range. If desired, the Subcontract Laboratory may analyze a linear range verification sample within each batch for which results exceeding the high calibration standard are to be reported. Results for the linear range verification sample must be within \pm ten percent of the known value, and must be reported with the batch, if this approach is used. All other general inorganic results reported must be within the calibration range.

3.4.7 Laboratory Control Samples

Laboratory control samples (LCS) shall be analyzed using the same sample preparation and analysis methods used for LANL samples, with one LCS analyzed with each batch of up to 20 samples. LCS standards shall derive from a source different from that used to calibrate the instrument. The Subcontract Laboratory shall use LCS reference materials that match the matrix of the samples run, unless such materials are unavailable.

- a) Two exceptions to the LCS requirements are mercury and cyanide. Since the ICV is always digested for these analyses, it is equivalent to a LCS.
- b) Aqueous LCS analytical results shall agree within ± 20 percent of the true value for all general inorganic parameters.
- c) Solid LCS results shall fall within the control limits specified by the entity that prepared the reference material or statistically-derived limits developed by the Subcontract Laboratory. The Subcontract Laboratory shall include the control limits for solid LCS standards in the QC portion of the deliverable. Use of solid LCS with lower control limits of less than 30% or upper control limits greater than 150% is prohibited.
- d) If the LCS data fail to meet the specified acceptance criterion, the analysis shall be terminated and the samples associated with that LCS shall be redigested and reanalyzed, except as noted in (e), below.
- e) Exceptions to the reanalysis requirement are silver and antimony. LCS failures for silver and antimony shall be discussed in the case narrative but shall not be subject to the reanalysis requirement of d) above.

3.4.8 Replicate Analyses

One replicate sample shall be analyzed from each batch, with a minimum frequency of one per 20 samples.

- a) The replicate relative percent difference (RPD) is the measure of precision used for all general inorganic constituents. The RPD is calculated as follows:

$$\text{RPD} = \frac{|S - R|}{(S+R)/2} \times 100 \%$$

where, RPD = relative percent difference
S = sample value (original)
R = replicate sample value

The RPD shall be less than or equal to 20 percent for samples with concentrations greater than or equal to five times the RL. For samples with concentrations less than five times the RL but greater than the RL, the control limit is \pm RL. No precision criterion applies to samples with concentrations less than the RL.

- b) If the above criteria are not met for filtered water samples, or solid samples that have been crushed and homogenized, all samples in the analytical batch must be redigested and reanalyzed. If the replicate precision criteria are not met in the second analysis, the results associated with the best replicate result shall be reported and qualified with the "" flag as specified in section 4.1.9 (e) of this SOW. For unfiltered water samples and solid samples that have not been crushed and homogenized, results associated with a failed replicate analysis may be qualified with the "" flag as specified in section 4.1.9 (e) of this SOW and reported without reanalysis.
- c) Samples identified as field or equipment blanks shall not be used to satisfy the replicate analysis requirement.

3.4.9 Spiked sample analyses

Matrix spike analyses are performed as a measure of the ability to recover analyte. As with replicate analyses, the minimum frequency is one per batch or one per 20 samples, whichever is more frequent.

- a) The percent recovery for spiked samples is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{SSR} - \text{SR}}{\text{SA}} \times 100 \%$$

where, SSR = spiked sample result
SR = sample result
SA = spike added

- b) Matrix spikes shall be performed for all analytes other than sodium, potassium, magnesium, calcium, and the parameters listed in section 3.3.7. In addition to the exceptions listed here, aluminum and iron spikes are not required for soil samples. If the control criteria given in section (g) are not met for matrix spike results for filtered water samples, or solid samples that have been crushed and homogenized, all samples in the analytical batch must be re-digested and re-analyzed. If the control criteria are not met for the second matrix spike analysis, the results associated with the best matrix spike analysis shall be qualified "N" and reported. For unfiltered water samples and solid samples that have not been crushed and homogenized, results associated with a failed matrix spike analysis may be qualified and reported without reanalysis unless the results for the matrix spike are less than 30% or greater than 150%. In this case, the Subcontract Laboratory shall contact the LANL SMO for direction on the need for re-digestion and re-analysis of the batch. If the LANL SMO determines that re-digestion and re-analysis are needed, the Subcontract Laboratory shall report and invoice both analyses.
- c) For ion chromatography, ion specific electrode, and colorimetric techniques for which no digestion is employed, analytical spikes shall be analyzed. If an analytical spike result is outside the control criterion specified in section (g), all samples associated with the analytical batch shall be reanalyzed. If the control criterion is not met for the second analytical spike, the results associated with the best of the two spike analyses shall be qualified "N" and reported.
- d) The required spiking levels for CLP "target analytes" are those listed in the CLP SOW except as noted in (f) below.
- e) Laboratories running As, Cd, Pb, Sb, Se, and Tl by axial-viewing ICP-AES rather than GFAA or (ICP-MS, as applicable) shall spike at the CLP furnace AA spiking levels for each parameter.
- f) For general inorganic analytes not addressed in the CLP SOW and not addressed in sections 3.4.9(a) or 3.4.9(e), matrix spikes shall be prepared at meaningful levels to be chosen by the Subcontract Laboratory. The Subcontract Laboratory shall also chose appropriate spiking levels for TCLP extracts.
- g) The matrix spike recovery control limits are 75 to 125 percent. An exception to these control limits is made in the case for which the sample result exceeds four times the spike added, no control limits are applied in this case.
- h) Samples identified as field or equipment blanks shall not be used to satisfy the spike analysis requirement.

3.4.10 CRI and CRA analyses

CRA (AA) and CRI (ICP-AES and ICP-MS) standards are run at the beginning of each analysis run as a measure of accuracy near the reporting limit. CRA standards are prepared with concentrations at the CRQLs (or RLs), and CRI standards are at twice the CRQLs. The results for these analyses are reported on CLP Form II (Part 2) or equivalent. The advisory acceptance criterion for these analyses is 70 to 130 percent recovery. Recoveries outside the advisory limits must be discussed in the associated deliverable case narrative.

3.4.11 Internal standards for general inorganic analyses

- a) It is strongly recommended that internal standards (usually yttrium or scandium) be used in all ICP-AES work to compensate for possible transport effects.
- b) Internal standards are required for ICP-MS. The method guidance, including the control criteria for internal standard intensities given in section 8.3 of method 6020, shall be followed.

3.5 Organic Analytical and QC Requirements

Organic analytical and quality control requirements are specified in this section of the SOW. The Subcontract Laboratory shall follow the requirements specified in the USEPA SW-846 methods as requested by the LANL SMO. Additional general analytical and quality control criteria are specified in sections 3.5.1 through 3.5.10. Method-specific analytical requirements are given in section 3.5.11.

3.5.1 Required Target Analytes and Target MDLs

The target analytes and target MDLs or alternately CRQLs for each method are specified in Attachment 3. For some methods, the required surrogate and internal standard compounds are also specified.

3.5.2 Instrument calibration

Gas chromatograph (GC) and high performance liquid chromatography (HPLC) instrument calibration shall be performed using a minimum of five calibration standards unless otherwise specified in the method. The initial calibration will be verified using a second-source calibration verification standard. Subcontract Laboratories may a) verify the calibration using a second-source standard immediately after the initial calibration, b) use a second-source CCV standard with each analytical run, or c) use a second source LCS. If a second source LCS is used, the LCS must contain all of the compounds in the initial calibration.

a) Calibration acceptance criteria

Method-specific calibration criteria are specified in section 3.5.11 of this SOW. In the absence of method-specific calibration acceptance criteria, the general calibration acceptance criteria are:

- i. The percent relative standard deviation (percent RSD) for the response factors (RF) obtained from the five initial calibration standards must be less than 20 percent unless otherwise specified in the method. If the initial calibration fails this criterion, the Subcontract Laboratory shall take corrective action and perform a new initial calibration.
- ii. The percent difference of the daily or continuing calibration standard RF from the average RF obtained from the initial calibration must be within ± 15 percent unless otherwise

specified in the method. If the daily or continuing calibration fails this criterion, the Subcontract Laboratory shall perform a new initial calibration.

- iii. As described in SW-846 method 8000B, laboratories may use least-squares regression to generate linear calibration curves. Forcing the resulting curves through zero is not recommended. However, if the curves are forced through zero, a correlation coefficient of at least 0.995 must be obtained for the curve to be acceptable. The correlation coefficient of the least of squares (r) must pass without rounding.
- iv. Any deviations from these general requirements (such as non-linear calibration curves) must be approved by the LANL SMO on a case-by-case basis.
- v. Qualitative confirmation results at or above the MDL is required and shall be completed within the method required holding times.

b) Low-concentration soil VOC analysis calibration

For SW-846 methods 8021B and 8260B, a separate initial calibration shall be performed for low-concentration soil samples if the purge vessels or purge conditions used are different from those used for water. Medium-concentration soil extracts may be analyzed using the same purge vessels and initial calibration as those used for water samples.

3.5.3 Quantitation of Optional Compounds

The Subcontract Laboratory shall calibrate the GC instrument using a single standard containing the specified non-target analyte(s). Under such circumstances, the LANL SMO shall provide the Subcontract Laboratory with non-target compound standard material required for instrument calibration, or shall reimburse the Subcontract Laboratory for the purchase of a standard material at its cost.

3.5.4 Sample Preparation

a) VOC analysis

For SW-846 methods 8021B and 8260B, water and soil samples shall be prepared and purged into the GC instrument using method 5030B for aqueous samples or method 5035 for soil and waste samples. The Subcontract Laboratory may employ the VOC screening procedures described in the SW-846 methods 3810 or 3820, to determine if sample dilution is required.

b) VOC soil and solid waste extractions

Any low-concentration soil sample analysis for which a saturated detector response is observed in SW-846 methods 8021B and 8260B shall require a medium-concentration soil analysis. The smallest amount of soil sample on which a low-concentration analysis shall be performed is one gram. Medium and high-concentration soil and solid waste samples shall be extracted using methanol as described in method 5030B or method 5035 for soil and waste samples.

c) Toxicity Characteristic Leaching Procedure (TCLP) VOC extractions

For VOC TCLP extract analyses, the Subcontract Laboratory shall use properly maintained and inspected zero-headspace extraction vessels, as described in SW-846 method 1311, "Toxicity Characteristic Leaching Procedure," to extract samples.

d) Sample extraction and cleanup

Depending upon the characteristics of the sample matrix, the Subcontract Laboratory shall use an appropriate SW-846 3500 series method to extract samples for SW-846 methods 8081A, 8141A, 8151A, and 8270C.

Unless otherwise specified in this SOW, the guidance in the methods shall be followed for cleanup procedures. Initial dilution of extracts to eliminate interferences is generally not allowed due to the attendant harm to surrogate recoveries and detection limits. Extracts shall be subjected to appropriate cleanup steps when visual inspection or surrogate failures indicate that significant matrix interferences exist.

3.5.5 Sample Analysis Acceptance Criteria

The acceptance criteria for organic analyses are specified below. The Subcontract Laboratory at no additional cost to LANL shall reanalyze samples for which the analyses fail to meet these criteria.

- a) Sample extraction and analysis, confirmation of detection, and any required re-analyses, must be performed within the holding times specified in Attachment 4.
- b) The retention time of the surrogate compounds and any detected target analytes must be within the retention time acceptance windows for all columns. Unless otherwise specified in section 3.5.11 or the analytical method, retention time windows shall be calculated using the procedure described in SW-846 method 8000B. Retention times for all compounds in all CCVs must meet the retention time windows derived from the initial calibration, not the windows based on the daily continuing calibration standard.
- c) Unless otherwise specified in section 3.5.11, surrogate compound recoveries must be within the limits given in the specific SW-846 method. Surrogate compound recoveries shall be calculated using the procedure described in SW-846 method 8000B. Reported recoveries shall be accompanied by the applicable acceptance limits. If surrogate recoveries fail the acceptance criteria the sample shall be reanalyzed, typically after performing extract cleanup steps. If the surrogates fail in the second analysis, both results shall be reported and discussed in the case narrative. If the surrogates for the second analysis pass, the successful analysis results shall be reported.
- d) A saturated detector response for target compounds must initiate dilution and reanalysis for those compounds. The sample dilution must be made such that the final concentration of the analyte of interest in the diluted aliquot is greater than the quantitation limit or lowest calibration standard.
- e) The concentration of target analytes in the solution being analyzed must not exceed the concentration of the high calibration standard.
- f) The additional method-specific sample analysis acceptance criteria given in section 3.5.11 must be met.
- g) Method blanks and quality control samples shall be analyzed on the same instrument as the analytical samples.

Internal standards recommended by the method are required. If the Subcontract Laboratory has a valid technical reason for using different internal standard(s), they must receive approval to do so from the LANL SMO prior to sample analysis.

For methods where internal standards are recommended but where the compound(s) were not specified, then the laboratory shall choose one or more internal standards that are similar in analytical behavior to the compounds of interest, and are not expected to be found in the samples as collected by LANL. The internal standard(s) selected by the Subcontract Laboratory for these methods must also be approved by the LANL SMO prior to sample analysis. Unless otherwise specified in section 3.5.11 or in the analytical method, the internal standard shall be calculated and reported using the procedure described in the appropriate method and SW-846 method 8000B.

3.5.6 Blank Analysis

a) Method blank (preparation blank) analysis

A method blank shall be analyzed by the Subcontract Laboratory for all methods at a frequency of once per batch, once per 20 analytical samples, once per sample matrix, or at the frequency specified in the method, whichever is more frequent. Method blanks VOC analyses shall consist of reagent water that has been taken through the same preparation steps (as applicable) as those used for samples. For SW-846 methods 8081A, 8141A, 8151A, and 8270C, soil method blanks shall consist of 30 grams of reagent anhydrous sodium sulfate that has been taken through the same preparation steps as those used for the samples. Matrix-matched blanks (for example the addition of sand) for soil samples are allowed. Method blank acceptance criteria are given below in section (d). The Subcontract Laboratory, at no additional cost to LANL, shall reanalyze samples associated with an unacceptable method blank analysis. Sample analysis may only resume after the method blank has passed the blank acceptance criteria.

b) Instrument blank analysis

For SW-846 methods 8021B and 8260B, an instrument blank shall be analyzed after analysis of a sample or sample dilution that contained a target compound in greater concentration than the initial calibration range, or other contaminant that saturated the instrument's detector. Instrument blanks shall be analyzed in the same purge inlet position as was the contaminated sample and must meet the blank acceptance criteria given in section (d) below. If an instrument blank fails the blank acceptance criteria, the instrument shall be decontaminated and additional instrument blanks analyzed in the same purge inlet port until the blank acceptance criteria are met. Any samples analyzed after a sample that required a subsequent instrument blank shall be re-analyzed at no additional cost to LANL if an instrument blank analysis was not performed, or if the blank acceptance criteria were not met prior to analyzing those samples. Sample analysis may only resume after an instrument blank has passed the blank acceptance criteria.

c) Storage blank analysis

For SW-846 methods 8021B and 8260B, Subcontract Laboratory shall prepare one storage blank sample for each week in the month, at the beginning of each month, and store these in the appropriate sample storage area. Each storage blank sample shall consist of a 40 mL screw-cap volatile sample vial having a Teflon lined septum and filled with reagent water. One storage blank shall be analyzed at the end of each subsequent week. Target analytes measured above the associated MDL (with the exception of the common laboratory contaminants, which shall be reported

if above the RL) shall be reported by telephone and/or fax to the LANL SMO within 24 hours, and discussed in the case narrative of reports for samples stored during the applicable period. The storage blank reporting requirement is waived in the case for which all LANL samples stored during the period were analyzed and showed no detected target analytes.

d) **Blank acceptance criteria**

The acceptance criteria for all blank analyses are:

- i. All sample analysis acceptance criteria for the specific analytical method were met; and
- ii. The concentration of each target analyte found in the blank must be less than the target MDLs listed in Attachment 3. The exceptions for VOC and Semi-Volatile Organic Carbon (SVOC) methods are found in sections 3.5.11 (g) and (h). The blank contamination acceptance criterion can be waived in the case for which LANL samples showed no detected target analytes for compounds detected in the blank with approval from the LANL SMO prior to sample analysis.

3.5.7 Matrix Spike and Matrix Spike Duplicate Analyses

- a) The Subcontract Laboratory shall perform matrix spike (MS) and matrix spike duplicate (MSD) analyses for all methods except toxic organics-13, toxic organics-14, and Method 524.2 as requested by LANL. The Subcontract Laboratory shall not use field blank, equipment blank, or trip blank samples to satisfy this requirement.
- b) MS and MSD analyses must meet all sample analysis acceptance criteria. Unless otherwise specified in section 3.5.11, the MS and MSD accuracy and precision acceptance criteria shall be those calculated by the Subcontract Laboratory using the procedure given in SW-846 method 8000B and the QC acceptance criteria found within the specific SW-846 method. The Subcontract Laboratory will report recoveries and relative percent difference values for MS and MSD analyses in the QC section of deliverables.
- c) The Subcontract Laboratory shall use the spiking compounds specified in SW-846. Where no spiking compounds are specified in the method, The Subcontract Laboratory shall use a representative subset of the target compounds. This target subset shall have the prior approval of the LANL SMO.

3.5.8 Laboratory Control Sample (LCS) analysis

An LCS shall be analyzed by the Subcontract Laboratory for all methods at a frequency of once per Sample Delivery Group (SDG), once per matrix, or once per 20 analytical samples, whichever is more frequent. LCS analyses must meet all sample acceptance criteria. QC acceptance criteria for LCS results shall be derived statistically by each Subcontract Laboratory for each method using the procedure given for QC check samples in SW-846 method 8000B unless specific criteria are given in the SW-846 method. All samples associated with an unacceptable LCS analysis shall be re-extracted and reanalyzed at no additional cost.

The LCS shall be prepared from standard materials that are independent of those used for calibration and contain all of the analytes in the initial calibration if used for second-source calibration verification (see section 3.5.2 of this SOW). If the LCS is not used for second-source calibration verification, "short-list" LCS compounds from the same source as the calibration standards may be used provided that at least one LCS compound is quantitated against each internal standard.

The Laboratory Control Sample (LCS) acceptance windows shall be derived by the Subcontract Laboratory in all cases, with the exception of method published windows. The Subcontract Laboratory must follow the following criteria when establishing windows.

- a) The LCS must contain (at a minimum) the same analytes as the matrix spike samples.
- b) The LCS acceptance windows must not exceed matrix spike acceptance windows.
- c) If a laboratory is going to use published windows (e.g. CLP windows), then laboratory must adhere to all corrective action procedures stated in that method.
- d) For routinely spiked analytes the control windows should be close to 70 – 130%.
- e) For non-routine analytes the recovery windows shall not be less than 10% and not be greater than 150%.
- f) If any analyte fails in the short list LCS corrective action (re-extraction/re-analysis must be performed), irrespective of the matrix spike and matrix duplicate recoveries.
- g) If a full-list is used, up to 5% of the analytes may fail the LCS criteria as long as all compounds meet paragraphs d) and e) above and the failures can be shown to have no effect on data quality. ALL LCS failures and the potential effects on data quality MUST be documented and discussed in the applicable case narrative(s).

3.5.9 Second-column or GC/MS confirmation requirement

Second-column or GC/MS confirmation of compound identification is required where recommended by the method. The Subcontract Laboratory may use a single-standard calibration passing through the origin if using GC/MS as confirmation. If the subcontract laboratory is using a dissimilar column for confirmation then the confirmation column must be held to same QA/QC criteria as the primary. All confirmation results must be reported as part of the QC summary and must include estimated concentrations for confirmed compounds. In addition, confirmation analyses must be discussed in the case narratives of the applicable deliverables.

The Subcontract Laboratory must conduct MDL studies on the columns or on separate instruments used in confirmation analyses. The MDL reported for an analysis requiring second-column or GC/MS confirmation must be the higher of those obtained on the primary column and confirmation column (or instrument).

3.5.10 Use of Data Qualifiers

The Subcontract Laboratory shall adapt and use data qualifiers as described in CLP SOW OLM03.0 when reporting results for all organic analytical methods. Process artifacts (such as aldol condensates) and column degradation products (siloxanes) identified in LANL samples shall be discussed in the case narrative in addition to any data qualification requirements.

3.5.11 Method-Specific Analytical Requirements

The method-specific analytical requirements given below are organized by SW-846 method. The compounds listed in the attachments for the methods below are based upon site needs.

a) Method 8015B, modified for petroleum hydrocarbons by GC/FID

Petroleum hydrocarbon analysis shall be performed using a modified SW-846 method 8015B. Soil samples shall be extracted using methanol, methylene chloride, or other appropriate solvents. Water samples for volatile petroleum hydrocarbons will be purged. Analysis will be via a GC/Flame Ionization Detector (FID) instrument. At the request of the LANL SMO, the instrument may be calibrated for petroleum hydrocarbons based on a range of molecular weights or product type (such as gasoline range organics), or calibrated using a specific petroleum product (such as Fuel Oil No. 2). The capability to identify specific petroleum products that may be present in samples is desired but is not a requirement.

- i. Instrument calibration shall be based on the integrated area for all petroleum hydrocarbon peaks present in standard chromatograms.
- ii. Analysis of an instrument blank is required immediately after instrument calibration.
- iii. Modified 8015B method analyses are exempt from the sample acceptance criteria that require extract cleanup and reanalysis based on surrogate recovery.
- iv. The Subcontract Laboratory must develop and use MS/MSD acceptance criteria following SW-846 Method 8000 requirements or the MS/MSD acceptance criteria are:
 1. Recovery of the spike compounds must be within ± 25 percent of the theoretical value.
 2. The RPD must be ≤ 20 percent.
- v. The concentrations of the LCS compounds shall be near the midpoint of the calibration range. The Subcontract Laboratory shall calculate data acceptance criteria using the procedure for QC check samples given in SW-846 method 8000B.

b) Method 8021B, halogenated and aromatic VOCs by GC

Halogenated and aromatic VOC analysis shall be performed according to the requirements specified in SW-846 method 8021B, "Aromatic and Halogenated Volatiles by GC Using Photoionization and/or Electrolytic Conductivity Detectors."

- i. Analysis of an instrument blank is required immediately after instrument calibration.
- ii. An LCS shall be analyzed for every 20 samples or every batch, whichever is more frequent. The concentrations of the LCS compounds shall be near the midpoint of the calibration range. The Subcontract Laboratory shall calculate data acceptance criteria using the procedure for QC check samples given in SW-846 method 8000B.

c) Method 8081A organochlorine pesticides by GC

Organochlorine pesticide analysis shall be performed according to the requirements listed in SW-846 methods 8081A, "Organochlorine Pesticides by Gas Chromatography

- i. All soil sample extracts shall be subjected to the florisil cartridge cleanup procedure described in method 3620B. Water samples shall also be subjected to the florisil cleanup prior to reporting when matrix spike or surrogate results fail the acceptance criteria.
- ii. Soil, sediment, and biological sample extracts be subjected to the GPC cleanup procedure described in method 3640A when matrix spike or surrogate results fail the acceptance criteria. In addition, all water samples containing high molecular weight compounds that interfere with analysis of the target compounds must also undergo GPC cleanup.
- iii. All sample extracts that are contaminated with elemental sulfur shall be subjected to the sulfur cleanup procedure described in method 3660B.
- iv. An instrument blank consisting of clean solvent containing only the surrogate compounds at 20 µg/L shall be analyzed at the beginning and end of each analytical run sequence, and once every 20 analytical samples.
- v. In addition to Method 8081A acceptance criteria, the following additional sample analysis acceptance criteria are required:
 1. The Subcontract Laboratory shall derive surrogate recovery control limits according to the procedure given in SW-846 method 8000B.
 2. A standard for any identified multi-component analyte must be analyzed during a valid analytical sequence on the same instrument and column within 72 hours of its detection in a sample. The multi-component analyte CCV must pass against a previously analyzed initial calibration.
 3. Chromatographic peaks chosen to quantitate target analytes must be between 10 and 100 percent of full scale. If a chromatogram is replotted, the scaling factor used must appear on the chromatogram. Both the initial and the replotted chromatograms must be submitted with the data package.
 4. Confirmation must be performed on all positive results at or above the MDL. The confirmation analyses and calibration must pass all method QA/QC criteria (the same as the primary column).
- vi. A CCV must be run at least every 20 samples (preferably every 10). Recovery for the CCV compounds must be within ± 15 percent. If the CCV fails this acceptance criterion, analysts must take corrective action and reanalyze all extracts performed since the last successful CCV analysis.
- vii. If an internal standard is used, the internal standard area criteria and corrective actions specified in section 8.4.5 of method 8081A apply.
- viii. An LCS shall be analyzed for every 20 samples or every batch, whichever is more frequent. The LCS shall contain the organochlorine pesticides and a representative multi-component analyte. LCS data acceptance criteria shall be derived by the laboratory according to the procedure for QC check samples given in SW-846 method 8000B.

d) Method 8082 Polychlorinated Biphenyls (PCBs) by GC

PCB analysis shall be performed according to the requirements listed in SW-846 method 8082, "Polychlorinated Biphenyls by GC."

- i. $\text{H}_2\text{SO}_4/\text{KMnO}_4$ cleanup (method 3665A) is strongly recommended for all sample extracts.
- ii. Sulfur cleanup SW-846 Method 3660B) shall be used when extracts are contaminated with elemental sulfur.
- iii. LANL SMO may request that the Subcontract Laboratory report the seven target Aroclors (see Table VIA in Attachment 3) for this analysis. However, if the target PCB congeners are requested, decachlorobiphenyl (DCB) shall be used as an internal standard by adding it to each calibration standard and sample extract, including QC samples. In this latter case, tetrachloro-meta-xylene is used as a surrogate.
- iv. When PCBs are to be reported as Aroclors, decachlorobiphenyl and tetrachloro-meta-xylene shall be added to each sample extract as surrogates.
- v. A QC reference sample (method 8082, section 8.3.1) containing the target Aroclors, Aroclors 1016 and 1260, or specific target PCB congeners as appropriate shall be analyzed for every 20 samples or every batch, whichever is more frequent. Recovery for the reference sample compounds must be within ± 20 percent. If the reference sample fails this acceptance criterion, analysts must take corrective action and/or recalibrate.
- vi. A CCV must be run at least every 20 samples (preferably every 10). Recovery for the CCV compounds must be within ± 15 percent. If the CCV fails this acceptance criterion, analysts must take corrective action and reanalyze all extracts run since the last successful CCV analysis.
- vii. If an internal standard is used, the internal standard area criteria and corrective actions specified in section 8.3.3 of method 8082 apply.
- viii. An LCS shall be analyzed for every 20 samples or every batch, whichever is more frequent. The LCS shall contain the Aroclor 1016/1260 mixture. LCS data acceptance criteria shall be derived by the laboratory according to the procedure for QC check samples given in SW-846 method 8000B.
- ix. In addition to the acceptance criteria of SW846 Method 8082, the following sample analysis acceptance criteria are required:
 1. The laboratory shall conduct 2nd column or GC/MS confirmation on all detected Aroclors or PCB congeners, as appropriate.
 2. A standard for any identified multicomponent analyte must be analyzed during a valid analytical sequence on the same instrument and column within 72 hours of its detection in a sample.
 3. Chromatographic peaks chosen to quantitate target analytes must be between 10 and 100 percent of full scale. If a chromatogram is replotted, the scaling factor used must appear on the chromatogram. Both the initial and the replotted chromatograms must be submitted with the data package.

4. Confirmation must be performed on all positive results at or above the MDL. The confirmation analyses and calibration must pass all method QA/QC criteria (the same as the primary column).

e) Method 8141A, organophosphorus pesticides by GC

Organophosphorus pesticide analysis shall be performed according to the requirements listed in SW-846 method 8141A, "Organophosphorus Compounds by GC."

- i. The Subcontract Laboratory shall use an organophosphorus pesticide that is not expected to be present in samples as the surrogate compound. The Subcontract Laboratory must contact the LANL SMO for guidance and approval in selection of the surrogate compound.
- ii. GPC cleanup of sample extracts is not permitted. Florisil or sulfur cleanup may be required for certain samples. If the florisil or sulfur extract cleanup procedure is specified, the Subcontract Laboratory shall demonstrate analyte recovery greater than 85 percent prior to use.
- iii. In addition to Method 8141A acceptance criteria, the following additional sample analysis acceptance criteria are required:
 1. The recovery for the surrogate compounds must be greater than or equal to 60 percent and less than or equal to 150 percent.
 2. Chromatographic peaks chosen to quantitate target analytes must be between 10 and 100 percent of full scale. If a chromatogram is replotted, the scaling factor used must appear on the chromatogram. Both the initial and the replotted chromatograms must be submitted with the data package.
 3. Confirmation must be performed on all positive results at or above the MDL. The confirmation analyses and calibration must pass all method QA/QC criteria (the same as the primary column).
- iv. The LCS shall contain each of the target organophosphorus pesticides. The Subcontract Laboratory shall calculate data acceptance criteria using the procedure for QC check samples given in SW-846 method 8000B.
- v. The guidelines for GC/MS compound confirmation given in Method 8141A shall be followed.

f) Method 8151A, chlorinated herbicides by GC

Chlorinated herbicide analysis shall be performed according to the requirements listed in the SW-846 methods 8151A, "Chlorinated Herbicides by GC Using Methylation or Pentafluorobenzoylation Derivatization: Capillary Column Technique."

- i. The Subcontract Laboratory shall use 2,4-dichlorophenylacetic acid (DCAA) as a surrogate standard to monitor the performance of the method's extraction and analysis steps. DCAA shall be added to standards, blanks, and all analytical samples. If DCAA is expected to be present in samples, the Subcontract Laboratory shall use a chlorinated herbicide not present in samples as the surrogate compound. The Subcontract Laboratory must contact the LANL SMO for guidance and approval in selection of the surrogate compound.
- ii. In addition to Method 8141A acceptance criteria, the following additional sample analysis acceptance criteria are required:

1. The recovery for the surrogate compounds must be greater than or equal to 60 percent and less than or equal to 150 percent.
 2. Chromatographic peaks chosen to quantitate target analytes must be between 10 and 100 percent of full scale. If a chromatogram is replotted, the scaling factor used must appear on the chromatogram. Both the initial and the replotted chromatograms must be submitted with the data package.
 3. Confirmation must be performed on all positive results at or above the MDL. The confirmation analyses and calibration must pass all method QA/QC criteria (the same as the primary column).
 4. Calculate sample results as described in Method 8000B only if the calibration standards have been analyzed in the same manner as the samples (standards have undergone the same hydrolysis and esterification steps required by the method for the samples). If calibration is performed using standards prepared from the methyl esters, then the calculated concentrations must include correction factors for the molecular weight differences between the methyl ester and the acid herbicide.
- iii. A CCV must be run at least every 10 samples. Recovery for the CCV compounds must be within ± 15 percent. If the CCV fails this acceptance criterion, analysts must take corrective action and reanalyze all extracts run since the last successful CCV analysis.
- iv. The LCS shall contain each of the specified target chlorinated herbicides. The Subcontract Laboratory shall derive data acceptance criteria using the procedure for QC check samples given in SW-846 method 8000B.
- g) Method 8260B and CLP VOC analysis by GC/MS

VOC analysis shall be performed according to the requirements listed in the SW-846 method 8260B, "VOCs by GC/MS" or the CLP method. The LANL SMO shall specify which method will be used for analysis. If EPA method 524.2 or a 25 mL purge is requested, the Subcontract Laboratory must determine whether the 8260 analyte list is adequate to meet LANL SMO requirements. If a 25 mL purge is used, the Subcontract Laboratory must discuss that fact in the case narrative.

- i. For method 8260B, the minimum average response factor for the initial calibration's system performance check compounds (SPCCs) shall be 0.10 for chloromethane, bromoform, and 1,1-dichloroethane, and 0.30 for 1,1,2,2-tetrachloroethane, and chlorobenzene. These criteria also apply to daily continuing calibration verification standards. The minimum response factor for all other analytes shall be greater than 0.05.
- ii. A method blank consisting of reagent water shall be run once every 12 hours immediately after the initial calibration standard or the continuing calibration standard.
- iii. For method 8260B, the concentration of methylene chloride blank analyses must be less than 2.5 times the required RL, and the concentration of acetone and 2-butanone must be less than five times their required RL.
- iv. For method 8260B, the additional sample analysis acceptance criteria are:

1. The extracted ion current profile (EICP) area for each of the internal standards must be between 50 and 200 percent of the response for the internal standard in the most recent continuing calibration standard.
 2. The retention time for each of the internal standards must be within 30 seconds of the associated retention time in the most recent continuing calibration standard.
 3. No quantitation ion may saturate the instrument's detector. Blank analyses must follow immediately when this occurs, and additional decontamination procedures employed as necessary.
- v. An LCS must be included in each analytical batch. See sections 3.5.2 and 3.5.8 of this SOW for LCS requirements. The Subcontract Laboratory shall calculate percent recovery acceptance criteria by the using the procedure for QC check samples in SW-846 method 8000B.
- vi. The Subcontract Laboratory shall tentatively identify and report up to 20 non-target compounds having the greatest apparent concentration in the sample and whose response is greater than ten percent of the nearest internal standard. These compounds shall be tentatively identified and quantitated following the guidelines provided within the specific analytical method being used.
- vii. The linearity requirements of method 8260B, section 7.3.8, apply (RSD for target analytes must be 15% or less). Refer to section 3.5.2 of this SOW for least-squares regression calibration options.
- viii. The acceptance criteria (80 to 120 percent recovery) and corrective actions (recalibrate if the problem cannot be corrected) for calibration check compounds given in section 7.4.5 of the method shall be strictly followed. The calibration check compounds are listed in section 7.3.6.3 of the method. These criteria apply to both initial and continuing calibration verification analyses.
- h) Method 8270C and CLP SVOC analysis by GC/MS

SVOC analysis shall be performed according to the requirements listed in the SW-846 method 8270C, "SVOC by GC/MS" or the CLP SVOA method. The LANL SMO facility shall specify which method will be used for analysis. The LANL SMO may request analysis for the target analytes listed in EPA method 625, "Base/Neutrals and Acids." However, the Subcontract Laboratory shall use method 8270C to perform the actual analysis. For such analyses the Subcontract Laboratory shall adhere to the analytical and QC requirements specified in this SOW for method 8270C and the method itself; only the required target analyte list shall change.

- i. For the CLP method, all soil, sediment, and biological sample extracts must undergo GPC cleanup using method 3640A. For SW-846 method 8270C, GPC cleanup shall be used as necessary to eliminate interferences. In addition, all water samples containing high molecular weight compounds that interfere with analysis of the target compounds must also undergo GPC cleanup.
- ii. For method 8270C, the additional sample analysis acceptance criteria are same as those given above in section 3.5.11 (g) (iv) for VOC analysis by GC/MS.
- iii. An LCS must be included in each extraction batch of up to 20 samples. See sections 3.5.2 and 3.5.8 of this SOW for LCS requirements. The Subcontract Laboratory shall calculate

percent recovery acceptance criteria by the using the procedure for QC check samples in SW-846 method 8000B..

- iv. The Subcontract Laboratory shall tentatively identify and report up to 30 non-target compounds having the greatest apparent concentration in the sample and whose response is greater than ten percent of the nearest internal standard. These compounds shall be tentatively identified and quantitated following the guidelines provided in the specific analytical method being used.
 - v. The target phthalate esters are exempt from the method blank reanalysis requirements if found at concentrations less than five times the RL.
 - vi. The calibration linearity, decafluorotriphenylphosphine (DFTPP) tuning, method blank, system performance check compounds (SPCC), and calibration check compound (CCC) requirements of the SW-846 method apply to all analyses.
- i) Method 8280A, polychlorinated dioxins and furans by GC/MS
- Sample analysis shall be performed according to the requirements listed in the SW-846 method 8280A, "The Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans by High Resolution GC/Low Resolution MS."
- i. The Subcontract Laboratory shall use the internal standard, recovery standard, and the cleanup standard compounds listed in Table 3 of the method.
 - ii. The GC/MS tune shall be checked daily. The relative ion abundance criteria listed in Table 9 of the method must be met for all standard and target compounds in all standard and sample analyses.
 - iii. Initial calibration shall be performed using the five calibration solutions listed in Table 1 of the method. The percent RSD for the internal standards and the target compounds for the five calibration standards must be less than 15 percent.
 - iv. Calibration verification shall be performed once every 12 hours using the standards solution given in Table 4 of Method 8280A. The calibration verification analysis must meet the criteria given in section 7.13.3.6 of Method 8280A.
 - v. Internal standard recovery for analytical samples must be ≥ 25 percent and ≤ 150 percent. Samples that fail this criterion must be re-extracted and re-analyzed.
 - vi. The identification criteria given in section 7.14.5 of Method 8280A must be met for all target analytes reported as being present in samples. Sample-specific estimated detection limits, estimated maximum possible concentrations, and toxic equivalent concentrations shall be calculated as outlined in section 7.15 of Method 8280A and reported by the Subcontract Laboratory.
 - vii. MS and MSD samples shall be prepared using the compounds listed in Table 5 of Method 8280A.
 - viii. The LCS requirements given in section 8.4 of Method 8280A apply.
 - ix. The column resolution between 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD) and all other unlabeled tetrachlorodibenzodioxin (TCDD) isomers must meet the resolution criterion of less than 25% valley between 2,3,7,8-TCDD and the closest eluting TCDD isomer.

- x. for positive identification of compounds, the retention time criteria given in section 7.14.5.1 and the signal to noise criteria in section 7.14.5.3 of Method 8280A must be met.

j) Method 8318, N-methylcarbamate pesticides by HPLC

Analysis of N-methylcarbamate pesticides shall be performed according to the requirements specified in the SW-846 method 8318, "N-Methylcarbamates by High Performance Liquid Chromatography (HPLC)."

- i. The Subcontract Laboratory shall use a surrogate compound to monitor the analytical system. The surrogate compound should be a carbamate pesticide that is not expected to be present in the samples. The Subcontract Laboratory shall consult the LANL SMO for guidance on the choice of the surrogate compound prior to analysis of samples.
- ii. The method blank shall be analyzed immediately after instrument calibration and before sample analysis.
- iii. Target analytes detected in samples will be confirmed by substituting the sodium hydroxide and o-phthalaldehyde for reagent water in the post column reactor and reanalyzing the extracts. Continued fluorescence response indicates the presence of an interferent.
- iv. The MS/MSD shall be analyzed with each batch of up to 20 samples. The Subcontract Laboratory shall spike directly and analyze the extract of the sample associated with an unacceptable MS or MSD recovery in order to check for interference due to quenching. The result of quench check analyses shall be discussed in the case narrative.
- v. Each extraction batch (up to a maximum of 20 samples) shall include an LCS. The Subcontract Laboratory shall calculate percent recovery acceptance criteria by the using the procedure for QC check samples in SW-846 method 8000B.
- vi. Confirmation must be performed on all positive results at or above the MDL. The confirmation analyses and calibration must pass all method QA/QC criteria (the same as the primary column).

k) Method 8330, nitroaromatics and nitramines by HPLC

Nitroaromatics and nitramines analysis shall be performed according to the requirements specified in the SW-846 method 8330, "Nitroaromatics and Nitramines by HPLC."

- i. The Subcontract Laboratory shall use an appropriate surrogate compound to monitor the performance of this analytical method.
- ii. Daily calibration response factors for the surrogate and target compounds on both columns shall agree within ± 15 percent of the average response factor obtained from the initial calibration.
- iii. The instrument blank shall be analyzed immediately after instrument calibration and before sample analysis.
- iv. The MS/MSD acceptance criteria shall be:

1. Recovery of the spike compounds must be within ± 25 percent of the theoretical value except for methyl-2,4,6-trinitrophenylnitramine (tetryl). Subcontract Laboratory-derived acceptance limits shall be used for recovery of that compound.
 2. The RPD must be ≤ 20 percent for all spike compounds except where tetryl is used. Subcontract Laboratory-derived precision acceptance limits shall be used for that compound.
 3. Confirmation must be performed on all positive results at or above the MDL. The confirmation analyses and calibration must pass all method QA/QC criteria (the same as the primary column).
- v. The LCS shall contain all of the target analytes at concentrations near the midpoint of the calibration range. The Subcontract Laboratory must develop LCS acceptance criteria following SW-846 Method 8000 requirements or the recovery for the target analytes must be within ± 20 percent of the theoretical value except for tetryl. Subcontract Laboratory-derived acceptance limits shall be used for recovery of that compound.
- vi. All detections must be confirmed by analysis on a cyano column.
- l) [RESERVED]
- m) Method TO-14A, VOCs in ambient air using GC
- Analysis shall be performed according to the requirements specified in EPA method TO-14A, "Determination of VOCs in Ambient Air Using SUMMA[®] Passivated Canister Sampling and Gas Chromatographic Analysis," revision 1.0.
- i. A GC/MS analytical system shall be used.
 - ii. Canisters obtained from the Subcontract Laboratory shall be certified as containing less than 0.2 ppbv VOCs through humid zero air analysis as described in EPA Method TO-14A.
 - iii. An acceptable daily humid zero air instrument blank, as described in EPA Method TO-14A, shall be analyzed immediately prior to and after instrument calibration. These instrument blanks must be less than 0.2 ppbv for all target analytes before analysis may proceed.
 - iv. For GC/MS analytical systems, the GC/MS system tune check shall be performed daily prior to sample analysis by sampling a canister containing BFB. The BFB tune check mass spectrum shall meet the ion abundance criteria listed in Table 4 of Method TO-14A. If the relative abundance for any of the ions listed Table 4 differs by \geq ten percent from those obtained during the previous day's BFB tune check, the instrument must be re-calibrated.
 - v. Initial instrument calibration shall be performed using three standard concentration levels and a humid zero air standard. Daily calibration verification shall be performed using a mid-range standard. Recoveries for the target analytes in the calibration verification standard must be within ± 20 percent of the known values.
 - vi. As discussed in Method TO-14A, the retention time windows for all target analytes must be checked via the analysis of three standards at least once every 72 hours.

- vii. As discussed in Method TO-14A, the retention time for compounds identified in samples must be within ± 0.1 minutes of the theoretical retention times resulting from the calibration or retention time check runs.
- viii. However, the relative abundance of quantitation ions must be within ± 15 percent of those in the applicable reference mass spectra. Exceptions to this requirement are vinyl chloride and methylene chloride, for which the acceptance criterion is ± 25 percent.
- ix. MS and MSD are not required for this method.
- x. The LCS shall contain all of the target analytes at concentrations near the midpoint of the calibration range. Recovery for the target analytes must be within ± 20 percent of the theoretical value.

3.6 Radiochemistry Analytical QC Requirements

Standards used in batch quality control analyses, such as LCS and spiking standards, need not be NIST traceable. Standards requiring NIST traceability are discussed in the calibration section (3.6.9) below.

3.6.1 Calibration Verification

Calibration verification samples and calibration blanks are not required for radiochemistry batch QC. This statement refers only to batch QC and in no way diminishes the calibration requirements given in section 3.6.9 of this SOW.

3.6.2 Preparation Blanks

One preparation blank shall be included for every 20 samples or one per batch, at a minimum. An empty or water-filled container for the appropriate geometry shall be analyzed for gamma spectroscopy. Subcontract Laboratories shall not use silica sand or any other matrix substitute except water in preparation blanks for solid sample analyses. Artificial urine may be used in preparation blanks for urine sample analyses.

- a) Preparation blank analysis is applicable to all analyses requiring sample preparation prior to analysis. Preparation blank results shall be calculated assuming aliquot sizes comparable to the sample aliquots used in the analysis.
- b) If any blank result is greater than its associated DLC, the case narrative for that deliverable shall specifically discuss that fact.
- c) Samples associated with any preparation blank result that is greater than its associated MDC shall be redigested and reanalyzed. Exceptions to this requirement are samples for which the measured concentration is greater than or equal to five times the preparation blank value. Reanalysis is not required for such samples.

- d) Preparation blanks for alpha spectrometry, gas flow proportional counter, and Lucas cell techniques shall be placed randomly or sequentially, such that the blank position varies from batch to batch. Instrument analyzed logs shall be maintained to demonstrate compliance with this requirement.

3.6.3 Laboratory Control Samples

Laboratory control samples (LCS) shall be analyzed using the same sample preparation and analysis methods used for LANL samples. One LCS shall be analyzed with each batch of up to 20 samples. LCS standards shall derive from a source different from that used to calibrate the instrument.

- a) A Subcontract Laboratory representative shall call the LANL SMO for assistance if solid LCS standards appropriate to requested analyses cannot be obtained. Aqueous LCS standards shall be analyzed if neither the Subcontract Laboratory nor the LANL SMO can obtain appropriate solid LCS materials.
- b) The aqueous LCS analytical results shall agree within ± 20 percent of the true value unless the laboratory has sufficient historical evidence to support a different control limit that is documented as described in Section 2.1.1, Methods, Quality Control, and Documentation..
- c) Solid LCS results shall fall within the control limits specified by the entity that prepared the reference material or within the statistically-derived limits developed by the laboratory. The Subcontract Laboratory shall include the control limits in the QC portion of the deliverable.
- d) If the LCS data fail to meet the applicable acceptance criterion, all samples associated with that LCS shall be re-digested and reanalyzed. If an insufficient sample amount remains for reanalysis and the LCS recoveries are greater than 150% or less than 30%, then the LANL SMO must be immediately notified.
- e) LCS results reported with the quality control data for gamma spectroscopy shall include Am-241 [59.5 kilo electron volts (keV)], Cs-137 (661.7 keV), and Co-60 (1332 keV) at minimum.

3.6.4 Replicate Analyses

One replicate sample shall be included for every 20 samples or one per batch, at a minimum.

- a) The replicate error ratio (RER) is used to determine replicate precision for radiochemical results. The RER is given by:

$$\text{RER} = \frac{|S - R|}{\sigma_{95}S + \sigma_{95}R}$$

where, RER = replicate error ratio

S = sample value (original)
R = replicate sample value
 $\sigma_{95}S$ = sample uncertainty (95%)
 $\sigma_{95}R$ = replicate uncertainty (95%)

Radiochemical replicate determinations shall agree when the 95 percent confidence level uncertainties are considered. That is, the RER shall be less than one.

- b) If the RER control criterion is not met for filtered water samples, or for solid samples that have been crushed and homogenized, all samples in the analytical batch must be redigested and reanalyzed (see the exceptions in 3.6.4 d) & e) below). The result associated with the best replicate analysis shall be reported and the discrepancy noted in the case narrative. For unfiltered water samples and solid samples that have not been crushed and homogenized, results associated with a failed replicate analysis shall be qualified and reported without reanalysis or redigested and reanalyzed as described above at the Subcontractor's discretion.
- c) Samples identified as field or equipment blanks shall not be used to satisfy the replicate analysis requirement.
- d) Replicate analyses may not be possible in ^3H analysis when the moisture content is too low or the sample size is too small. A discussion of this problem shall be included in the case narrative if ^3H replicates cannot be analyzed.
- e) Circumstances occasionally preclude adequate homogenization of samples. Examples of this are some plutonium analyses and samples from areas where depleted uranium munitions have been used. When the Subcontract Laboratory believes that the reanalysis requirement should be waived in a specific case due to unavoidable non-homogeneity, the Subcontract Laboratory shall seek LANL SMO approval for suspension of the reanalysis requirement.

3.6.5 Spiked Sample Analyses

Matrix spike analyses are performed on field samples as a measure of the ability to recover analytes. As with replicate analyses, the minimum frequency is one per batch or one per 20 samples, whichever is more frequent.

- a) If a matrix spike result is outside the control criterion specified in section 3.6.5 (d), all samples associated with the analytical batch shall be redigested and reanalyzed. As described in Section 3.6.4 above addressing replicate analyses, unfiltered water samples and unprepared solid samples are exempt from the reanalysis requirement. Results for unfiltered water samples and unprepared solid samples for which the matrix spike failed the acceptance criterion may be qualified and reported without reanalysis.
- b) Matrix spikes are not required for gamma spectroscopy, Rn-222, ^3H , or any analyses utilizing a tracer or carrier that is chemically identical to the analyte. In addition, Ra-226 analyses that employ a Ba-133 tracer are exempt from the matrix spike requirements.
- c) Sample spiking levels for radiochemical analyses shall not exceed 100 pCi/L or 100 pCi/g.
- d) The spike recovery control limits are ± 25 percent, with the following exception. When the sample result exceeds four times the amount of spike added no control limits shall apply.
- e) Samples identified as field or equipment blanks shall not be used to satisfy the spike analysis requirement.

- f) The considerations of sections 3.6.4 (d) and (e) may also apply to the matrix spike analysis and reanalysis requirements. The actions recommended in those sections should be followed if applicable.

3.6.6 Chemical Recovery Requirements for Radionuclides

- a) Correction of analytical results for radionuclide chemical recovery shall be performed sample specifically unless the LANL SMO has given prior approval for a batch-correction procedure.
- b) Recovery guidelines for tracer and carrier results shall be 50 to 105 percent. The LANL SMO is aware that the tracer recovery requirements cannot be met for some difficult matrices. Recoveries that do not meet the acceptance criterion given in this paragraph must be approved by the LANL SMO prior to submission of the deliverable.
- c) The concentration of tracer material added shall be sufficient to result in a maximum of ten percent uncertainty at the 95 percent confidence level in the measured recovery.

3.6.7 Blank Subtraction Process

Blank subtraction shall be done only in liquid scintillation counting. Results for the other counting techniques shall be corrected for instrument background only, and shall not be blank subtracted.

Three blanks must be utilized for liquid scintillation. The detector background is measured with the blank from the vendor's QC set, sample results are subtracted for calibration blank results, and random contamination is identified and reported via the preparation blank results.

- a) The data from the vendor's blank are used to assess instrument background.
- b) The calibration blank contains the scintillation "cocktail" and any reagents added to the batch, and is placed in a vial from the same lot used for the samples, but is not subjected to the separation or distillation steps/apparatus. The calibration blank is used to determine the background for a particular batch of samples. This result is subtracted from all the samples in the batch.
- c) The preparation blank is used to identify contamination from sample preparation processes. Preparation blanks are made in the same way the calibration blanks are, but are additionally subjected to the same separation or distillation steps used for the samples. This result is reported as preparation blank and is not subtracted from each sample result.

3.6.8 Target *A Priori* MDCs

The tables in Attachment 2 give target minimum detectable concentration values for radionuclide analyses by analytical technique and matrix. The Subcontract Laboratory shall adjust analytical conditions to meet the target MDCs. For gamma spectroscopy, Cs-137 and Co-60 shall be reported for every sample. Analytical conditions shall be adjusted to meet the specified MDCs for those radionuclides. The analytical conditions chosen will determine the MDCs for other reported nuclides.

3.6.9 Counting instrument calibration requirements

Radionuclide analyses that do not involve nuclear disintegrations are defined to be general inorganic analyses. Such analyses are subject to the analytical and quality control requirements in the appropriate section of this SOW. This applies to uranium determination by fluorimetry and ICP-MS, as well as any radionuclide determinations by column-extraction/flow-injection ICP-MS. Radiochemistry counting instruments are subject to the minimum calibration requirements given below.

Primary calibration shall be performed using NIST traceable standards except where such standards are unavailable. The words "check" and "verification" below apply to measurements performed to verify the primary calibrations. Standards used for this purpose shall be independent of the primary calibrants, and shall also be NIST traceable or have been directly compared with NIST standards. If such verifications fail, the Subcontract Laboratory shall reassess all data acquired since the last successful check and notify the LANL SMO of the outcome of the reassessment.

a) Gas flow proportional counting

- i. Long background counts (1000-minute minimum) shall be performed at least monthly.
- ii. Daily background checks shall be performed.
- iii. Detector efficiency shall be determined at least annually, with recalibration performed when daily checks (see below) fail the laboratory's acceptance criteria.
- iv. Detector efficiency checks shall be performed daily before use.
- iii. Mass attenuation curves shall be generated at least annually.
- iv. Voltage plateau curve determinations shall be made at least annually, with performance checks made after each gas bottle change or maintenance activity.
- v. Cross talk determinations shall be made at least annually.
- vi. Laboratory calibration procedures shall require that backgrounds be checked after counting high-activity samples.

b) Alpha spectrometry

- i. Background counts equal in duration to the longest expected sample count time shall be performed at least monthly.
- ii. Energy/channel calibrations shall be performed at least annually, with verification performed at least monthly.
- iii. Detector efficiency shall be determined at least annually, with verification performed at least monthly.
- iv. Laboratory calibration procedures shall require that backgrounds be checked after counting high-activity samples.

c) Gamma spectroscopy

- i. Calibration background counts equal in duration to the longest expected sample count time shall be performed at least monthly, with verification performed weekly. Use of the method blank for weekly background checks is acceptable, provided that the data are compared to the original calibration background.
- ii. Energy/channel calibrations shall be performed at least annually, with verification performed weekly.
- iii. Efficiency calibrations shall be performed at least annually, with verification performed weekly.
- iv. Resolution calibrations shall be performed annually, with verification performed weekly.

d) Liquid scintillation

- i. Efficiency/quench curves shall be established at least annually for each radionuclide to be counted, with daily verification checks performed.
- ii. The vendor-supplied set of calibration vials shall be analyzed with each sample batch.
- iii. Each batch shall contain a batch blank vial to be used for blank subtraction.

e) Kinetic phosphorescence analysis (KPA) for uranium

KPA shall not be used in the analysis of LANL samples. ICP-MS is the preferred technique for total uranium determinations; however, fluorimetry may also be used.

f) Alpha scintillation (Ra-226 by Rn emanation)

- i. The efficiency of detector/cell combinations (cell constants) shall be determined at least annually, with verification after maintenance activities.
- ii. Detector background shall be measured before counting each sample.

3.6.10 Reporting Non-Target Radionuclides in Gamma Spectroscopy

The Subcontract Laboratory shall only report non-target radionuclides that are man-made and are identified with a high degree of confidence using the gamma spectroscopy software. These non-target radionuclides shall be reported without any additional charge to LANL, only if requested by the LANL SMO.

3.6.11 Reporting K-40 for soils in gamma spectroscopy

⁴⁰K shall be reported in every soil sample, if ⁴⁰K is not found in the soil sample, the Subcontract Laboratory shall provide a correct action report with the sample analysis report.

3.7 Asbestos Analysis

3.7.1 Accreditation

The Subcontract Laboratory must be accredited by the American Industrial Hygiene Association (AIHA) to be eligible to perform airborne asbestos analysis for LANL under this subcontract. Subcontract Laboratories must participate in and report results to the LANL SMO for all performance evaluation rounds to demonstrate that the accreditation is current. In addition, the LANL SMO must receive copies of each report, response and close-out letter for audits performed by the accrediting agency.

3.7.2 Staff Qualifications

Individuals performing the preparation and phase-contrast microscopy analysis of airborne asbestos filters shall have successfully completed the NIOSH 582 course. Individuals analyzing bulk samples shall have successfully completed the McCrone Research Institute course in polarized-light microscopy identification and quantitation of asbestos minerals in bulk samples.

3.7.3 Quality Control

- a) The Subcontract Laboratory performing airborne asbestos analysis shall conform to the requirements of the accrediting agency, including participation in the Proficiency Analytical Testing (PAT) program and the inter-laboratory sample exchange program. In addition, archived PAT program samples shall be analyzed with every sample batch and reported with the batch results. The known values and acceptance windows provided by the PAT program shall be used as acceptance criteria. The Subcontract Laboratory QA officer or his/her designee shall periodically re-label the known samples so that they are submitted as blinds to the analyst.

- b) The Subcontract Laboratory performing bulk asbestos analysis shall conform to the requirements of the AIHA, including participation in the AIHA Bulk Asbestos Proficiency Analytical Testing Program. Participation in the NIST National Voluntary Laboratory Accreditation Program for bulk asbestos is also recommended. The Subcontract Laboratory is encouraged to retain samples from those programs and submit them as blinds with each batch as specified above for airborne samples. Required QC practices in the Subcontract Laboratory procedures shall include verification of microscope alignment and performance. Specific QC practices for particular asbestos types and matrices shall be determined by mutual agreement between the Subcontract Laboratory and the LANL SMO.

4.0 ANALYTICAL DATA DELIVERABLE REQUIREMENTS

A Case Narrative shall be included in every hardcopy deliverable. Required components of the case narrative follow:

- Laboratory name
- Request Number (RN)
- Sample numbers included in the RN
- Documentation of quality control, sample, shipment and/or analytical problems in processing the sample, anomalies noted in the data, decision trees/corrective actions taken to solve problems, and other information that might be of use to the data review personnel or users of the data in making decisions.

In addition, the case narrative shall contain the following statement:

“I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, except as detailed in this case narrative.”

This statement shall be immediately followed by the name of the Subcontract Laboratory Manager or designee, their title, and the date of signature. The hardcopy of the case narrative shall be signed in original and dated by the Laboratory Manager or designee over or next to the typed name, title, and date.

4.1 Analytical Data Package Contents and Format

The Subcontract Laboratory shall provide a complete and accurate Analytical Data Package as described in this Section for all analyses conducted. The Subcontract Laboratory may use CLP software to generate forms for certain analyses or may use other software that generates forms that meet the requirements given below. Information required in the sections below that cannot be accommodated by the CLP software shall be provided on attached forms. If CLP Form Is are used, the forms must contain all analytes identified in this SOW as analytes for the method (i.e.; not the CLP short list/8240 list). If more than 5 calibration standards are used for the initial calibration, all standards used must be reported with applicable %RSD values on the appropriate forms.

4.1.1 Analytical Data Packages

The analytical data packages provided to the LANL SMO shall contain all the items discussed in sections (a) through (i), below. Analyst worksheets meeting the minimum requirements given in this SOW shall accompany the associated analytical data. Two copies of the data package are required with each submittal. A comprehensive case narrative is required for all data reports submitted.

- a) A completed Deliverable Transmittal/Review form.
- b) A case narrative describing the contents of the Analytical Data Package prepared for the specific LANL Request for Analysis, an index of samples associated with the delivery order including both the LANL sample IDs and the Subcontract Laboratory sample IDs, and a description of problems encountered or deviations from the method in the analysis of the samples associated with the LANL Request for Analysis. The case narrative shall describe the circumstances leading to the use of data qualifiers and list the affected samples. In addition, the type of digestion used shall always be clearly specified in the case narrative for general inorganic analysis of soil samples and the preparatory or extraction method shall be referenced for organic methods. All case narratives shall include a signed statement affirming that the analytical work and data package has been reviewed and are in

compliance with the requirements of this SOW (Exact text is given in Section 3.3 of this SOW). Any dilutions required must be addressed in the case narrative along with the reason for dilution. If no target analytes are identified, the case narrative must state the corrective actions taken (i.e. clean up techniques attempted or other actions taken).

- c) One original Analysis Results form (Form I or equivalent) for each sample associated with the deliverable. The required contents of each Analysis Results form are outlined in section 4.1.3 of this SOW.
- d) QC data deliverables consisting of completed CLP QC data reporting forms or equivalent for all sample analyses associated with the delivery order. The QC data deliverables are discussed in detail in section 4.1.8 of this SOW.
- e) Signed and dated original COC forms received with each sample shipment, indicating sample receipt and custody by the Subcontract Laboratory.
- f) One electronic copy of the analytical data and quality control results formatted as outlined below in section 4.1.6 of this SOW. Laboratories are encouraged to submit an electronic copy of the analytical data and quality control results by e-mail. An e-mail address will be provided.
- g) For radiochemistry, the Subcontract Laboratory shall adhere to the spirit of the CLP reporting requirements in preparing analytical reports. This means that the Subcontract Laboratory performing radiochemical analyses shall include shipping documents, analyst worksheets, instrument printouts, standard preparation logs, digestion logs, and other forms of raw data in the reports. Raw data shall include all aliquot weights/volumes, tracer/carrier recoveries, counting times, detector efficiencies, and other information necessary to recreate analytical results. Radiochemistry counting instrument calibration data shall not be included with data reports, but shall be maintained by the Subcontract Laboratory as records. Radiochemistry analyst worksheets shall include certification that the required calibrations were successfully performed on schedule and reference the relevant computer file names and dates.
- h) Standards certification information, log entries for water quality, log entries for balance calibration verification, and other similar ancillary information shall not be included in analytical reports. Such information shall, for the duration of this subcontract including all extensions, be maintained by the Subcontract Laboratory as records.
- i) The deliverables shall be on 8½- by 11-inch paper, one-sided, and paginated. Shipping documents, instrument printouts, standard preparation logs, digestion logs, analyst work sheets, or other forms of "raw" data shall be included unless the LANL SMO requests specific exclusion of this information (in whole or in part).

4.1.2 Reporting Forms for Analytical Results

- a) The Analysis Results form shall be used to report parameter concentrations measured by the Subcontract Laboratory. The use of CLP forms is preferred, although these must be adapted for use with non-CLP methods. This decision is left to the discretion of the Subcontract Laboratory.
- b) The Subcontract Laboratory shall specify the LANL sample ID, date analyzed, date extracted (where appropriate), request number, report date, and a qualitative description of sample appearance on each page of the Analysis Results form. Alternatively, the Subcontract Laboratory may provide

sample descriptions by including sample digestion/extraction logs or a tabular summary of qualitative descriptions with the deliverable. For each result, the Subcontract Laboratory shall provide the parameter name; parameter value; uncertainty value (where applicable); MDL, MDC or DLC (as applicable); units of measure; data qualifier(s); method of preparation and analysis; and analysis date on the Analysis Results form. Analysis Results forms shall include the extraction date (as applicable). Alternatively, a tabular summary of extraction dates may be provided immediately following the Analysis Results forms.

4.1.3 "Less Than" Results

Mathematical "less than" signs shall not be used in reporting LANL analytical results. Qualifiers for low-level general inorganic and organic results are discussed in section 3.3.3 of this SOW. Radiochemical results that are less than the MDC or DLC shall be reported as measured, without concentration qualifiers, as discussed in section 3.3.4. All other analytical and QC results shall not be censored to the Contract-Required Quantitation Limit (CRQL), but reported down to the Method Detection Limit (MDL).

4.1.4 Analytical Uncertainties and Detection Limits

The analytical uncertainty values (1 sigma, see glossary) and DLCs for radiochemical parameters shall be reported.

4.1.5 Electronic Data Deliverable (EDD) Format

- a) All hardcopy data packages that are provided under this subcontract must also be transmitted electronically using the LANL Electronic Data Deliverable (see Attachment 10). The value of each data element in the EDD shall be equivalent to the value of the corresponding data element in all hardcopy forms provided by the Subcontract Laboratory. The result reported for any given element shall be the same wherever that data element is used.
 - i. The Subcontract Laboratory shall use the current version of the column descriptions for the Electronic Data Deliverable as shown in Attachment 10.
 - ii. The current EDD requirements will be posted on the web site and the Subcontract Laboratory shall be provided with written notice of updates by the LANL SMO. The Subcontract Laboratory will have 60 calendar days to comply with any changes made to the EDD after the subcontract is awarded.
 - iii. The Subcontract Laboratory is not required to supply data element values that are not identified in the LANL list of required data elements. For those data elements, the data element tag must be present in the EDD, but the value may be a null value.
 - iv. Expenses incurred by the Subcontract Laboratory to implement changes made to the LANL EDD after the subcontract is awarded will be reimbursed at cost.
 - v. The Subcontract Laboratory will have 90 calendar days from the Subcontract's commencement date to deliver the requirements of the new EDD.

- a) At the time of sample submission to the Subcontract Laboratory, the EDD requirements for that request will be specified.
- b) The LANL SMO may not require an associated EDD or may require a modified EDD for specific sample delivery groups.
- c) The cost for EDD formats other than the standard LANL EDD shall be specified and established prior to the Subcontract Laboratory accepting the sample delivery group for sample analysis. The Subcontract Laboratory may negotiate prices for non-standard EDDs on an individual basis.

4.1.6 Reporting Conventions

Reporting conventions are as listed below:

- a) Ammonium and ammonia are reported as N.
- b) $\text{NO}_2 + \text{NO}_3$ is reported as N.
- c) Nitrate is reported as N.
- d) Nitrite is reported as N.
- e) Total phosphorus is reported as P.
- f) Orthophosphate is reported as PO_4 .
- g) Acidity and alkalinity are reported as CaCO_3 .
- h) Dissolved oxygen is reported as O_2 .
- i) Sulfate is reported as SO_4 .
- j) Silica is reported as SiO_2 .
- k) Specific conductivity is reported as $\mu\text{S}/\text{cm}$ (micro Siemens per centimeter).
- l) Turbidity is reported as Nephelometric Turbidity Units (NTUs).
- m) Biological Oxygen Demand is reported as mg/L BOD.
- n) Color is reported as Color Units.
- o) Corrosivity by pH is reported in pH units.
- p) Ignitability is reported in $^\circ\text{C}$.
- q) All inorganic parameters must be reported as mg/L for waters and mg/Kg for soil/solids. All organic analytes must be reported as ug/L for waters and ug/Kg for soils/solids.

4.1.7 QC Deliverables

QC data deliverables for general inorganic chemistry and radiochemistry shall include items listed below. An analogous approach should be used for organic chemistry using the reporting forms from the CLP SOW for Organic Analyses. The delivery order number shall be given on each page of the QC data deliverable. QC limits for solid reference materials shall be included in the QC deliverable.

- a) ICV and CCV analysis data shall include the parameter name, true ICV concentration, found ICV concentration, ICV percent recovery, true CCV concentration, found CCV concentration(s), and each CCV percent recovery. The use of CLP Form II-IN, or an equivalent format that presents the same information, is acceptable.
- b) ICB and CCB analysis data shall include the parameter name, ICB analysis result, and CCB analysis result(s). The use of CLP Form III-IN, or equivalent, is acceptable.
- c) Preparation blank analysis data shall include the parameter name and PB results for each analytical batch. The use of CLP Form III-IN, or equivalent, is acceptable.
- d) ICS analysis data shall include the parameter name, true concentration values for solutions A and AB, initial measured values for solutions A and AB, initial percent recovery for solution AB, final measured values for solutions A and AB, and the final percent recovery for solution AB. The use of CLP Form IV-IN, or equivalent, is acceptable.
- e) Spike analysis data shall include the parameter name, spiked sample result, sample result, spike added, and spike percent recovery for each spike analysis. In addition, include the required data qualifiers for spike analyses that fall outside the control limits. The use of CLP Form V (Part 1)-IN, or equivalent, is acceptable.
- f) Replicate analysis data shall include the parameter name, sample result, replicate result, and RPD or Relative Error Ratio (RER), as appropriate. Sample and replicate results for radionuclide and gross radiation determinations shall be accompanied by the one sigma uncertainty values. Include the required data qualifiers for replicate analyses that fall outside the applicable control limit. The use of CLP Form VI-IN, or equivalent, is acceptable.
- g) LCS analysis data shall include the parameter name, true concentration of the LCS, measured concentration of the LCS, and the percent recovery for the LCS. The use of CLP Form VII-IN, or equivalent, is acceptable. Solid LCS data shall be accompanied by the applicable acceptance criteria.
- h) Standard addition results shall be reported for GFAA, as appropriate. The use of CLP Form VIII-IN, or equivalent, is acceptable.
- i) Provide analysis run logs, CLP Form XIV-IN or equivalent for all parameters.
- j) Radionuclide tracer or carrier recoveries, or standard recoveries used for batch correction, shall be reported in the QC deliverable. Recoveries that fail to meet the criteria specified in section 3.6.6 of this SOW shall be reported by telephone to the LANL SMO and explained in the case narrative.
- k) QC results reported in more than one request number shall agree in all places reported and the batch number will agree in all requests.

4.1.8 General Inorganic Chemistry and Radiochemistry Data Qualifiers

General inorganic chemistry and radiochemistry data qualifiers available for use by the Subcontract Laboratory are listed and discussed below. The use of these data qualifiers is required on the Analysis Results form, the electronic data deliverable, and the QC data deliverable. Of the qualifiers discussed below, only the "H, N," and ""*"" may be used in reporting radionuclide and gross radiation results.

- a) In the event that the holding time for a particular parameter had expired prior to analysis, flag the associated results with an "H" on the Analysis Results form and the electronic data deliverable.
- b) Analytical results obtained for samples that required dilution prior to analysis shall be qualified with the "I" flag. This qualifier indicates that the related detection limits are elevated due to the presence of an interference or because of a high parameter value.
- c) Data associated with failed ICP-AES serial dilution results shall be flagged with the "E" flag. The "E" flag shall also be used to qualify GFAA data according to the guidelines specified in the CLP SOW. In both cases, the specific requirements of the CLP SOW apply to the use of this qualifier. When this flag is used, an explanatory note shall always be included in the case narrative.
- d) Analytical results associated with a spike analysis that was outside control limits shall be qualified with the "N" flag.
- e) Analytical results associated with a replicate sample analysis that was outside the control limit shall be qualified with a ""*"" flag.
- f) GFAA analytical results associated with a post-digestion spike that was outside the control limits, while the sample absorbance was less than 50 percent the spike absorbance, shall be qualified with the "W" flag. The use of this data qualifier is discussed in the CLP SOW.
- g) GFAA analytical results associated with a duplicate injection that failed to meet the duplicate injection precision criterion shall be qualified with the "M" flag. The precision criterion for use of this data qualifier is discussed further in the CLP SOW.
- h) GFAA analytical results obtained by the method of standard additions (MSA) shall be qualified with the "S" flag.
- i) GFAA analytical results obtained by MSA, and for which the MSA correlation coefficient is less than 0.995, shall be qualified with the "+" flag.

4.1.9 Organic Chemistry Data Qualifiers

Organic chemistry data qualifiers available for use by the Subcontract Laboratory are listed and discussed in the CLP SOW on pages B-38 through B-40. As with general inorganic chemistry and radiochemistry, the use of these data qualifiers is required on the Analysis Results form, the electronic data deliverable, and the QC data deliverable.

4.1.10 Completeness

Partial deliverables shall not be submitted unless specifically requested by the LANL SMO. In addition to the deliverable requirements given in this section, the LANL SMO reserves the right to request analyzed logs and

chromatograms (organic chemistry only) relevant to samples from other Subcontract Laboratory clients that were analyzed before or during the analytical runs for LANL samples. This is sometimes necessary to investigate suspected carryover contamination. Failure to submit complete responses to such LANL SMO requests in a timely manner may result in the suspension of the Subcontract Laboratory from participation in this subcontract. Further, the chromatograms submitted under this SOW section shall not be edited or altered in any way, other than to delete client-specific information, prior to submission to the LANL SMO.

4.1.11 Significant Figures

- a) A maximum of three significant figures shall be used to report the final analytical result.
- b) Uncertainty and detection limit values shall be reported to no more than two significant figures.
- c) Analytical results, uncertainties and detection limits may be reported to one place beyond the last significant figure given for MDLs or MDCs, in the attachments. For example, the MDL for aluminum in water is 0.03 mg/L. A result of 0.033 mg/L may be reported, while 0.0336 mg/L would be rounded UP to 0.034 mg/L.
- d) Truncation of numbers is not allowed at any time.
- e) All numbers less than one must have a zero to the left of the decimal point.

4.2 Analytical Data Deliverable Deadlines

4.2.1 Turn-Around Times

- a) When standard turn-around time is requested, a report of analytical results, both electronic and hard-copy, is due to the LANL SMO 20 business days from the date of receipt of the last sample associated with each request number. Turn-around times for accelerated delivery requests shall be 1, 3, 5, 10, and 15 business days, and shall be mutually agreed upon by the Subcontract Laboratory contact point and the LANL SMO. Hardcopy results (Form 1s only) with accelerated turn-around times shall be faxed to the LANL SMO with the full deliverable due by the standard 20 business-day deadline.
- b) Any Subcontract Laboratory that has any part of the analytical data package rejected, including the EDD, shall have ten business days from receipt of rejection until a corrected version of the analytical data package is submitted to LANL SMO. Corrected reports and reports for any requested reanalysis are due ten business days from the date of the request unless required ingrowth times preclude this. In that case, the reanalysis reports are due no later than 15 business days from the request date.
- c) The LANL SMO reserves the right to request expedited reanalysis when circumstances require this. Reimbursement shall be made according to the specifications of section 1.7.2 of this SOW, and will be at the standard turn-around time rates unless expedited reanalysis are requested. For reanalysis turn-around times less than ten business days, payment will be at the applicable rate for the corresponding expedited analyses (subject to the stipulations of section 1.7.2). Reanalysis reports shall be submitted according to the guidelines for the report level originally requested for that delivery order.

4.2.2 Invoices

Invoices shall be submitted monthly for the delivery orders reported in that period. Invoices shall contain delivery order numbers, the number of samples, analyses performed, unit cost, and extended cost. Invoices shall be itemized and organized in such a way as to facilitate detailed review and cost verification without additional Subcontract Laboratory input. In addition, an electronic copy, in an Excel format, of the invoice shall be supplied to the University and to the LANL SMO (by e-mail). The invoice requirements are listed in Attachment 9.

4.2.3 Price Reduction

- a) All deliverables, both electronic and hard-copy, shall be due at the specified time unless advance written permission to deviate from the deliverable schedule is given by the LANL SMO. Price reductions will be implemented for late deliverables at the discretion of the LANL SMO, at the rate of two percent per business day.
- b) Unit prices will be those for the period when the deliverable arrives. However, the percent price reductions will be calculated based upon the originally requested turn around time. That is, a report for results with a ten-day requested turn around that arrives on the 15th day will be paid for at the 15-day turn around rates less ten percent. If the same report arrives on the 17th day, payment will be made at the 15-day turn around time prices less 14 percent.
- c) Price reductions will not accumulate on weekends or holidays recognized by LANL.
- d) If a Subcontract laboratory fails to meet quality control criteria, if reanalysis is precluded by expiration of holding times and the data cannot be used for its original purpose, there will be no payment for the sample analysis.
- e) If deliverables do not contain the required supporting documentation, and if the Subcontract Laboratory cannot deliver such documentation upon request, then the data quality is negatively affected and nonpayment will be implemented.
- f) If holding times are missed, and the samples arrived at the Subcontract Laboratory far enough in advance to allow reasonable time for analysis, then the Subcontract Laboratory is responsible for reduced data quality, and nonpayment will be implemented. If Subcontract Laboratory personnel notify the LANL SMO that holding times would be missed far enough in advance to select and ship another Subcontract Laboratory, then nonpayment will not be implemented. If the samples arrive at the Subcontract Laboratory very close to the holding time expiration, and if LANL SMO personnel did not inform the Subcontract Laboratory to expect the short holding time, then nonpayment will not be applicable.
- g) If a Subcontract Laboratory uses an unapproved alternate laboratory without prior approval of the LANL SMO, then nonpayment for any project data provided by the unapproved vendor will apply.
- h) Nonpayment will be implemented when the Subcontract Laboratory fails to meet technical requirements, such as detection limits, inadequate analytical technique, inappropriate wavelength, too-short count time, or excessive dilution. The Subcontract Laboratory will not be penalized if the error is due to unforeseen technical problems beyond their control, such as sample matrix.

- i) Failure to submit progress reports, MDL studies, performance evaluation criteria, or corrective action reports may result in discontinued use of the Subcontract Laboratory.

4.2.4 Reporting PE Results

The reports for any PE samples submitted by the LANL SMO shall be due 20 business days from the date of sample receipt.

4.3 Reporting Results for More Than One Analytical Category

Reports that contain data for any combination of the major analytical categories (general inorganic, organic, radiochemistry, or asbestos) shall be organized by category. That is, the results forms, custody documents, and quality control reports for each category shall be placed together in the deliverables.

5.0 LABORATORY HEALTH AND SAFETY, WASTE MANAGEMENT, AND ETHICS AGREEMENT REQUIREMENTS

The Subcontract Laboratory shall have the documents listed below, as applicable, and demonstrate their implementation through maintenance of employee training records.

- A chemical hygiene plan.
- A waste management plan.
- A radiological safety plan. The radiological safety plan or a site-specific plan for LANL SMO samples shall require radiation screening of all samples submitted for chemical analysis during the sample receipt/login process.
- Ethics agreements. The Subcontract Laboratory shall have signed ethics agreements on file for all personnel contributing to project management, sample management, analysis, data review, and data reporting.

6.0 REFERENCES

U.S. Environmental Protection Agency, Methods for the Determination of Metals in Environmental Samples, EPA 600 4-91-010, June 1991, and Supplement 1, 1995.

U.S. Environmental Protection Agency, Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-media, Multi-Concentration, ILMO3.0, 1994.

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U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, Report SW-846, Third Edition, June 1998 (Update IV).

U.S. Environmental Protection Agency, Index to EPA Test Methods, EPA 600 4-79-020, November 1998.

U.S. Environmental Protection Agency, USEPA Drinking Water Methods for Radionuclide Parameters, EPA 600 4-80-032, June 15, 1998.

U.S. Environmental Protection Agency, US EPA Drinking Water Methods for Chemical Parameters, EPA/600/4-88/039, December 1988, Revised December 8, 1998.

Occupational Safety and Health Administration, OSHA Analytical Methods Manual, Second Edition, Part 1, Volumes 1, 2, and 3, January 1990.

Occupational Safety and Health Administration, OSHA Analytical Methods Manual, Second Edition, Part 1, Volume 4, October 1993.

Occupational Safety and Health Administration, OSHA Analytical Methods Manual, Second Edition, Part 2, Volumes 1 and 2, August 1991.

For further guidance, refer to http://www/osh-slc.gov/SLTC/analytical_methods.

7.0 ATTACHMENTS

Attachment 1 General Inorganic Parameters and MDLs

Table I	Metal Target Analytes Contract-Required Quantitation Limits (CRQLs)
Table II	Miscellaneous General Inorganic Target Analytes, Methods, and Contract-Required Quantitation Limits (CRQLs)

Attachment 2 Radiochemical Parameters and MDCs

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Attachment 3 LANL Requirements for Organic Analyses (continued)

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Table XIII	Method 8331: Tetrazene by Reverse Phase High Performance Liquid Chromatography or USATHAMA Reversed-Phase High Performance Liquid Chromatography Methods for the Determination of Tetrazene in Water or Soil (1989) Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)
Table XIV	Method 8332: Nitroglycerine by High Performance Liquid Chromatography or USATHAMA Reversed-Phase High Performance Liquid Chromatography Methods for the Determination of Nitroglycerine and Pentaerythritol Tetranitrate in Water or Soil (1989) Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)
Table XV	Method TO-13: Determination of Polynuclear Aromatic Hydrocarbons in Ambient Air Using Gas Chromatographic and High Performance Liquid Chromatographic Analysis Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)
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Attachment 4 Holding Times and Preservation Techniques

Table I Sample Preservation Techniques and Holding Times

Attachment 5 Policy Statement for Sharing Laboratory Performance Information

Attachment 6 Example Chain-of-Custody

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Attachment 8 Sample Container Label

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Attachment 10 Electronic Data Deliverable Description

Attachment 1

Table I
Metal Target Analytes Required Contract-Required Quantitation Limits (CRQLs)

Analyte	CRQL		
	Water mg/L	Solid ^a mg/kg	Air Filter µg/sample
Aluminum ^b	0.100	10	10
Antimony ^b	0.002	0.2	1
Arsenic ^{b,c}	0.010	0.2	2
Barium ^{b,c}	0.2	10	10
Beryllium ^b	0.002	0.1	1
Boron	0.2	5	NA
Cadmium ^{b,c}	0.002	0.25	1
Calcium ^b	5	250	NA
Chromium ^{b,c}	0.01	0.5	5
Chromium(+6)	0.01	0.5	NA
Cobalt ^b	0.05	0.5	1
Copper ^b	0.25	0.5	1
Iron ^b	0.1	300	10
Lithium	1	2.5	NA
Lead ^{b,c}	0.003	2	2
Magnesium ^b	5	250	10
Manganese ^b	0.015	20	5
Mercury ^{b,c}	0.0002	0.05	0.005
Molybdenum	1	2.5	1
Nickel ^b	0.02	0.2	1
Potassium ^b	5	250	10
Selenium ^{b,c}	0.001	0.2	2
Silver ^{b,c}	0.01	0.2	1
Silica	0.1	5	NA
Sodium ^b	5	250	100
Strontium	0.01	0.5	10
Thallium ^b	0.001	0.1	1
Tin	0.05	2.5	1
Titanium	0.05	0.1	NA

Table I
Metal Target Analytes Contract-Required Quantitation Limits (CRQLs)
(continued)

Analyte	CRQL		
	Water mg/L	Solid ^a mg/kg	Air Filter µg/sample
Uranium	0.001	0.1	1
Vanadium ^b	0.05	0.5	1
Zinc ^b	0.1	5	2

^a The MDL must be met regardless of the digestion method used.

^b These analytes are Target Analyte List metals.

^c These analytes are Resource Conservation and Recovery Act TCLP metals.

NA = Not Applicable

Table II
Miscellaneous General Inorganic Target Analytes, Methods, and
Contract-Required Quantitation Limits (CRQLs)

Analyte	Method Nos.	CRQL	
		Water mg/L	Solid mg/kg
Acidity as CaCO ₃	305	10	NA
Alkalinity as CaCO ₃	310	10	NA
Ammonium as N	350	0.1	2
Bicarbonate/carbonate	SM 2320B	10	NA
Biological oxygen demand (BOD), 5 day	405	2	NA
Bromide	300	0.1	2
Carbon, dissolved organic (DOC)	415	1	NA
Carbon, total organic (TOC)	415, 9060	1	100
Chemical oxygen demand (COD)	410	5	NA
Chloride	300, 325, 9250	1	20
Chromium (VI)	7196A	0.01	0.5
Color (color units)	110	1	NA
Corrosivity (mm/year)	1110	NA	NA
Cyanide, total	335, 9010	0.01	0.2
Dissolved oxygen (DO)	360	0.05	NA
Fluoride	340, 300	0.1	2
Hardness as CaCO ₃	130	10	NA
Ignitability (°C)	1010, 1020A	1	1
Iodide	300	0.5	10

Table II
Miscellaneous General Inorganic Target Analytes, Methods, and
Contract-Required Quantitation Limits (CRQLs)
(continued)

Analyte	Method Nos.	CRQL	
		Water mg/L	Solid mg/kg
Nitrate as N	300, 353, 9200	0.1	2
Nitrate + nitrite as N	300, 353	0.1	2
Nitrite as N	300, 253	0.1	2
Oil and grease	1664, 9070	5	100
pH (unitless)	150, 9040B, 9045C	0.1	0.1
Phenols, total recoverable	420, 9065	0.05	1
o-Phosphate as P	300	0.1	2
Phosphorus, total as P	365	0.01	0.2
Sulfide	376	1	20
Sulfate	300	1	20
Specific conductance (µmho/cm)	120, 9050	1	NA
Solids, settleable (mL/L/hr.)	160	0.2	NA
Solids, total (TS)	160	10	NA
Solids, total dissolved (TDS)	160	10	NA
Solids, total suspended (TSS)	160	3	NA
Solids, volatile	160	20	NA
Total organic halide (TOX)	9020B	5	NA
Total Kjeldahl nitrogen	351	0.5	10
Total petroleum hydrocarbons	418, 9073	1	20
Turbidity (NTU)	180	0.05	NA
Uranium, total	908	0.001	0.2

NA = Not Applicable

Attachment 2

Table I Required Gamma Spectroscopy Radionuclides and Minimum Detectable Concentrations (MDC) by Matrix.

Radionuclide	Water (pCi/L)	Solid (pCi/g)	Air Filter (pCi/sample)	Urine (pCi/L)	Vegetation (pCi/g)
40K	NA	NA	NA	NA	NA
60Co	150.00	0.50	200.00	2000.00	5.00
106Ru	NA	NA	NA	NA	NA
125Sb	NA	NA	NA	NA	NA
134Cs	NA	NA	NA	NA	NA
137Cs	15.00	0.10	20.00	200.00	0.50
152Eu	NA	NA	NA	NA	NA
154Eu	NA	NA	NA	NA	NA
155Eu	NA	NA	NA	NA	NA
208Tl	NA	NA	NA	NA	NA
211Bi	NA	NA	NA	NA	NA
214Bi	NA	NA	NA	NA	NA
212Pb	NA	NA	NA	NA	NA
214Pb	NA	NA	NA	NA	NA
227Th	NA	NA	NA	NA	NA
234Th	NA	NA	NA	NA	NA
233Pa	NA	NA	NA	NA	NA
235U	NA	NA	NA	NA	NA
241Am	NA	1.00	NA	NA	NA

Table II
Alpha Spectrometry Radionuclides and Required Minimum Detectable
Concentrations (MDCs) by Matrix

Radionuclide	MDC					
	Water pCi/L	Solid pCi/g	Air Filter pCi/sample	Urine pCi/L	Vegetation pCi/g	Feces Ash pCi/g
²⁴¹ Am	0.05	0.05	0.06	0.06	0.006	0.04
²⁴⁴ Cm	0.05	0.05	0.06	0.06	0.006	0.04
²³⁷ Np	0.05	0.05	0.06	0.06	0.006	0.04
²¹⁰ Po	1	0.5	1	1	0.5	0.5
²³⁸ Pu	0.05	0.05	0.06	0.06	0.006	0.04
^{239/240} Pu	0.05	0.05	0.06	0.06	0.006	0.04
²²⁶ Ra	1	0.5	1	1	0.5	0.5
²²⁸ Th	0.1	0.1	0.1	0.1	0.1	0.1
²³⁰ Th	0.1	0.1	0.1	0.1	0.1	0.1
²³² Th	0.1	0.1	0.1	0.1	0.1	0.1
²³⁴ U	0.1	0.1	0.1	0.1	0.01	0.1
²³⁵ U	0.1	0.1	0.1	0.1	0.01	0.1
²³⁸ U	0.1	0.1	0.1	0.1	0.01	0.1

Table III
Gas Proportional Counting Radionuclides and Required Minimum Detectable
Concentrations (MDCs) by Matrix

Radionuclide	MDC			
	Water pCi/L	Solid pCi/g	Air Filter pCi/sample	Vegetation pCi/g
Gross α	1	1	2	1
Gross β	1	1	2	1
⁹⁰ Sr	1	0.5	2	0.5
²¹⁰ Pb	1	5	2	5
²¹⁰ Po	1	1	2	1
²²⁶ Ra	1	1	2	1
²²⁸ Ra	0.5	0.5	1	0.5
⁹⁹ Tc	1	5	10	5

Table IV
Liquid Scintillation Counting Radionuclides and Required Minimum Detectable
Concentrations (MDCs) by Matrix

Radionuclide	MDC			
	Water pCi/L	Solid pCi/g	Air Filter pCi/sample	Swipe pCi/100cm ²
³ H	250	250 ^a (pCi/L)	10	10
¹⁴ C	500	10	20	20
^{99m} Tc	5	10	20	20
²¹⁰ Pb	1.0	5	10	10
²²² Rn	200	200		

^a For ³H the specified solid MDC applies to the extracted water.

Attachment 3

LANL Requirements for Organics Analyses

The LANL-required target analyte lists and Contract-Required Quantitation Limits (CRQLs) for organic analyses are given in this attachment. The listed CRQLs are not reporting limits; they are minimum performance requirements based upon values given in the published methods. The Subcontract Laboratory shall report all analytical results for organic analyses to the Subcontract Laboratory-determined MDL value.

Factors for determining Estimated Quantitation Limits (EQLs) for various matrices have been provided for some methods based upon the factors given in the published methods.

The LANL-required surrogate compounds are also specified in this attachment for the following methods: SW-8081, SW-8082, SW-8260A, SW-8270B, and SW-8330.

This attachment contains 16 tables.

Table I
Modified Method 8015B:
Petroleum Hydrocarbons by Gas Chromatography / Flame Ionization
Detector Required Analyte Suites and Contract-Required Quantitation Limits
(CRQLs)

Analyte Suite	Water CRQL (µg/L)	Soil CRQL (mg/kg)
Gasoline Range Organics (GRO)	10	1
Diesel Range Organics (DRO)	10	1
Total Petroleum Hydrocarbons (TPH)	10	1

Table II (a)
Method 8021B: Aromatic and Halogenated Volatiles by Gas Chromatography
Using Photoionization and/or Electrolytic Conductivity Detectors (BTEX)
Required Target Analyte List and Contract-Required Detection Limits

Compound Name	CAS No.	Water CRQL ^a (µg/L)
Benzene	71-43-2	1.0 PID
Chlorobenzene	108-90-7	1.0 PID 1.0 HECD
1,2-Dichlorobenzene	95-50-1	1.0 PID 1.0 HECD
1,3-Dichlorobenzene	541-73-1	1.0 PID/HECD
1,4-Dichlorobenzene	106-46-7	1.0 PID 1.0 HECD
Ethylbenzene	100-41-4	1.0 PID
Toluene	108-88-3	1.0 PID
m-xylene	1330-20-7	1.0 PID
p-xylene		1.0 PID
o-xylene		1.0 PID

^a CRQL for low-level soil samples (µg/kg) is equivalent to the CRQL for water samples.

Table II (b)
Method 8021B: Aromatic Volatile Organics by Gas Chromatography (BTEX)
Method 8021B: Determination of Estimated Quantitation Limits (EQLs) for
Various Matrices

Matrix	Factor
Ground water	10
Low-concentration soil	10
Water miscible liquid waste	500
High concentration soil and sludge	1250
Non-water miscible waste	1250

EQL = [Method detection limit (Table III(a))] X [Factor (Table III(b))]. For non-aqueous samples, the factor is on a wet-weight basis.

Table III
Method 8021B: Internal Standards

Analyte	CAS
Fluorobenzene	462-06-6
2-Bromo-1-chloropropane	3017-95-6
α,α,α -trifluorotoluene	98-08-

Table IV
Method 8021B: Determination of Estimated Quantitation Limits (EQLs)
for Various Matrices

Matrix	Factor
Ground water	10
Low-concentration soil	10
Water miscible liquid waste	500
High concentration soil and sludge	1250
Non-water miscible waste	1250

EQL = [Method detection limit (Table IV(a))] X [Factor (Table IV(b))]. For non-aqueous samples, the factor is on a wet-weight basis.

Table V (a)
Method 8081A: Organochlorine Pesticides
Gas Chromatography (Capillary Column Technique)
Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)

Compound Name	CAS No.	Water CRQL (µg/L)	Soil CRQL (µg/kg)
Aldrin	309-00-2	0.05	1.7
α-BHC	319-84-6	*0.05	1.7
β-BHC	319-85-7	0.05	1.7
δ-BHC	319-86-8	0.05	1.7
γ-BHC (Lindane)	58-89-9	0.05	1.7
α-Chlordane	5103-71-9	0.05	1.7
γ-Chlordane	5103-74-2	0.05	1.7
4,4'-DDD	72-54-8	0.1	3.3
4,4'-DDE	72-55-9	0.1	3.3
4,4'-DDT	50-29-3	0.1	3.3
Dieldrin	60-57-1	0.1	3.3
Endosulfan I	959-98-8	0.05	1.7
Endosulfan II	33213-65-9	0.1	3.3
Endosulfan sulfate	1031-07-8	0.1	3.3*
Endrin	72-20-8	0.1	3.3
Endrin aldehyde	7421-93-4	0.1	3.3
Endrin ketone	53494-70-5	0.1*	3.3*
Heptachlor	76-44-8	0.05	1.7
Heptachlor epoxide	1024-57-3	0.05	1.7
4,4'-Methoxychlor	72-43-5	0.5*	17*
Toxaphene	8001-35-2	5.0*	170*

* Not in table in SW846

Table V (b)
Method 8081A: Determination of Estimated Quantitation Limits (EQLs)
for Various Matrices

Matrix	Factor
Ground water	10
Low-concentration soil	330
High concentration soil and sludge	10,000
Non-water miscible waste	100,000

EQL = [Method detection limit (Table VI(a))] X [Factor (Table VI(b))]. For non-aqueous samples, the factor is on a wet-weight basis.

Table V (c)
Method 8081 and 8082: Organochlorine Pesticides and PCBs as Aroclors by
Gas Chromatography (Capillary Column Technique)
Required Surrogate Compounds

Surrogate Compounds	CAS No.	Acceptance Criteria	
		Water	Soil
Decachlorobiphenyl	2051-24-3	50-160%	50-160%
Tetrachloro-m-xylene	877-09-8	50-160%	50-160%

Table VI (a)
Method 8082: Polychlorinated Biphenyls (PCBs) by Gas Chromatography
Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)

Compound Name	CAS No.	CRQL Water (µg/L)	CRQL Soil (µg/kg)
Aroclor – 1016	12674-11-2	1.0	33
Aroclor – 1221	11104-28-2	2.0	67
Aroclor – 1232	11141-16-5	1.0	33
Aroclor – 1242	53469-21-9	1.0	33
Aroclor – 1248	12672-29-6	1.0	33
Aroclor – 1254	11097-69-1	1.0	33
Aroclor – 1260	11096-82-5	1.0	33

Table VI (b)
Method 8082: Determination of Estimated Quantitation Limits (EQLs)
for Various Matrices

Matrix	Factor
Ground water	10
Low-concentration soil	330
High concentration soil and sludge	10,000
Non-water miscible waste	100,000

EQL = [Method detection limit (Table VII(a))] X [Factor (Table VII(b))]. For non-aqueous samples, the factor is on a wet-weight basis.

Table VII (a)
Method 8260B: Volatile Organic Compounds by Gas Chromatography /
Mass Spectrometry
Required Target Analyte List and Contract-Required Detection Limits and
Surrogate Compounds

Compound Name	CAS No.	CRQL Water ^a (µg/L) 5mL/25mL
Acetone	67-64-1	10/2.0
Benzene	71-43-2	5/0.5
Bromobenzene	108-86-1	5/0.5
Bromochloromethane	74-97-5	5/0.5
Bromodichloromethane	75-27-4	5/0.5
Bromoform	75-25-2	5/1.0
Bromomethane	74-83-9	10/1.0
2-Butanone	78-93-3	10/2.0
n-Butylbenzene	104-51-8	5/0.5
sec-Butylbenzene	135-98-8	5/0.5
tert-Butylbenzene	98-06-6	5/0.5
Carbon disulfide	75-15-0	5/0.5
Carbon tetrachloride	56-23-5	5/0.5
Chlorobenzene	108-90-7	5/0.5
Chloroethane	75-00-3	10/1.0
Chloroform	67-66-3	5/0.5
Chloromethane	74-87-3	10/1.0
2-Chlorotoluene	95-49-8	5/0.5
4-Chlorotoluene	106-43-4	5/0.5
Dibromochloromethane	124-48-1	5/0.5
1,2-Dibromo-3-chloropropane	96-12-8	10/2.0
1,2-Dibromoethane	106-93-4	5/0.5
Dibromomethane	74-95-3	5/0.5
1,2-Dichlorobenzene	95-50-1	5/0.5
1,3-Dichlorobenzene	541-73-1	5/0.5
1,4-Dichlorobenzene	106-46-7	5/0.5
Dichlorodifluoromethane	75-71-8	10/1.0
1,1-Dichloroethane	75-34-3	5/0.5
1,2-Dichloroethane	107-06-2	5/0.5
1,1-Dichloroethene	75-35-4	5/0.5
cis-1,2-Dichloroethene	156-59-2	5/0.5
trans-1,2-Dichloroethene	156-60-5	5/0.5

Table VII (a)
Method 8260B: Volatile Organic Compounds by Gas Chromatography /
Mass Spectrometry
Required Target Analyte List and Contract-Required Detection Limits and
Surrogate Compounds (continued)

Compound Name	CAS No.	CRQL Water ^a (µg/L)
1,2-Dichloropropane	78-87-5	5/0.5
1,3-Dichloropropane	142-28-9	5/0.5
2,2-Dichloropropane	594-20-7	5/1.0
1,1-Dichloropropene	563-58-6	5/0.5
cis-1,3-Dichloropropene	10061-01-5	5/0.5
trans-1,3-Dichloropropene	10061-02-6	5/0.5
Ethylbenzene	100-41-4	5/0.5
2-Hexanone	591-78-6	10/2.0
Iodomethane	74-88-4	5/0.5
Isopropylbenzene	98-82-8	5/0.5
4-Isopropyltoluene	99-87-6	5/0.5
Methylene chloride	75-09-2	10/2.0
4-Methyl-2-pentanone	108-10-1	10/2.0
n-Propylbenzene	103-65-1	5/0.5
Styrene	100-42-5	5/0.5
1,1,1,2-Tetrachloroethane	630-20-6	5/0.5
1,1,2,2-Tetrachloroethane	79-34-5	5/0.5
Tetrachloroethene	127-18-4	5/0.5
Toluene	108-88-3	5/0.5
1,1,1-Trichloroethane	71-55-6	5/0.5
1,1,2-Trichloroethane	79-00-5	5/0.5
Trichloroethene	79-01-6	5/0.5
Trichlorofluoromethane	75-69-4	5/0.5
1,2,3-Trichloropropane	96-18-4	5/1.0
Trichlorotrifluoroethane	26523-64-8	5/0.5
1,2,4-Trimethylbenzene	95-63-6	5/0.5
1,3,5-Trimethylbenzene	108-67-8	5/0.5
Vinyl chloride	75-01-4	10/1.0
p-Xylene Total	1330-20-7	5/0.5
m-Xylene		0.03
o-Xylene		0.06

^a MDL for low-level soil samples (µg/kg) is equivalent to the MDL for water samples.

Table VII (b)
Method 8260B: Determination of Estimated Quantitation Limits (EQLs)
for Various Matrices

Matrix	Factor
Ground water	10
Low-concentration soil	10
Water miscible liquid waste	500
High concentration soil and sludge	1250
Non-water miscible waste	5000

EQL = [Method detection limit (Table X(a))] X [Factor (Table X(b))]. For non-aqueous samples, the factor is on a wet-weight basis.

Table VII (c)
Method 8260B: Required Surrogate Compounds

Surrogate Compounds	CAS No.	Acceptance Criteria	
		Water	Soil
4-Bromofluorobenzene	460-00-4	86-115%	74-121%
1,2-Dichloroethane-d4	17060-07-0	80-120%	80-120%
Toluene-d8	2037-26-5	88-110%	81-117%
Dibromofluoromethane		86-118%	80-120%

Table VIII
Method 8260B: Required Internal Standard Compounds

Internal Standard Compound	CAS No.
Fluorobenzene	462-06-6
Chlorobenzene-d5	[3114-55-4]
1,4-dichlorobenzene-d4	[3855-82-1]
1,4-difluorobenzene	540-36-3
Pentafluorobenzene (optional)	363-72-4

Table IX (a)
Method 8270C: Semivolatile Organic Compounds by Gas Chromatography /
Mass Spectrometry
Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)

Compound Name	CAS No.	CRQL Water ^a (µg/L)	CRQL Soil ^a (µg/kg)
Acenaphthene	83-32-9	10	330
Acenaphthylene	208-96-8	10	330
Aniline	62-53-3	20	660
Anthracene	120-12-7	10	330
Azobenzene	103-33-3	20	660
Benz(a)anthracene	56-55-3	10	330
Benzo(b)fluoranthene	205-99-2	10	330
Benzo(k)fluoranthene	207-08-9	10	330
Benzo(g,h,l)perylene	191- 24-2	10	330
Benzo(a)pyrene	50-32-8	10	330
Benzoic acid	65-85-0	20	660
Benzyl alcohol	100-51-6	20	660
Bis(2-chloroethoxy) methane	111-91-1	10	330
Bis(2-chloroethyl) ether	111-44-4	10	330
Bis(2-ethylhexyl) phthalate	117-81-7	10	330
4-Bromophenyl phenyl ether	101-55-3	10	330
Butyl benzyl phthalate	85-68-7	10	330
4-Chloroaniline	106-47-8	20	660
4-Chloro-3-methylphenol	59-50-7	20	660
2-Chloronaphthalene	91-58-7	10	330
2-Chlorophenol	95-57-8	10	330
4-Chlorophenyl phenyl ether	7005-72-3	10	330
Chrysene	218-01-9	10	330
Dibenz(a,h)anthracene	53-70-3	10	330
Dibenzofuran	132-64-9	10	330
Di-n-butyl phthalate	84-74-2	10	330
1,2-Dichlorobenzene	95-50-1	10	330
1,3-Dichlorobenzene	541-73-1	10	330
1,4-Dichlorobenzene	106-46-7	10	330
3,3'-Dichlorobenzidine	91-94-1	20	660
2,4-Dichlorophenol	120-83-2	10	330

Table IX (a)
Method 8270C: Semivolatile Organic Compounds by Gas Chromatography /
Mass Spectrometry
Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)
(continued)

Compound Name	CAS No.	CRQL Water ^a (µg/L)	CRQL Soil ^a (µg/kg)
Diethyl phthalate	84-66-2	10	330
2,4-Dimethylphenol	105-67-9	10	330
Dimethyl phthalate	131-11-3	10	330
4,6-Dinitro-2-methylphenol	534-52-1	50	1650
2,4-Dinitrophenol	51-28-5	50	1650
2,4-Dinitrotoluene	121-14-2	10	330
2,6-Dinitrotoluene	606-20-2	10	330
Di-n-octyl phthalate	117-84-0	10	330
Fluoranthene	206-44-0	10	330
Fluorene	86-73-7	10	330
Hexachlorobenzene	118-74-1	10	330
Hexachlorobutadiene	87-68-3	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
Hexachloroethane	67-72-1	10	330
Indeno(1,2,3-cd)pyrene	193-39-5	10	330
Isophorone	78-59-1	10	330
2-Methynaphthalene	91-57-6	10	330
2-Methylphenol	95-48-7	10	330
3-Methylphenol	108-39-4	10	330
4-Methylphenol	106-44-5	10	330
Naphthalene	91-20-3	10	330
2-Nitroaniline	88-74-4	50	1650
3-Nitroaniline	99-09-2	50	1650
4-Nitroaniline	100-01-6	20	660
Nitrobenzene	98-95-3	10	330
2-Nitrophenol	88-75-5	10	330
4-Nitrophenol	100-02-7	50	1650
N-Nitrosodimethylamine	62-75-9	20	660
N-Nitrosodiphenylamine	86-30-6	10	330
N-Nitroso-di-n-propylamine	621-64-7	10	330
2,2'-Oxybis (1-chloropropane)	108-60-1	10	330

Table IX (a)
Method 8270C: Semivolatile Organic Compounds by Gas Chromatography /
Mass Spectrometry
Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)
(continued)

Compound Name	CAS No.	CRQL Water ^a (µg/L)	CRQL Soil ^a (µg/kg)
Pentachlorophenol	87-86-5	50	1650
Phenanthrene	85-01-8	10	330
Phenol	108-95-2	10	330
Pyridine	110-86-1	20	660
Pyrene	129-00-0	10	330
1,2,4-Trichlorobenzene	120-82-1	10	330
2,4,5-Trichlorophenol	95-95-4	10	330
2,4,6-Trichlorophenol	88-06-2	10	330

^a The MDL should be approximately ten times less than the EQL.
 NA = Not Applicable

Table IX (b)
Method 8270C: Determination of Estimated Quantitation Limits (EQLs)
for Various Matrices

Matrix	Factor
High concentration soil and sludge	125
Non-water miscible waste	500

EQL = [Estimated Quantitation Limit (Table XI(a))] X [Factor (Table XI(b))]. For non-aqueous samples, the factor is on a wet-weight basis.

Table IX (c)
Method 8270C: Required Surrogate Compounds

Surrogate Compounds	CAS No.	Acceptance Criteria	
		Water	Soil
2-Fluorobiphenyl	321-60-8	43-116%	30-115%
2-Fluorophenol	367-12-4	21-110%	25-121%
Nitrobenzene-d5	4165-60-0	35-114%	23-120%
Phenol-d6	13127-88-3	10-110	24-113%
p-Terphenyl-d14	1718-51-0	33-141%	18-137%
2,4,6-Tribromophenol	118-79-6	10-123%	19-122%

Table X
Method 8270C: Required Internal Standard Compound

Internal Standard Compound	CAS No.
1,4-Dichlorobenzene-d4	3855-82-1
Naphthalene-d8	1146-65-2
Acenaphthalene-d10	
Phenethrene-d10	1517-22-2
Chrysene-d12	1719-03-05
Perylene-d2	1520-96-3

Table XI
Method 8280A: Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by
High Resolution Gas Chromatography / Low Resolution Mass Spectrometry (HRGC/LRMS)
Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)

Compound Name	CAS No.	CRQL Water (ng/L)	CRQL Soil (µg/kg)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	10	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	25	2.5
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6	25	2.5
1,2,3,6,7,8-HxCDD	57653-85-7	25	2.5
1,2,3,7,8,9-HxCDD	19408-74-3	25	2.5
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-39-4	25	2.5
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	3268-87-9	50	5
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	10	1
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	25	2.5
2,3,4,7,8-PeCDF	57117-31-4	25	2.5
1,2,3,4,7,8-HxCDF	70648-26-9	25	2.5
1,2,3,6,7,8-HxCDF	57117-44-9	25	2.5
1,2,3,7,8,9-HxCDF	72918-21-9	25	2.5
2,3,4,6,7,8-HxCDF	60851-34-5	25	2.5
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	25	2.5
1,2,3,4,7,8,9-HpCDF	55673-89-7	25	2.5
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0	50	5
Total TCDD	41903-57-5	NA	NA
Total PeCDD	36088-22-9	NA	NA

Table XI
Method 8280A: Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by
High Resolution Gas Chromatography / Low Resolution Mass Spectrometry (HRGC/LRMS)
Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)
(continued)

Compound Name	CAS No.	CRQL Water (ng/L)	CRQL Soil (µg/kg)
Total HxCDD	34465-46-8	NA	NA
Total HpCDD	37871-00-4	NA	NA
Total TCDF	30402-14-3	NA	NA
Total PeCDF	30402-15-4	NA	NA
Total HxCDF	55684-94-1	NA	NA
Total HpCDF	38998-75-3	NA	NA

NA = Not Applicable

Table XII (a)
Method 8330: Nitroaromatics and Nitramines by High Performance
Liquid Chromatography
Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)

Compound Name	CAS No.	Water CRQL (µg/L)	Soil CRQL (mg/kg)
2-Amino-4,6-Dinitrotoluene (2-Am-DNT)	35572-78-2	0.5	0.25
4-Amino-2,6-Dinitrotoluene (4-Am-DNT)	1946-51-0	0.5	0.25
1,3-Dinitrobenzene (DNB)	99-65-0	0.5	0.25
2,4-Dinitrotoluene (24DNT)	121-14-2	0.5	0.25
2,6-Dinitrotoluene (26DNT)	606-20-2	0.5	0.26
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.5	1
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	0.5	0.65
Nitrobenzene (NB)	98-95-3	0.5	0.26
2-Nitrotoluene (2NT)	88-72-2	0.5	0.25
3-Nitrotoluene (3NT)	99-08-1	0.5	0.25
4-Nitrotoluene (4NT)	99-99-0	0.5	0.25
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	0.5	2.2
1,3,5-Trinitrobenzene (135TNB)	99-35-4	0.5	0.25
2,4,6-Trinitrotoluene (TNT)	118-96-7	0.5	0.25

Table XII (b)
Method 8330: Nitroaromatics and Nitramines by High Performance
Liquid Chromatography
Required Surrogate Compounds
(use either or both)

Surrogate Compounds	CAS No.	Acceptance Criteria*	
		Water	Soil
3,4-Dinitrotoluene (required)	610-39-9	50-160%	50-160%
2-Methyl-4-nitroaniline (optional)	99-55-8	50-160%	50-160%
1,4-Dinitrobenzene (optional)	100-25-4	50-160%	50-160%
1,2-Dinitrobenzene (optional)	528-29-0	50-160%	50-160%

*Specific surrogates are not designated in the method.

Table XIII

RESERVED

Table XIV
Method 8332: Nitroglycerine by High Performance Liquid
Chromatography
OR

USATHAMA Reversed-Phase High Performance Liquid Chromatography
Methods for the Determination of Nitroglycerine and Pentaerythritol
Tetranitrate in Water or Soil (1989)

Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)

Compound Name	CAS No.	Water MDL (µg/L)	Soil CRQL (mg/kg)
Nitroglycerine (NG)	53-63-0	5	0.5
Pentaerythritol tetranitrate (PETN)	78-11-5	5	0.5

Table XV

RESERVED

Table XVI

**Method TO-14: Determination of Volatile Organic Compounds in
Ambient Air Using SUMMA Passivated Canister Sampling and Gas
Chromatographic Analysis**

Required Target Analyte List and Contract-Required Quantitation Limits (CRQLs)

CAS No	Compound	CRQL ppbv ^a
67-64-1	Acetone	5.0
75-05-8	Acetonitrile	1.0
98-86-2	Acetophenone	0.2
107-02-8	Acrolein	0.5
107-13-1	Acrylonitrile	0.5
71-43-2	Benzene	0.2
100-47-0	Benzonitrile	0.5
100-44-7	Benzyl Chloride	0.2
75-27-4	Bromodichloromethane	0.2
75-25-2	Bromoform	0.2
74-83-9	Bromomethane	0.5
106-99-0	Butadiene[1,3-]	0.2
106-97-8	Butane[n-]	0.2
71-36-3	Butanol[1-]	0.5
78-93-3	Butanone[2-]	0.5
106-98-9	Butene[1-]	0.2
590-18-1	Butene[cis-2-]	0.2
624-64-6	Butene[trans-2-]	0.2
75-15-0	Carbon Disulfide	0.2
56-23-5	Carbon Tetrachloride	0.2
126-99-8	Chloro-1,3-butadiene[2-]	0.2
107-05-1	Chloro-1-propene[3-]	0.2
108-90-7	Chlorobenzene	0.2
124-48-1	Chlorodibromomethane	0.2
75-45-6	Chlorodifluoromethane	0.2
75-00-3	Chloroethane	0.5
67-66-3	Chloroform	0.2
74-87-3	Chloromethane	0.5
110-82-7	Cyclohexane	0.5
108-94-1	Cyclohexanone	0.2
287-92-3	Cyclopentane	0.2
142-29-0	Cyclopentene	0.2
106-93-4	Dibromoethane[1,2-]	0.2
76-14-2	Dichloro-1,1,2,2-tetrafluoroethane[1,2-]	0.2
95-50-1	Dichlorobenzene[1,2-]	0.2
541-73-1	Dichlorobenzene[1,3-]	0.2
106-46-7	Dichlorobenzene[1,4-]	0.2
75-71-8	Dichlorodifluoromethane	0.2

Table XVI
Method TO-14: Determination of Volatile Organic
Compounds in Ambient Air Using SUMMA Passivated
Canister Sampling and Gas Chromatographic Analysis
Required Target Analyte List and Contract-Required
Quantitation Limits (CRQLs)
(continued)

75-34-3	Dichloroethane[1,1-]	0.2
107-06-2	Dichloroethane[1,2-]	0.2
75-35-4	Dichloroethene[1,1-]	0.2
156-59-2	Dichloroethene[cis-1,2-]	0.2
156-60-5	Dichloroethene[trans-1,2-]	0.2
78-87-5	Dichloropropane[1,2-]	0.2
10061-01-5	Dichloropropene[cis-1,3-]	0.2
10061-02-6	Dichloropropene[trans-1,3-]	0.2
60-29-7	Diethyl Ether	0.5
75-83-2	Dimethylbutane[2,2-]	0.2
79-29-8	Dimethylbutane[2,3-]	0.2
565-59-3	Dimethylpentane[2,3-]	0.2
123-91-1	Dioxane[1,4-]	1.0
64-17-5	Ethanol	0.5
140-88-5	Ethyl Acrylate	0.2
637-92-3	Ethyl tert-Butyl Ether	0.2
100-41-4	Ethylbenzene	0.2
142-82-5	Heptane	0.2
87-68-3	Hexachlorobutadiene	0.2
110-54-3	Hexane	0.2
591-78-6	Hexanone[2-]	0.5
7642-09-3	Hexene[cis-3-]	0.2
4050-45-7	Hexene[trans-2-]	0.2
75-28-5	Isobutane	0.2
540-84-1	Isooctane	0.2
78-78-4	Isopentane	0.2
78-79-5	Isoprene	0.2
98-82-8	Isopropylbenzene	0.2
126-98-7	Methacrylonitrile	0.5
67-56-1	Methanol	10
80-62-6	Methyl Methacrylate	0.2
1634-04-4	Methyl tert-Butyl Ether	0.2
563-45-1	Methyl-1-butene[3-]	0.2
763-29-1	Methyl-1-pentene[2-]	0.2
691-37-2	Methyl-1-pentene[4-]	0.2
513-35-9	Methyl-2-butene[2-]	0.2
108-10-1	Methyl-2-pentanone[4-]	0.5
108-87-2	Methylcyclohexane	0.2
96-37-7	Methylcyclopentane	0.2
75-09-2	Methylene Chloride	0.2
592-27-8	Methylheptane[2-]	0.2
589-81-1	Methylheptane[3-]	0.2
591-76-4	Methylhexane[2-]	0.2
589-34-4	Methylhexane[3-]	0.2
107-83-5	Methylpentane[2-]	0.2

Table XVI
Method TO-14: Determination of Volatile Organic
Compounds in Ambient Air Using SUMMA Passivated
Canister Sampling and Gas Chromatographic Analysis
Required Target Analyte List and Contract-Required
Quantitation Limits (CRQLs)
(continued)

96-14-0	Methylpentane[3-]	0.2
98-83-9	Methylstyrene[alpha-]	0.2
98-95-3	Nitrobenzene	0.2
79-46-9	Nitropropane[2-]	0.2
111-84-2	Nonane[1-]	0.2
111-65-9	Octane[n-]	0.2
109-66-0	Pentane	0.5
109-67-1	Pentene[1-]	0.2
627-20-3	Pentene[cis-2-]	0.2
646-04-8	Pentene[trans-2-]	0.2
80-56-8	Pinene[alpha-]	0.2
127-91-3	Pinene[beta-]	0.2
67-63-0	Propanol[2-]	0.5
107-12-0	Propionitrile	0.5
103-65-1	Propylbenzene[1-]	0.2
115-07-1	Propylene	0.2
100-42-5	Styrene	0.2
79-34-5	Tetrachloroethane[1,1,2,2-]	0.2
127-18-4	Tetrachloroethene	0.2
109-99-9	Tetrahydrofuran	0.2
108-88-3	Toluene	0.2
76-13-1	Trichloro-1,2,2-trifluoroethane[1,1,2-]	0.2
120-82-1	Trichlorobenzene[1,2,4-]	0.2
71-55-6	Trichloroethane[1,1,1-]	0.2
79-00-5	Trichloroethane[1,1,2-]	0.2
79-01-6	Trichloroethene	0.2
75-69-4	Trichlorofluoromethane	0.2
95-63-6	Trimethylbenzene[1,2,4-]	0.2
108-67-8	Trimethylbenzene[1,3,5-]	0.2
565-75-3	Trimethylpentane[2,3,4-]	0.2
108-05-4	Vinyl Acetate	0.5
75-01-4	Vinyl Chloride	0.2
95-47-6	Xylene[1,2-]	0.2
108-38-3	Xylene[1,3-]	0.2

^a ppbv = parts per billion by volume.

ATTACHMENT 4

Table I
 Sample Preservation Techniques and Holding Times

Parameter(s)	Method	Matrix	Container ^a	Preservation ^b	Holding Time ^b	
					Sample	Extract
Inorganic Analytes:						
All metals except Hg and Cr(VI) ^c	SW-6010, 6020, and 7000-series; or CLP	Water, Total	P, 500 mL	HNO ₃ to pH<2	180 Days	N/A
		Water, Dissolved	P, 500 mL	Filter on site; HNO ₃ to pH<2	180 Days	N/A
		Water, Suspended	P, 500 mL	None	180 Days	N/A
		Solid/Other	G, 250 mL	None	180 Days	N/A
Hg	SW-7470A; or CLP	Water, Total	P, 500 mL	4 °C; HNO ₃ to pH<2	28 Days	N/A
		Water, Dissolved	P, 500 mL	Filter on site; 4 °C; HNO ₃ to pH<2	28 Days	N/A
	SW-7471A; or CLP	Solid/Other	G, 250 mL	4 °C	28 Days	N/A
Cr(VI)	SW-7196 or 7199	Water	P, 500 mL	4 °C	24 Hours	N/A
	SW-3060A and SW-7196 or 7199	Solid/Other	G, 250 mL	4 °C	30 Days	4 days
Volatile Organic Analytes:						
Aromatic VOCs (BTEX)	SW-8021B	Water	G(A) with Teflon-lined septa, 2 x 40 mL	4 °C; H ₂ SO ₄ or HCl to pH<2	14 Days	N/A
		Solid/Other	G, 125 mL	4 °C	14 Days	N/A

Table I
Sample Preservation Techniques and Holding Times
(continued)

Parameter(s)	Method	Matrix	Container ^a	Preservation ^b	Holding Time ^b	
					Sample	Extract
Volatile Organic Analytes:						
Halogenated VOCs	SW-8021B	Water	G(A) with Teflon-lined septa, 2 x 40 mL	4 °C; H ₂ SO ₄ or HCl to pH<2	14 Days	N/A
		Solid/Other	G, 125 mL	4 °C	14 Days	N/A
VOCs	SW-8260A; or CLP	Water	G(A) with Teflon-lined septa, 2 x 40 mL	4 °C; H ₂ SO ₄ or HCl to pH<2	14 Days	N/A
		Solid/Other	ENCORE samplers (2)	-14 °C	14 Days	7 Days (at -14 °C)
Semivolatile Organic Analytes:						
Phenols	SW-8041	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
SVOCs	SW-8270A; or CLP	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
Organochlorine Pesticides, PCBs, and Herbicides:						
Pesticides/PCBs	SW-8081; or CLP	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
PCBs	SW-8082	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days

Table I
Sample Preservation Techniques and Holding Times
 (continued)

Parameter(s)	Method	Matrix	Container ^a	Preservation ^b	Holding Time ^b	
					Sample	Extract
Organochlorine Pesticides, PCBs, and Herbicides:						
Chlorinated Herbicides	SW-8151A	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
Polychlorinated dioxins & furans	SW-8280A	Water	G(A), 4 L	4 °C	30 Days	45 Days
Polychlorinated dioxins & furans	SW-8280A	Solid/Other	G, 250 mL	4 °C	30 Days	45 Days
High Explosives:						
Nitroaromatics and Nitramines	SW-8330	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
Tetrazene	SW-8331	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
Nitroglycerine & PETN	SW-8332	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
Miscellaneous Organic Analytes:						
GRO, DRO, TPH	SW-8015 Modified	Water	G(A), 2x1L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
Organophosphorus Compounds	SW-8141A	Water	G(A), 4 L	4 °C	7 Days	40 Days

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	Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
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Table I
Sample Preservation Techniques and Holding Times
(continued)

Parameter(s)	Method	Matrix	Container ^a	Preservation ^b	Holding Time ^b	
					Sample	Extract
Miscellaneous Organic Analytes:						
Nonvolatile organic compounds	SW-8321	Water	G(A), 4 L	4 °C	7 Days	40 Days
		Solid/Other	G, 250 mL	4 °C	14 Days	40 Days
PAHs in Filter Cartridges	TO-13	Adsorbate	Tenax, PUF, or XAD-2 Filter Cartridge	4 °C	7 Days	40 Days
VOCs	TO-14	Gas	SUMMA® Canister	None	7 Days	N/A
Radiological Analytes:						
All radiochemical parameters except radioactive iodine, tritium, and Radon-222		Water, Total	P, 1 L	HNO ₃ to pH<2	180 Days	N/A
		Water, Dissolved	P, 1 L	Filter on site; HNO ₃ to pH<2	180 Days	N/A
		Water, Suspended	P, 1 L	None	180 Days	N/A
		Solid/Other	G, 250 mL	None	180 Days	N/A
Tritium	Liquid scintillation counting	Water	P, 1 L	None	180 Days	N/A
		Solid/Other	G, 250 mL	None	180 Days	N/A
Radon-222	Liquid scintillation counting	Water	G(A), 2 x 40 mL	None	72 Hours	N/A
Inorganic Nonmetallic Analytes:						

Bromate, Bromide, Chlorate, Chloride, or Fluoride by IC	SW-9056 or EPA 300.0	Water	P, 1 L	None	28 Days	N/A
		Solid/Other	G, 125 mL	4 °C	28 Days	N/A

Table I
Sample Preservation Techniques and Holding Times
 (continued)

Parameter(s)	Method	Matrix	Container ^a	Preservation ^b	Holding Time ^b	
					Sample	Extract
Inorganic Nonmetallic Analytes:						
Bromide	EPA 320.1	Water	P, 100 mL	None	28 Days	N/A
Chlorite by IC	EPA 300.0	Water	P, 100 mL	4 °C	Immediately	N/A
Chloride	SW-9250; or EPA 325.1, 325.2, or 325.3	Water	P, 100 mL	None	28 Days	N/A
Cyanide, total	SW-9010A or 9012A; EPA 335.4; or CLP	Water	P, 1 L	4 °C; NaOH to pH>12	14 Days	N/A
	SW-9010A or 9012A; or CLP	Solid/Other	G, 125 mL	4 °C	14 Days	N/A
Fluoride	EPA 340.1, 340.2, or 340.3	Water	P, 500 mL	None	28 Days	N/A
Iodide	EPA 345.1	Water	P, 100 mL	4 °C	24 Hours	N/A
NH ₃ - Nitrogen (Ammonia)	EPA 350.1, 350.2, or 350.3	Water	P, 1 L	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
NO ₂ - Nitrogen (Nitrite)	EPA 300.0 or EPA 354.1	Water	P, 500 mL	4 °C	48 Hours	N/A
NO ₃ - Nitrogen (Nitrate)	EPA 300.0 or EPA 352.1	Water	P, 500 mL	4 °C	48 Hours	N/A
Nitrate + Nitrite Nitrogen	EPA 353.1, 353.2, or 353.3	Water	P, 500 mL	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
		Solid/Other	G, 250 mL	4 °C	28 Days	N/A

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Orthophosphate - Phosphorus by IC	EPA 300.0	Water	P, 500 mL	4 °C	48 Hours	N/A
Phosphorus: Orthophosphate, dissolved	EPA 365.1, 365.2, or 365.3	Water	P, 500 mL	Filter on site; 4 °C	48 Hours	N/A

Table I
Sample Preservation Techniques and Holding Times
(continued)

Parameter(s)	Method	Matrix	Container ^a	Preservation ^b	Holding Time ^b	
					Sample	Extract
Phosphorus: Hydrolyzable	EPA 365.1, 365.2, or 365.3	Water	P, 500 mL	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
Total	EPA 365.1, 365.2, 365.3, or 365.4	Water	P, 500 mL	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
Total, dissolved	EPA 365.1, 365.2, 365.3, or 365.4	Water	P, 500 mL	Filter on site; 4 °C; H ₂ SO ₄ to pH<2	24 Hours	N/A
Silica, dissolved (SiO ₂)	EPA 370.1	Water	P, 125 mL	Filter on site; 4 °C	28 Days	N/A
Sulfide (S ²⁻)	EPA 376.1 or 376.2	Water	P, 500 mL	4 °C; 2 mL zinc acetate plus NaOH to pH>9	7 Days	N/A
Sulfate (SO ₄ ²⁻)	EPA 300.0 or EPA 375.1, 375.2, 375.3, or 375.4	Water	P, 500 mL	4 °C	28 Days	N/A
Sulfate (SO ₄ ²⁻)	EPA 300.0 or EPA 375.1, 375.2, 375.3, or 375.4	Solid/Other	G, 125 mL	4 °C	28 Days	N/A
Aggregate Analytes:						
Acidity as CaCO ₃	EPA 305.1	Water	P, 500 mL	4 °C	14 Days	N/A

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Alkalinity as CaCO ₃	EPA 310.1 or EPA 310.2	Water	P, 500 mL	4 °C	14 Days	N/A
Biological oxygen demand (BOD)	EPA 405.1	Water	P, 1L	4 °C	48 Hours	N/A
Carbon, dissolved organic (DOC)	EPA 415	Water	G(A), 250 mL	Filter on site; 4 °C; H ₂ SO ₄ or HCl to pH<2	28 Days	N/A

Table I
Sample Preservation Techniques and Holding Times
(continued)

Parameter(s)	Method	Matrix	Container ^a	Preservation ^b	Holding Time ^b	
					Sample	Extract
Aggregate Analytes:						
Carbon, total organic (TOC)	SW-9060; EPA 415.1	Water	G(A), 250 mL	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
		Solid/Other	G, 125 mL	4 °C	28 Days	N/A
Chemical oxygen demand (COD)	EPA 410.1, 410.2, 410.3, 410.4	Water	P, 500 mL	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
Color	EPA 110.1, EPA 110.2, or EPA 110.3	Water	P, 500 mL	4 °C	48 Hours	N/A
Hardness as CaCO ₃	EPA 130	Water	P, 1 L	4 °C	28 Days	N/A
Nitrogen - Total Kjeldahl	EPA 351.1, 351.2, 351.3, or 351.4	Water	P, 1 L	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
		Solid/Other	G, 250 mL	4 °C	28 Days	N/A
Oil and grease, total recoverable	SW-9070; EPA 413.1 or 413.2	Water	G, 1 L	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
Petroleum hydrocarbons, total recoverable	EPA 418.1	Water	G(A), 1 L	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A

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		Solid/Other	G, 125 mL	4 °C	28 Days	N/A
Phenolics, total recoverable	SW-9065; or EPA 420.1, 420.2, or 420.3	Water	G, 1 L	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
		Solid/Other	G, 125 mL	4 °C	28 Days	N/A
pH	SW-9040B; SW-9045C; or EPA 150.1 or 150.2	Water	P, 125 mL	None	Immediately	N/A

Table I
Sample Preservation Techniques and Holding Times
(continued)

Parameter(s)	Method	Matrix	Container ^a	Preservation ^b	Holding Time ^b	
					Sample	Extract
Aggregate Analytes:						
Specific conductance	SW-9050; EPA 120	Water	P, 125 mL	4 °C	28 Days	N/A
Solids:						
Total (TS)	EPA 160.3	Water	P, 500 mL	4 °C	7 Days	N/A
Total, dissolved (TDS)	EPA 160.1	Water	P, 500 mL	4 °C	7 Days	N/A
Total, suspended (TSS)	EPA 160.2	Water	P, 500 mL	4 °C	7 Days	N/A
Volatile	EPA 160.4	Water	P, 500 mL	4 °C	7 Days	N/A
Total organic halides (TOX)	SW-9020B	Water	G, 1 L	4 °C; H ₂ SO ₄ to pH<2	28 Days	N/A
		Solid/Other	G, 125 mL	4 °C	28 Days	N/A
Turbidity	EPA 180.1	Water	P, 500 mL	4 °C	48 Hours	N/A

^a P=plastic (polyethylene or equivalent), G=glass, G(A)=amber glass. All glass containers (except Teflon-lined septum vials) must have a Teflon-lined screw-cap. These requirements apply to containers provided by the analytical Subcontract Laboratory.

^b Other regulatory or project requirements may apply. If so, the analytical Subcontract Laboratory will be advised.

^c The LANL target analyte list for metals includes mercury.

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Attachment 5

RESERVED

Attachment 6

Example Chain-of-Custody

Los Alamos

CHAIN OF CUSTODY DOCUMENT NUMBER:

NATIONAL LABORATORY

REQUEST NUMBER:

ANALYSIS TYPE:

ATTN:

SAMPLE ID	CONT ID	CONTAINER DESCRIPTION	ANALYSIS ORDER CODE
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Final Page of CHAIN OF CUSTODY DOCUMENT FOR REQUEST NUMBER 3788R Page 1

Relinquished by:	Date	Time	Received by	Date	Time
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Printed Name Signature	Printed Name Signature
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Printed Name Signature	Printed Name Signature
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Printed Name Signature	Printed Name Signature
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Received for DISPOSAL by:	Date	Time	Remarks:
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Printed Name Signature	
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Attachment 7

Request for Analysis

(Date)

Request Number:

Los Alamos
National Laboratory

Analysis Type:

Attn:

Please analyze the enclosed samples
according to the schedule indicated

These samples are on:

SHIP DATE:
REPORT DUE:
TURN AROUND REQ'D:

LANL Request Number:
Per Agreement Number:
Project Cost Code:

RAD SCREENING:
COMMENTS:

LANL ER SMO CONTACT:

ANALYSIS ORDER CODE	ANALYTE(S)	SAMPLE ID	CONT ID	SAMPLE MATRIX	DATE SAMPLED	COMMENTS
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Attachment 8

Sample Container Label

LOS ALAMOS NATIONAL LABORATORY	
Location:	OU
Location ID:	TA
(Sample ID)	Date Time
anal:	Preserv
Collected by:	Initials:

Attachment 9

INVOICING REQUIREMENTS

The electronic file of invoicing information is to be submitted using Microsoft Excel. No columns may be hidden or outlined. No borders, shading of cells, or extra rows are to be included. Column headings are to be typed with the exact names and order described in the following table:

Column Format for Excel Spreadsheet of Invoicing Information

Column Name	Data Type	Maximum Size	Format
LAB NAME	Text	255	Upper Case
CONTRACT #	Text	255	Upper Case
INVOICE#	Text	255	Upper Case
DATE	Date/Time	8	Upper Case using format "DD-MON-YY"
LAB BATCH	Text	255	Upper Case
LANL REQ#	Text	16	Upper Case
# SAMPLES	Number	8	
ORDER CODE	Text	12	Upper Case
MATRIX	Text	255	Upper Case
UNIT COST	Number	8	No currency symbols
EXTENDED COST	Number	8	No currency symbols

Addendum Attachment
Column Descriptions for the Electronic Data Deliverable

Analytical Chemistry data will be delivered to the client in a text file. The column headings are described in the table below, with the description of the data to be included in that column. The file must contain all columns, whether they actually contain values or not, and they are to appear in the order described. Each column will be separated from the next using the “pipe” symbol (|) as a delimiter. No additional spaces should be included at the beginning or end of a column. Certain columns must reference a restricted list of values in order to ensure data integrity, as designated in the table under the heading “Limited list of values”.

Data Element	Definition	Date Type	Required	Limited list of values
Request Number	An identifier used to designate a group of samples submitted together for analysis.	Text	All records	
Chain of Custody ID	An identifier for the chain of custody received by the laboratory from the client	Text	All records	
Reporting Number	An identifier used to designate a report of data for a specific request number submitted together for analysis.	Text	All records	
Lab Code	Identifier for the lab doing this analysis.	Text	All records	x
Collection Date	The date the sample was collected.			
Lab Receipt Date	Date the sample arrived at the analytical laboratory.	Date	All records	
Prep_Date	The date the sample was extracted or otherwise prepared for analysis.			
Analysis Date	Date (and time, if required) of analysis of this aliquot.	Date	All records	
Client_Sample_Id	Client's identifier for a sample. This should be the basis on which the client identifies the sample.	Text	Non QC records	
Lab Sample Id	Lab identifier for a sample. This code is the primary link into the lab's record keeping system. It is not necessarily one-to-one with the Client_Sample_ID. Unique within the lab.	Text	All records	
Lab Matrix	The matrix of the aliquot produced in a handling activity at the laboratory. This what the lab sees it as, not necessarily what we see. It is more restricted (Soil, Water, Sediment). We might call it runoff water or groundwater.	Text	All records	x
PH	The pH measured by the lab.	Number		

Data Element	Definition	Date Type	Required	Limited list of values
Analyte Suite	The analytical suite as defined by the client.	Text	All records	See list below.
QC_Batch Id	Lab defined identifier for a group of sample or aliquots that are linked together by a common process or operation. The batch referenced by this batch id is the one used to associate QC analyses with submitted samples.	Text	All records	
Analysis Method	The analytical method that was requested for this analysis. This is the official method number requested by the client.	Text	All records	x
Analytical Technique	The instrument type or other identifier used to analyze the sample in compliance with the requested analysis method.			
Prep Method	The method used to prepare a sample	Text		See list below
Dilution Factor	The overall dilution of the aliquot. A value of one should correspond to nominal conditions for the method. Values less than one correspond to concentrations.	Number		
Percent Moisture	Percent of sample composed of water.	Number		
Analyte Code	The code for the analyte. In the case of organic compounds, this is the CAS number. In the case of radionuclides, elements, or inorganic compounds, it is the chemical symbol. Isotopes shall be represented by the symbol, a hyphen, and the mass (e.g. Pu-239). Ions shall be represented by the chemical formula without any subscripts, superscripts, or indication of charge (e.g. Cl ₂ , NH ₄). Codes for operationally defined parameters (BOD, COD, TDS, TSS, etc.) shall appear on the analytical service request.	Text	All records	x
Analyte Name	The name of the analyte.	Text	All records	x
IDL	Instrument Detection Limit	Number	Units to be same as result units	
MDL	Method Detection Limit	Number	Units to be same as result units	
MDA	Minimum Detectable Activity	Number	Units to be same as result units	
Quantitation Limit	Quantitation Limit	Number	Units to be same as result units	

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Data Element	Definition	Date Type	Required	Limited list of values
DLC	Decision Level Concentration	Number	Units to be same as result units	
Text Result	A result that cannot be represented numerically	Text	If No Numeric Result	x
Result	Reportable result for the analyte. Value computed from several analyses.	Number	If No Text Result	
Uncertainty	Total propagated uncertainty. Expressed as 1 sigma.	Number		
Result Unit	Units for Results.	Text	If Numeric Result exists.	
Lab Qualifier	A string of single letter result qualifiers assigned by the lab, based on defined rules and values.	Text		
Amount Added	Specifies a known amount of analyte that has been added to the aliquot. Can be used with spikes, surrogates, tracers, standard additions, and calibration standards. Expressed as a sample concentration in the same units as the result.	Number	Units to be same as result units	
Analyte Type	The type of analyte reported. Examples are surrogates and tracers	Text	QC	x
QC Type	The code indicating the type of QC sample. Examples are matrix spikes and lab control samples.	Text	QC	x
Percent Recovery	The recovery of an analyte expressed as a percentage of the amount added.	Number		
Relative Percent Difference	A calculated quality control value used as an indicator of precision for the results of an analytical procedure.	Number		
Comments		Text. Limited to 500 characters.		

Each record must be uniquely identified by a combination of the following fields:

- Lab sample id
- Request
- Suite
- QC type
- Analyte Type
- Analyte
- Analytical Method

Limited list of acceptable values for individual columns.

Analytical suites

	Code	Description
GENINORG		General Inorganics
HEXP		High Explosives
METALS		Metals
PCB		PCBs
RAD		Radionuclides
SVOA		Semivolatile Organics
VOA		Volatile Organics

Analyte types

<u>Code</u>	<u>Definition</u>
CA	Carrier
IN	Internal Standard
OD	Other Detected Isotope
SM	System Monitoring Compound
SP	Spike
SU	Surrogate
TA	Target Analyte
TIC	Tentatively Identified Compound
TR	Tracer
UG	Unidentified gamma emission

Analysis methods

Allowed values for the Analysis Method field are limited to the methods listed in Tables 4.1, 4.2, 4.4 in the body of the addendum and the methods specified in the Addendum Attachments. The following general rules apply: (i) SW-846 methods. Use the four-digit method number, such as 8260. (ii) Clean water act and other so-called EPA methods. Use the three digit base number plus the method variation identifier following the period character, such as 160.2 (iii) Methods from *Standard Methods*. Use a SM prefix followed by the four-digit method number plus the method variation character, such as SM5210B. (iv) Laboratory in-house methods (such as for radionuclides) or special analyses outside the scope of the SOW and Addendum may be proposed. In these cases, an Analytical Method code must be obtained from the ESH-18 data coordinator before submitting results.

The analytical method code will be printed on the analytical service request. The service request may be used to validate entries to the Analytical Method field of the deliverable.

Prep Methods

The same general guidelines for Analytical Method field apply to the Prep Method field. The preparation method is an inclusive step of many Analytical Methods specified in the Addendum. In these cases, the Prep Method field may be left blank. However, if a preparation method is listed on the analytical service request, that method must appear in the Prep Method field of the electronic deliverable.

Detection Limit Types

<u>Detection Limit Type</u>	<u>Definition</u>
MDC	Minimum Detectable Concentration
DLC	Decision Level Concentration
MDL	Method Detection Limit

Lab Matrices

<u>Lab Matrix Code</u>	<u>Description</u>
W	Water
SO	Soil
SED	Sediment

QC Types

<u>Code</u>	<u>Description</u>
BS	Blank Spike
BSD	Blank Spike Duplicate
CS	Client Sample
DL	Dilution
LB	Lab Blank
LCS	Lab Control Sample
LCSD	Lab Control Sample Duplicate
LR	Lab Replicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
RE	Reanalysis

Glossary

Accreditation for Asbestos Analysis	For this subcontract, this refers to accreditation by the American Industrial Hygiene Association (AIHA) to be eligible to perform airborne asbestos analysis under their accreditation program.
Accuracy	The extent to which the results of a calculation or measurement approach the true value of the calculated or measured quantities, and are free of errors.
AEA	Atomic Energy Act and amendments.
Aliquot	A representative sample of a larger quantity.
Alpha Scintillation Detector	An analytical instrument used to detect and quantify individual scintillations when emitted alpha particles strike a phosphor during the process of radioactive decay.
Alpha Spectrometry	A type of spectroscopy that discriminates among alpha particles emitted during radioactive decay according to their energy level, and which is used to identify and quantify different alpha-emitting radionuclides in a sample.
Analysis	A process used to measure one or more attributes of a sample in a clearly defined controlled systematic manner. Often requires treating a sample chemically or physically before measurement.
Analysis Acceptance Criteria	The analysis acceptance criteria for organic analyses are given in SOW section 3.5.5.
Analysis Request Form Analysis required	See Request for Analysis Form and Attachment 7. The analysis required, turnaround time and other pertinent information will be specified by LANL in the Request for Analysis Form accompanying the COC form and analytical samples submitted to the Subcontract Laboratory.
Analysis Results Form	The Analysis Results form reports parameter concentrations measured by the Subcontract Laboratory. The use of CLP forms is preferred, although these must be adapted for use with non-CLP methods. This decision is left to the discretion of the Subcontract Laboratory.
Analyte	The particular chemical or radiochemical species to be identified and/or quantified.
Analyte Definitions	For analyses performed under this SOW, the term "general inorganic" refers to the analytes listed in Attachment 1, the term "radiochemical" refers to the analytes listed in Attachment 2, and the term "organic" refers to the analytes listed in Attachment 3.
Analytical	A term describing the precise identification and quantification of target compounds, ions or radionuclides present in a sample.

Analytical Data Packages	The analytical data packages provided to the LANL SMO are discussed in section 4.1.1. The analytical data package format is comparable to those specified in the CLP inorganic and organic statements of work.
Analytical Holding Time	Analytical holding time refers to the time elapsed between sample collection or preparation (as specified by the analytical procedure) and laboratory analysis.
Analytical Sample	An aliquot of various media (liquid, solid, or gaseous) which is submitted to a Subcontract Laboratory for the detection and quantification of specific target compounds, ions or radionuclides.
Analytical Uncertainty	The analytical uncertainty values (in 1 sigma) and DLCs for radiochemical parameters. See Uncertainty
ASTM	American Society of Testing and Materials.
ASTM Class A Glassware	Glassware that conforms to the ASTM Class A standard for containers used in the preparation and analysis of standards, reagents and samples for LANL under this SOW.
ASTM Type I,II Water	For the purposes of this SOW, ASTM Type I water is water having conductivity less than 0.06 $\mu\text{mho/cm}$ or resistivity greater than 16.67 $\text{M}\Omega\text{-cm}$. ASTM Type II water is water having conductivity less than 1 $\mu\text{mho/cm}$ or resistivity greater than 1 $\text{M}\Omega\text{-cm}$. The applicable ASTM standard is D 1193-77.
Background Counts	The somewhat steady level of radiation present in all natural environments, which produces an instrument noise recorded as individual disintegrations or counts.
Batch	A group of samples, which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, than each group of 20 samples or less will all be handled as a separate batch.
Bias	<p>The deviation due to matrix effects of the measured value ($x_s - x_u$) from a known spiked amount. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike). Thus, the bias (B) due to matrix effects based on a matrix spike is calculated as:</p> $B = (x_s - x_u) - K$ <p>Where:</p> <p>x_s = measured value for spiked sample, x_u = measured value for unspiked sample, and K = known value of the spike in the sample</p> <p>Using the following equation yields the percent recovery (%R).</p> $\%R = 100 (x_s - x_u) / K$
BOD	Biological oxygen demand.
Calibration	A process used to identify the relationship between the true, or reference, analyte concentration, or other variable and the response of the measurement instrument, chemical analysis method, or other measurement system.

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Calibration Blank	A calibration standard prepared to contain negligible or unmeasurable amounts of analytes. It is used to establish the zero concentration point for analytical measurement calibration.
Calibration Standard	A sample prepared to contain known amounts of the analytes of interest and other constituents required for the analysis.
Carrier	A compound with similar chemical and physical properties that is used to introduce a specific radioactive tracer into a sample. Without the use of carriers, the small amounts of radioactive tracers used in analyses would tend to stick to the surface of glassware, syringes and other analytical equipment.
Carryover Contamination	Target analytes that are introduced during Subcontract Laboratory handling and analysis from a previous analytical sample or Subcontract Laboratory standard, and which were not present in the original sample.
CAS Number	Chemical Abstract Services number which uniquely identifies a chemical substance.
Case File	All documents and records associated with each specific delivery order, including all electronic data.
Case Narrative	A narrative description (See Section 4.1.1 (b) of this SOW) of any problems or corrective actions that may affect data quality of the data reported in an Analytical Data report.
CCV	Continuing Calibration Verification. An analytical sample included in the analyses of a batch to verify that the process or measurement is still in calibration.
Certified Standard	A certified standard is a material that is guaranteed to meet specified conditions of purity, concentration or weight for a defined time period by its manufacturer. The material must be accompanied by a certificate of analysis.
Chain of Custody (COC)	An unbroken, documented trail of accountability designed to ensure that the physical integrity of samples, data, and records remains uncompromised.
Characterization Management Program	The DOE-AL Characterization Management Program (CMP), formerly called the Field Sample Management Program (FSMP), strives to improve the quality of the chemical analysis data acquired and to reduce duplication of effort.
Check Sample	Interference check samples (ICS) for ICP-AES analyses are required by the method to check how well the instrument is set up to account for known interferences in the analysis of samples.
Chemical	Any naturally occurring or man made substance characterized by a definite molecular composition, including molecules that contain radionuclides
Chemical Analysis	The term chemical analysis refers to all general inorganic, organic, and radiochemical analyses.
Chemical Analysis	Analysis including all general inorganic, organic, and radiochemical procedures to identify and/or measure quantities of defined species.

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Chemical Analysis Laboratory	Any Subcontract Laboratory performing chemical analysis under this Statement of Work.
Chromatogram	The pattern formed on the adsorbent medium by the layers of components separated by the process of chromatography, or a time-based graphic recording (as of concentration of eluted materials vs. time) of a chromatographic separation.
Cleanup	A prescribed treatment of a sample to prepare the sample for analysis of the specified analyte. This treatment may be either chemical or physical in nature.
CLP	USEPA Contract Laboratory Program (CLP).
COC seal	The Chain of Custody seal is a specifically designed piece of tape attached to the lid and sides of a sample container in such a manner that the sample can not be opened without destroying this tape. An intact COC seal suggests that no sample tampering has occurred during transit of the sample from LANL to the Subcontract Laboratory.
Column Degradation Products	Column degradation products (siloxanes) identified in LANL samples will be discussed in the case narrative in addition to any data qualification requirements.
Compound Confirmation	Compound confirmation is a procedure for ensuring that reported analytes were actually detected in the analyses. For GC/MS the required compound confirmation procedure is given in the guidelines contained in EPA Method 8141A.
Conductivity	Conductivity is the measurement of the current that can pass through a sample solution and is proportional to the total concentration of ionized salts.
Control Limits	Control limits specify the parameters within which all analyses must be performed.
Controlled Document	Controlled documents are those subject to special preparation, distribution, and tracking protocols. The document control protocols ensure that persons in possession of documents are known, so that complete incorporation of revisions or implementation of new versions can be verified against the list of document holders.
Corrective Action Report (CAR)	A quality program report that describes the actions taken for data not within control limits or any non-routine events that occur at the Subcontract Laboratory.
Correlation Coefficient	Correlation coefficient is a number or function indicating the degree of correlation (positive or negative) between two sets of data or between two random variables and is equal to their covariance divided by the product of their standard deviations.
CRQL	CRQL is the acronym for contract required quantitation limit. These are not intrinsically tied to instrument sensitivity, but rather are contract-required limits.
Curie (Ci)	A unit of radioactivity defined as that quantity of any radioactive nuclide that has an activity of 3.7×10^{10} disintegrations per second.
Daily Requirements	Daily requirements for checking refrigerators, balances, and the like apply only to business days. Daily requirements for instrument calibration and standards preparation refer only to days when the instruments are used.

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Data Qualifiers	Data qualifiers as described in CLP SOW OLM03.0 shall be used when reporting results for all organic analytical methods. General inorganic chemistry and radiochemistry data qualifiers available for use by the Subcontract Laboratory are listed in Section 4.1.9. The use of these data qualifiers is required on the Analysis Results form, the electronic data deliverable, and the QC data deliverable.
Data Verification/ Review by Laboratory	A data verification/review by supervisors or peers is required for all analyst worksheets describing analysis of LANL samples shall undergo. A field shall be provided on each worksheet for the reviewer's initials. The reviewer need not sign each page of a submittal; only one signature per data submittal (per analytical batch) is required. Worksheet review signatures signify that the analyst has met the requirements of the method, Subcontract Laboratory QA policies, and this SOW.
Deionized Water (DI)	Deionized water (DI) has had all ions removed by an ion exchange process.
Deliverable Levels	The deliverable levels are specifications for classes of analytical data reports.
Digestate	A digestate is a sample medium treated by a digestion process to release or remove specific target analytes for subsequent analyses.
Digestion	The process of releasing or removing target analytes from a sample so that they may be quantified in subsequent tests.
Dilution	Dilution is the process of reducing the concentration of target analytes by the adding of solvent (usually water).
Disposal Requirements	Disposal requirements in this SOW make the Subcontract Laboratory solely responsible for the lawful disposal of all LANL samples after the 90-day sample storage requirement is fulfilled.
Distillation	Distillation is the process of purifying a liquid by successive evaporation and condensations, which leave non-volatile impurities behind.
DLC	DLC is the acronym for decision level concentration. When calculated according to the equation in this SOW, the DLC gives the level at which there is a five percent probability of reporting a false positive for a sample containing no analyte. The DLC is calculated sample specifically using variable values from the actual analytical conditions.
DO	Dissolved oxygen.
DOE-AL	Acronym for the Department of Energy Field Office at Albuquerque, New Mexico.
DQO	Data Quality Objectives. The qualitative and quantitative goals that are developed before sampling begins that clarify the investigative objectives and identify the type, quantity and quality of data needed to support decisions.
Dried	Dried refers to a treatment where a solid is heated a temperature sufficiently high to remove the free water present, but also low enough to avoid chemical changes in the material being treated.

Dry Weight Basis	Dry weight is the weight of a solid or semisolid material after the free water content has been removed by drying. Analytical results are reported on a dry weight basis (e.g., mg/kg or µg/kg) unless otherwise specified by the analytical procedure or the LANL SMO.
Duplicate Analysis	An analysis performed on a pair of identical prepared subsamples of the same sample.
Duplicate Measurement	One of a pair of measurements performed on a prepared sample under identical conditions.
Duplicate Sample	A duplicate sample is a split taken by the LANL sampling team and submitted as a sample for the purpose of assessing both sampling and analytical precision.
EDD	EDD is the acronym for electronic data deliverable. This is the computer file containing analytical results and associated information. The value of each data element in the electronic data deliverable (EDD) shall be identical or equivalent to the value of the corresponding data element in all hardcopy forms provided by the Subcontract Laboratory. The result reported for any given element shall be the same wherever that data element is used.
EICP	Extracted ion current profile.
ELPAT	Environmental Lead Proficiency Analytical Testing Program.
EPA	Environmental Protection Agency. EPA is the federal agency that is responsible for enforcing environmental laws.
EQL	Estimated Quantitation Level (EQL) is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine Subcontract Laboratory operating conditions. The EQL is generally 5 to 10 times the MDL. It may, however, be chosen within these guidelines to simplify data reporting. For many analytes, the EQL concentration is selected as the lowest non-zero standard in the calibration curve. Sample EQLs are highly matrix dependent.
Error	Any discrepancy between a computed, observed, or measured quantity and the expected or theoretically correct value of that quantity.
Extraction Holding Time	Extraction holding time refers to the time elapsed from sample collection time to sample preparation time.
FID	Flame ionization detector
Field Blank	A blank sample (either prepared in the field or carried to the sampling site), is a sample exposed to sampling conditions (e.g., bottle caps removed, preservatives added, etc.), and sent to the Subcontract Laboratory for analysis in the same manner in which environmental samples are analyzed. Used to identify the presence of contamination potentially added during the sampling process. See also trip blank.
Field Duplicate	Independent sample which is collected as close as possible to the same point in space and time as the original sample. Useful in documenting the precision of the sampling process.

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Field Matrix Spike	A known amount of a field sample to which a known amount of the target analyte has been added. Used to compute the proportion of added analyte that is recovered upon analysis.
Field Reagent Blank	See Field Blank.
Field Sample	Field samples are those collected to characterize environmental media as opposed to field quality control samples.
Field Split	A field sample that has been divided in the field into equally representative portions . Also called a split sample
Gamma Radiation	A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require dense shielding, such as concrete, steel, or lead to be blocked.
Gamma Spectroscopy	A form of spectroscopy in which gamma rays are sorted according to their energy levels and are then used to identify and quantify the presence of gamma-emitting radionuclides in a sample
GC	Gas chromatography
GC/MS	Gas chromatography/mass spectroscopy.
GEDD	The DOE General Electronic Data Deliverable (GEDD) master specification. The data dictionary is located at http://FSF.lanl.gov (go to data management).
Geotechnical Laboratory	A laboratory qualified to make physical measurements and associated geological evaluations solid media submitted for analysis. Geotechnical laboratories may use the most recent ASTM methods instead of SOPs, provided that, in practice, there are no deviations from the method.
GFAA	Graphite furnace/atomic absorption.
Good Automated Laboratory Practice (GALP)	Good Automated Laboratory Practice (GALP) covers the use of automated calculation routines and the handling of information stored in modern laboratory databases and is used as defined by the EPA for chemical analysis laboratories.
Grab Sample	A specimen collected by a single application of a field sampling procedure to a target population.
Half-life	The time required for one-half of the radioactive atoms initially present in a sample to decay. Each radionuclide has a characteristic half-life ranging from a fraction of a second to thousands of years.
Handling	Work performed by the Subcontract Laboratory in the process of unpacking, preparing, analyzing and disposing of a sample.

Holding Time (for both analysis and extraction)	The maximum elapse of time that one can expect to store a sample without unacceptable changes in analyte concentrations. Holding times apply under prescribed storage conditions and deviations in storage conditions may affect the holding time. Extraction holding time refers to the time elapsed from sample collection time to sample preparation time. Analytical holding time refers to the time elapsed between sample collection or preparation (as specified by the analytical procedure) and laboratory analysis.
Homogenized	A homogenized sample has been blended into a uniform mixture and reduced in particle size to reduce so that particles are uniformly small and evenly distributed.
HPLC	High Performance Liquid Chromatography.
Humid Zero Air Analysis	Humid zero air analysis is a technique by the laboratory to certify that canisters supplied for sample collection contain less than 0.2 parts per billion by volume (ppbv) VOCs.
Humid Zero Air Standard	An analytical standard used for initial instrument calibration along with three standard concentration levels. Daily calibration verification shall be performed using a mid-range standard. Recoveries for the target analytes in the calibration verification standard must be within ± 20 percent of the known values.
ICP-AES	Inductively coupled plasma-atomic emission spectroscopy.
ICP-MS	Inductively couple plasma-mass spectrometry.
ICS	Interference check samples.
ICV	Initial calibration verification.
IDL	IDL is the acronym for instrument detection limit. This is a measure of instrument sensitivity, usually without any consideration for contributions to the signal from reagents. Techniques requiring reagent additions for all standards and samples are exceptions in that IDLs for those techniques do include reagent contributions to the signal.
Incomplete Reports and Errors	Incomplete reports and errors refer to those identified by comparison with historical data, or if QC data are either missing or outside the control limits, or if the data are unusable for any reason.
Initial Calibration	The process used to establish the relationship between instrument response and analyte concentration at several analyte concentration values to demonstrate that an instrument is capable of acceptable analytical performance.
Instrument Blank	An analyte-free matrix used to determine if any contamination of the instrument will be detected in samples.
Instrument Calibration Interference	See "initial calibration" and "CCV (Continuing calibration verification)". A chemical or physical entity whose influence results in a decrease or increase in the response of an analytical method or other measurement system relative to the response obtained in the absence of the entity.

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Interference Check Samples	Interference check samples (ICS) are used to determine the amount of interference encountered during the analysis of a sample for target analytes. The constituent composition of the interference check samples is specified in the CLP SOW.
Interferent/Fluorescence Response	Interferent/fluorescence response can occur in the analysis of N-methylcarbamate pesticides performed according to EPA SW-846 method 8318. An interferent is a contaminant that reduces the amount of fluorescence expected under these analytical conditions. In Method 8318, target analytes detected in samples will be confirmed by substituting the sodium hydroxide and o-phthalaldehyde for reagent water in the post column reactor and reanalyzing the extracts. Continued fluorescence response indicates the presence of an interferent.
Inter-Laboratory Comparison Studies Intermediate Dilution	Performance evaluation studies conducted by various government and private agencies. (See SOW section 2.5) An intermediate dilution is a dilution of some stock solution that requires further dilution before use in instrument calibration or quality control sample preparation. Intermediate dilutions are not used to calibrate instruments in undiluted form.
Internal Standard	An internal standard is a spike added to a sample and is used to determine the percent recovery during sample preparation and instrument efficiency during analysis. Internal standards recommended by the EPA method are required unless approval prior to sample analysis was received from the LANL SMO. For methods where internal standards are recommended but the specific compound(s) are not specified, the Subcontract Laboratory shall choose one or more internal standards similar in analytical behavior to the compounds of interest, and not expected to be found in the samples. In the latter case, the choice of an internal standard must be approved by the LANL SMO prior to sample analysis.
Ion Chromatography	Ion chromatography is the separation and detection of target ions by their differential travel and absorption on a medium.
Ion Specific Electrode	An ion specific electrode is a sensor used to determine the concentration of an ion in solution by placing it in the solution and measuring the resulting electrical current.
KPA	Kinetic phosphorescence analysis for total uranium. KPA has been found to be unreliable due to strong susceptibility to interferences from constituents commonly found in LANL samples.
Laboratory Duplicate Sample	The portions of a sample taken from the same sample container, prepared for analysis and analyzed independently but under identical conditions. Each duplicate sample is expected to be equally representative of the original sample.
LANL	Los Alamos National Laboratory.

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LANL Data Validation Qualifiers	Data qualifiers are as follows: "A" Contractually required data are not available for data review and evaluation. "U" The analyte was analyzed for but not detected. "J" The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis. "J+" The analyte was positively identified, and the result is likely be biased high. "J-" The analyte was positively identified, and the result is likely to be biased low. "UJ" The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific detection or quantitation limit "RPM" Without further review of the raw data, the sample results are unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. Presence or absence cannot be verified. Any results qualified as RPM must be evaluated for relevance to data use. "P" Professional judgement should be applied to using the data in decision-making. "PM" Professional judgement should be applied to using the data in decision making. A manual review of raw data is recommended to determine if the defect impacts data use for decision-making. "R" The data are rejected as a result of major problems with quality assurance/quality control (QA/QC) parameters.
LANL Sample	Any sample sent from the LANL SMO for analysis under this SOW.
LCS	Laboratory Control Sample. A known matrix spiked with compound(s) representative of the target analytes. This is used to document Subcontract Laboratory performance.
Leachate	A liquid that has percolated through waste, soil, rock, or other material and has mobilized chemical species in the process.
Leaching	The separation or dissolving out of soluble constituents from a solid material or matrix by the natural action of percolating water or chemicals.
Leading Zeros	Leading zeros are placed after a decimal point and before the numbers (greater or less than zero) representing an analytical result.
Less Than	Numerical result that includes all values below a defined value. Mathematical "less than" signs shall not be used in reporting LANL analytical results.
LIMS	The Laboratory Information Management System of the Subcontract Laboratory.

LQAP	The Subcontract Laboratory quality assurance plan (LQAP) for each Subcontract Laboratory, and any secondary laboratories accepted for participation in the subcontract, (see Section 2.2.1).
MAPEP	The Mixed Analyte Performance Evaluation Program is operated by the U.S. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho.
Matrix	The component or substrate (e.g., surface water, drinking water, soil, sludge) that contains the analyte of interest.
Matrix Duplicate	An intra-laboratory (within the Subcontract Laboratory) split sample which is used to document the precision of a method in a given sample matrix.
Matrix Spike (MS)	An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.
Matrix Spike Analysis	This is a measure of the ability of a method or process to adequately recover analytes or to establish a bias.
Matrix Spike Duplicates (MSD)	MSDs are intra-laboratory split samples spiked with identical concentrations of target analytes. The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.
MDC	MDC is the acronym for minimum detectable concentration. The MDC provides general information about the sensitivity of analytical techniques in radiochemistry based upon assumed nominal conditions.
MDL	MDL is the acronym for method detection limit. This is a measure of instrument sensitivity using solutions that have been subjected to all sample preparation steps for the method. Reagent contributions to the signal are thus included in the MDL.
Mesh	Mesh refers to the size of the openings or pores in a sieve or screen through which solid samples are passed in preparation for analysis. The preparation method may specify the mesh sizes (pore diameters) that must be used.
Method	A body of procedures and techniques for systematically performing an activity.
Method Blank	An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.
Method Blank Subtraction	Method blank subtraction shall be done only in liquid scintillation counting and not in other radiochemistry analytical methods. Results for the other counting techniques shall be corrected for instrument background only, and shall not be blank subtracted.
Mixed Waste	Waste that contains both hazardous waste (as defined by RCRA and its amendments) and radioactive wastes [as defined by the Atomic Energy Act (AEA) and its amendments].
MSA	Mass Spectrometry Analysis.

Muffled Sand	Muffled sand has been treated by heating in a muffle furnace to remove all volatile organic impurities. Soil sample MDL determinations for organics may be performed using muffled sand, an appropriate salt, or other soil matrix substitute. The specific choice of soil substitute is left to the Subcontract Laboratory's discretion.
Neat Materials	Neat materials are chemicals and reagents that are free from admixture or dilution. The one-year shelf life limit shall not apply to neat materials or unopened ampoules containing solutions of organic compounds. The manufacturer's expiration date, if any, shall apply to neat materials and unopened ampoules containing organic standard solutions.
NIST Traceable Standards	National Institute for Science and Technology (NIST) traceable standards are those provided by this agency or used to calibrate standards used by the Subcontract Laboratory, and which must be used where specified in this SOW.
Non-routine Analysis	A non-routine analysis is one not defined in this SOW , but which may be required to achieve a specific LANL objective. (See entry for Routine Analysis in Glossary).
Non-Target Radionuclides	Radionuclides not included on the target radionuclide list given in Attachment II, Table 1.
Null value	A null value is a zero or a non-detect value for an analyte. The Subcontract Laboratory is not required to supply data element values that are not identified in the list of required data elements provided in the EDD requirements. For those data elements not required by LANL, the data element tag must be present in the EDD, but the value may be a null value.
Optional Compounds	Optional compounds are those not routinely required in instrument calibration or the reporting of analytical results.
Organic-free Reagent Water	For volatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. For semivolatiles and nonvolatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest.
OSHA	Occupational Safety and Health Administration.
Out of Control	A condition in which a measured quality control parameter does not meet the specified or acceptable criteria for that parameter.
PAHs	Polynuclear Aromatic Hydrocarbon Compounds.
PAT	The Proficiency Analytical Testing (PAT) Program is operated by the American Industrial Hygiene Association. Participation in the Proficiency Analytical Testing (PAT) program includes the AIHA-required inter-laboratory sample exchange program.
PCBs	Polychlorinated biphenyl compounds.
PE Samples	Performance evaluation (PE) samples are samples with known constituent concentrations that are periodically submitted to test Subcontract Laboratory analytical and reporting performance.

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Percent Moisture	The percent moisture refers to the portion (percentage) of a soil or sludge sample that may be removed by drying the sample under controlled conditions. Percent moisture measurements shall be made and reported for all LANL soil samples, and unless otherwise specified, soil sample results for all analyses shall be reported on a dry weight basis. (See water content)
Performance-based Methods	Performance-based methods are based on the achievement of desired detection limits in cases where industry-standard methods do not address particular analytes and may be utilized with prior approval from the LANL SMO.
Pesticides	Pesticides are chemicals (often halogenated organic compounds) that are an agent used to destroy pests.
PETN	Pentaerythritol tetranitrate.
pH	The negative logarithm of the hydrogen ion activity.
Photoionization Detectors	Photoionization detectors record the ionization of a molecule or atom caused by its absorption of radiant energy as a means for quantifying analytes. They are used in the detection of aromatic and halogenated volatiles by GC.
PPBV	Parts per billion by volume.
Precision	<p>A concept used to describe dispersion of measurements with respect to a measure of location or central tendency. Precision may be represented by the inverse of the standard deviation of a set of measurements. The most commonly used estimates of precision are the relative standard deviation (RSD) or the coefficient of variation (CV).</p> $RSD = CV = S / \bar{X}$ <p>Where \bar{X} = the arithmetic mean of the x measurements, and S = variance; and the relative percent difference (RPD) when only two samples are available.</p> $RPD = 100 [(x_1 - x_2) / \{(x_1 + x_2) / 2\}]$
Preparation	Preparation is the action or process of making samples ready for analysis and may involve extractions, dilutions and other laboratory treatments. Sample preparation shall be conducted according to the specifications of the analytical procedures listed in this SOW.
Preparation Blank	A preparation blank (PB) consists of DI water and the appropriate reagents and is included in each batch of samples requiring digestion or distillation.
Prepared Sample	A sample treated in such a manner as to render it amenable to analysis. May include chemical or physical treatments.
Primary Contact Person	The primary contact person is the individual assigned by the Subcontract Laboratory to act as the contact point for all work related to this SOW.

PUF	Polyurethane foam (PUF). PUF contained in Tenax or Amberlite XAD-2 resin cartridges is used to collect samples of polynuclear aromatic hydrocarbons (PAHs) by filtering ambient air. The PUF cartridges are analyzed for PAHs according to the requirements specified in EPA method TO-13.
Qualifier	A qualifier is a letter code indicating, on a gross scale, a verifiable or potential data deficiency. Qualifier flags are assigned to data based on the outcome of data validation checks.
Quality Control (QC) Sample	A Quality Control (QC) sample provides information useful for adjusting, controlling, or verifying the continuing acceptability of sampling and/or analytical activities in progress.
Quarterly Progress Report	A quarterly progress report (QPR) describes new analysis methods and changes in old methods; summaries of non-routine incidents during the reporting period, and copies of the associated CARs; descriptions of changes in the LQAP that affect the analysis of or documentation for LANL samples; changes in QA and key technical personnel, including resumes of new personnel; changes in certification status with any regulatory or certifying agencies; and GALP infractions. Quarterly progress reports shall address calendar quarters and are due by the 15th day of the month following the reporting period.
Radioactive materials license	A current radioactive materials license that is appropriate to the materials the Subcontract Laboratory anticipates receiving under this contract is required for all laboratories. If the radioactive materials license has expired, the Subcontract Laboratory shall have a letter of timely renewal on file. Photocopies of new or updated licenses shall be provided to the LANL SMO with the next quarterly progress report.
Radioactive tracer	A radioactive tracer is a radioactive material added to, or introduced to a sample for the purpose of monitoring chemical or physical losses of target analytes. The tracer is assumed to behave in the same manner as that of the target analytes.
RCRA	Resource Conservation and Recovery Act and amendments.
Reagent	Reagents are chemicals of known purity that are used in analytical methods. This term does not apply to materials used to calibrate instruments or to perform quality control activities. Such materials are called standards.
Reagent Blank	See Method Blank.
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents, which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society (ACS).
Reagent Water	Water that has been generated by any method which would achieve the performance specification for ASTM Type II water. For organic analyses, see definition of organic-free reagent water.
Record	Record is the term applied to information that results from performance under this SOW. Records must be maintained in such a way as to ensure that they can be provided or retrieved in their entirety on demand or otherwise supplied as a deliverable under this subcontract.

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Reference Material	A material containing known quantities of target analytes in solution or in a homogenous matrix. It is used to document the bias of the analytical process.
Relative Percent Difference	<p>The relative percent difference (RPD) is the measure of precision used for all general inorganic constituents. The RPD is calculated as follows:</p> $RPD = \frac{ S - R }{(S+R)/2} \times 100$ <p>where, RPD = relative percent difference S = sample value (original) R = replicate sample value</p> <p>The RPD shall be less than or equal to 20 percent for aqueous samples and less than or equal to 35 percent for soil samples when concentrations are greater than or equal to five times the MDL. For samples with concentrations less than five times the MDL but greater than the MDL, the control limit is \pm MDL. No precision criterion applies to samples with concentrations less than the MDL.</p>
Relative Precision	Relative precision is precision measured relative to a particular value and is expressed as the relative standard deviation (RSD). See "Precision" in this Glossary.
Replicate	A replicate is a sample split taken by the Subcontract Laboratory and prepared separately from the original sample for the purpose of assessing analytical precision. See also Duplicate Sample.
Replicate Error Ratio	<p>The replicate error ratio (RER) is used to determine replicate precision for radiochemical results. The RER is given by:</p> $RER = \frac{ S - R }{\sigma_{95}S + \sigma_{95}R}$ <p>where, RER = replicate error ratio S = sample value (original) R = replicate sample value $\sigma_{95}S$ = sample uncertainty (95%) $\sigma_{95}R$ = replicate uncertainty (95%)</p>
Report Review	The Subcontract Laboratory's QA or technical staff shall conduct a data verification and completeness review of all data transmitted to the LANL SMO. In addition, reviews shall include 100 percent verification of agreement between EDDs and hard copy reports, as defined in section 2.2.1(s) of this SOW, until the efficacy of the EDD production process is demonstrated. Signature evidence of this review in the case narrative is required.
Reporting Conventions	Reporting conventions are that each analysis result for general inorganic parameters shall be accompanied by the MDL where applicable. MDLs shall be adjusted to reflect the sample specific conditions for that sample, including dilution factors, moisture content, and sample aliquot sizes used in the analysis of each sample. Results less than the MDL shall be qualified with a "U" flag. General inorganic analysis results between the MDL and the RL shall be qualified with a "B" flag. See SOW sections 4.1.7, 4.1.8 and 4.1.9 for a detailed description of reporting conventions.
Reporting Limit (RL)	The reporting limit is the limit reported for those analytes that are not detected in a sample. The reporting limits are derived by the Subcontractor Laboratory as described in each method and this statement of work.

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Representativeness	Representativeness is the degree to which data accurately and precisely represent a characteristic of a population or an environmental condition.
Request for Analysis Form	A form used by LANL (see Attachment 7) to specify which analyses are to be performed on a batch of samples submitted to a Subcontract Laboratory. The Analytical Request form submitted to a Subcontract Laboratory specifies which analytes the laboratory is required to analyze the sample for and which methods apply to those analyses..
Request Number	A request number is a unique number assigned by LANL to each shipment of samples (See Attachment 6). The Analytical Request Form (see Attachment 7) that accompanies the samples will include the LANL request number and other information which detail the samples submitted and the analyses requested. On the day of shipment, LANL will fax to the Subcontract Laboratory a copy of the Analytical Request Form.
Routine Analysis	A routine analysis is defined as including the categories of inorganics, metals, organics, radiochemistry, and high explosives described in this SOW.
Routine Data Validation	Routine data validation describes the process of reviewing analytical data relative to quantitative acceptance criteria. The objective of routine data validation is to 1) estimate the technical quality of the data relative to minimum national standards adopted by LANL, and 2) indicate to data users the technical quality at a gross level by assigning qualifier flags to the data whose quality indicators do not meet the acceptance criteria.
Sample	See field sample.
Sample custody	Sample custody is transferred to the Subcontract Laboratory at the time of sample receipt, after which the Subcontract Laboratory is responsible for maintenance of unbroken chain of custody (COC). By definition, a sample is in custody if it is 1) in one's possession, 2) in view, or 3) in a controlled access area. Section 2.9 of this SOW provides additional detail regarding sample receipt and storage procedures.
Sample IDs	A unique sample identification number (ID) is assigned to each sample by the LANL SMO when it is collected. The COC submitted to the Subcontract Laboratory lists all sample IDs and each sample container has the sample ID on the label. When results are reported to the LANL SMO, the case narrative will describe each sample with both its LANL assigned and any Subcontract Laboratory assigned sample IDs.
Sample Matrix	The sample matrix in chemical analysis refers to that portion of a sample which is exclusive of the analytes of interest (e.g., soil and water components). Together the matrix and analytes of interest form the sample.
Sample Preparation	Sample preparation shall be conducted according to the specifications of the analytical procedures, except as noted in section 3.2.2 of this SOW.
Sensitivity	An indication of the lowest analyte concentration that can be measured with a specific degree of confidence.

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Serial Dilution	Serial dilutions are made by performing a series of dilutions of an aliquot taken from a stock solution for a target analyte. The first dilution of the original stock solution serves as the stock solution for the second dilution and the second dilution serves as the stock solution for the third dilution and so on.
Sigma	A sigma value is the statistical term equivalent to one standard deviation.
Significant Error	An error when an analyte is detected in a sample where it is not present, or when an analyte is present at a concentration above the instrument detection limit but is reported as undetected by the Subcontract Laboratory.
Significant Figures	Significant figures are the digits of a number beginning with the digit farthest to the left that is not zero and ending with the last digit farthest to the right that is not zero or is exactly zero. The LQAP shall specify the Subcontract Laboratory policy regarding the number of significant figures to be used in reporting analytical results. The significant figures requirements for this SOW can be found in section 4.1.11. A maximum of three significant figures shall be used to report the final analytical result.
Significant Result/value	A significant result or value is where the reported value for an analyte is greater than of the background value by one to three standard deviations as specified in the methods referenced in this SOW.
SMO	The sample management office (SMO) is the LANL entity within the Los Alamos National Laboratory that is responsible for technical administration of this SOW.
SOP	SOP is the acronym for standard operating procedure. SOPs are documents prepared by the Subcontract Laboratory as controlled documents that describe the step-by-step activities in the laboratory.
Spiked Sample	A spiked sample is a sample that has a known amount of target analyte added to it.
Split Samples	Aliquots of sample taken from the same container and analyzed independently. In cases where aliquots of samples are impossible to obtain, field duplicate samples should be taken for matrix duplicate analysis. These are usually taken after mixing or compositing and are used to document intra- and inter-laboratory precision.
Standard Addition	The practice of adding a known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.
Standard Curve	A plot of concentration of known analytes versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards which cover the working range of the instrument.
Standard Deviation	The standard deviation is a measurement of the dispersion of a frequency distribution that is the square root of the arithmetic mean of the squares of the deviation of each of the class frequencies from the arithmetic mean of the frequency distribution.
Standards	Standards are any material intended for, possibly as a dilution, in instrument calibration or to perform quality control activities.

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Stock Solution	A stock solution is a high-concentration standard. Stock solutions are not used to calibrate instruments or as quality control samples, but rather are diluted to produce the standards used to calibrate or prepare quality control samples.
Storage	Storage means the keeping of samples on the Subcontract Laboratory's premises until they are analyzed and properly disposed. For each type of analysis, the specified EPA method for sample storage shall be followed. The LQAP shall also describe procedures for the storage of samples. Laboratories shall have an SOP that requires daily temperature monitoring (on all business days) for refrigerated sample storage areas and the corrective action that will be initiated if a measurement falls outside the range $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The Subcontract Laboratory shall maintain logbooks for sample storage refrigeration units in which the daily temperature checks are recorded. The Subcontract Laboratory shall retain and store all LANL samples associated with a specific delivery order for a period of 90 days after issuing the analytical report for that delivery order.
Subcontract Laboratory	Subcontract Laboratory refers to an analytical laboratory that is authorized to receive and analyze LANL samples under the terms and conditions of this SOW.
Surrogate	An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples.
Target A Priori MDCs	Target <i>a priori</i> minimum detectable concentration (MDC) values for radionuclide analyses by analytical technique and matrix are given in Attachment 2 of this SOW. The Subcontract Laboratory shall adjust analytical conditions to meet the target MDCs.
Target Analyte	A chemical or parameter, the concentration, mass or magnitude of which is designed to be quantified by use of a particular test method.
Theoretical Value	The theoretical value is the actual value for an analyte contained in a PE sample submitted to a Subcontract Laboratory. A summary of analytical results and theoretical values for each round of PE samples will be provided to each Subcontract Laboratory by the LANL SMO after all the data for that round have been submitted to LANL.
Tracer	A tracer is a substance, usually a radioactive isotope, added to a sample to determine the efficiency of a chemical extraction, reaction or analysis. Recovery guidelines for tracer results shall be 40 to 105 percent. See section 3.6.6(b) in the SOW.
Trip Blank	A sample of analyte-free media taken from the Subcontract Laboratory to the sampling site and returned to the Subcontract Laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is typically used for documenting contamination of volatile organics samples.
Turn Around Time	Turn around time refers to the period between receipt of samples by the laboratory and receipt of the analytical report for those samples by the LANL SMO. The next business day after receipt date of samples is day 1 in counting the turnaround time.
Ultimate Disposal	The final disposal of hazardous substances and does not include temporary storage or other temporary measures of managing hazardous wastes.

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Uncertainty	Uncertainty refers to the range of values (expressed as plus or minus the measured value) that include the theoretical or true value of an analyte with a specific degree of confidence. Radiochemical analytical results shall be accompanied by sample-specific uncertainty bounds that reflect the 67 percent confidence level (1 sigma). The uncertainty bounds shall include not only the measurement counting error, but also a technique-specific error term that includes uncertainty values for each contributing measurement process, and a sample-specific contribution reflecting specific chemical recoveries, detectors used, etc. All radiochemical result uncertainties shall incorporate terms for technique-related and sample-specific measurement errors. General inorganic and organic analytical results shall not be accompanied by estimates of uncertainty.
Water Content	Water content is the amount of water in an unsaturated medium, expressed as the ratio of the weight of water in a sample to the weight of the oven-dried sample, often expressed as a percent. (See percent moisture)
Working Standards	Working standards are those used to calibrate instruments and are prepared from or calibrated against certified standards.
Worksheet	The term worksheet refers to any form used to describe the work in a particular analytical batch. Worksheets may present the data acquired or be a cover sheet for those data.
Worksheet Review	Worksheet review is a process for assessing the degree of compliance with Subcontract Laboratory and client requirements in the analysis documentation.