US Army Corps
of Engineers®
Buffalo District

FINAL

SAMPLING AND ANALYSIS PLAN

VOLUME 2 - QUALITY ASSURANCE PROJECT PLAN

TONAWANDA LANDFILL
FUSRAP SITE

TONAWANDA, NEW YORK

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QUALITY ASSURANCE PROJECT PLAN
TOWN OF TONAWANDA LANDFILL
TONAWANDA, NEW YORK

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LIST OF ACRONYMS AND SYMBOLS

%R	percent recovery
Am-241	Americium-241
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
CAS	Chemical Abstract Services
CCQC	Contractor Chemical/Radiological Quality Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chain of custody
cpm	counts per minute
CQC	Chemical Quality Control
CQCR	Chemical Quality Control Representative
Cs-137	Cesium-137
CX	Center of Expertise
DCQCR	Daily Chemical Quality Control Report
DMP	Data Management Plan
DOE	U.S. Department of Energy
DOT	United States Department of Transportation
DQCR	Daily Quality Control Report
DQO	data quality objective
ECWA	Erie County Water Authority
EPA	United States Environmental Protection Agency
FCO	Field Change Order
FCR	Field Change Request
FEIMS	FUSRAP Environmental Information Management System
FID	flame ionization detector
FOM	Field Operations Manager
FS	feasibility study
FSP	Field Sampling Plan
FUSRAP	Formerly Utilized Sites Remedial Action Program
GC	gas chromatography
GFAA	graphite furnace atomic absorption
GIS	Geographical Information System
GPS	Global Positioning System
GWS	Gamma Walkover Survey
HTRW	Hazardous, Toxic, and Radioactive Waste
IATA	International Air Transportation Association
ICP	inductively coupled plasma
IDW	investigation-derived waste
LCS	laboratory control sample
LIMS	Laboratory Information Management System
LOR	letter-of-receipt
M&TE	Measuring and Testing Equipment
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration

LIST OF ACRONYMS AND SYMBOLS (continued)

MDCR	minimum detectable count rate
MDL	method detection limit
MED	Manhattan Engineer District
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
NCR	Nonconformance Report
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMPC	Niagara Mohawk Power Company
NORM	Naturally Occurring Radioactive Material
NYSDEC	New York State Department of Environmental Conservation
OU	Operable Unit
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCOC	potential contaminants of concern
PID	photoionization detector
PPE	Personal Protective Equipment
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	quality control
QCSR	Quality Control Summary Report
Ra	Radium
Ra-226	Radium-226
RPD	relative percent difference
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
TAL	Target Analyte List
TCL	Target Contaminant List
Th	Thorium
Th-230	Thorium-230
TTL	Town of Tonawanda Landfill
U	Uranium
U-238	Uranium-238
USACE	United States Army Corps of Engineers
VOC	volatile organic compound

1.0 PROJECT DESCRIPTION

This Sampling and Analysis Plan (SAP) has been developed in accordance with the USACE guidance document *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, September 1994 (USACE 1994a). This SAP has been prepared for site characterization activities at the FUSRAP vicinity property known as Town of Tonawanda Landfill Site located in Tonawanda, New York. The SAP consists of the Field Sampling Plan (FSP), contained in Volume 1, the Quality Assurance Project Plan (QAPP), contained in this volume, and Volume 3, which consists of Field Standard Operating Procedureso.

This document presents the overall QAPP for activities to be performed during investigations and environmental monitoring at the Formerly Utilized Sites Remedial Action Program (FUSRAP) Town of Tonawanda Landfill in Tonawanda, New York. The United States Army Corps of Engineers (USACE) and the United States Environmental Protection Agency (EPA) require that all environmental monitoring and measurement efforts mandated or supported by these organizations participate in a centrally managed quality assurance (QA) program. Any party generating data for this project has the responsibility to implement minimum procedures to ensure that the precision, accuracy, representativeness, completeness, and comparability (PARCC) of its data are known and documented. To ensure that these responsibilities are met uniformly, each party must adhere to the QAPP. References for this QAPP are included in Section 15. In addition, a Data Management Plan (DMP) is provided in Appendix A.

This QAPP presents the overall organization, objectives, functional activities, and QA and quality control (QC) activities associated with the Town of Tonawanda Landfill investigations. It describes the specific protocols that will be followed for sampling, sample handling and storage, chain of custody, and laboratory analysis. This plan also presents information regarding data quality objectives (DQOs) for projects, sampling and preservation procedures for samples collected in the field, field and sample documentation, sample packaging and shipping, and laboratory analytical procedures for all media sampled.

All QA/QC procedures will be in accordance with applicable professional technical standards, EPA requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP is prepared by Science Applications International Corporation (SAIC) in accordance with EPA and USACE QAPP guidance documents, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA 1991), *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA 1994a), and *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 1994a).

This document is intended to be utilized in conjunction with the project Field Sampling Plan (FSP) and Site Safety and Health Plan (SSHP).

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The overall organizational chart shown in Figure 2-1 outlines the management structure that will be used to implement the limited subsurface characterization efforts at the Town of Tonawanda Landfill. The functional responsibilities of key personnel are described in the following parts of this section. The assignment of personnel to each position will be based on a combination of (1) experience in the type of work to be performed, (2) experience working with USACE personnel and procedures, (3) a demonstrated commitment to high quality and timely job performance, and (4) staff availability.

2.1 SAIC FUSRAP PROGRAM MANAGER

The SAIC FUSRAP Program Manager, Mike Giordano, P.E., ensures the overall management and quality of all SAIC FUSRAP projects performed under USACE contracts. This individual will ensure that all project goals and objectives are met in a high-quality and timely manner. Any QA and nonconformance issues will be addressed by this individual, in coordination with the SAIC Town of Tonawanda Landfill Program Manager, for corrective action.

2.2 SAIC TOWN OF TONAWANDA LANDFILL PROJECT MANAGER

The SAIC Project Manager, Frank Stevenson, P.E., has direct responsibility for implementing the FSP, QAPP, and activity-specific QA plan including all phases of work plan development, field activities, data management, and report preparation. This individual will also provide overall management of the project, and serve as the technical lead and point of contact with the USACE Task/Technical Lead. These activities will involve coordinating all personnel working on the project, interfacing with USACE personnel, and tracking project budgets and schedules.

2.3 SAIC TOWN OF TONAWANDA LANDFILL TECHNICAL MANAGER

The SAIC Task Manager, Steve McInall, has direct responsibility for implementing the FSP, QAPP, and activity-specific QA plan including all phases of work plan development, field activities, data management, and report preparation. These activities will involve coordinating all personnel working on the project, interfacing with USACE personnel, and tracking project budgets and schedules. The SAIC Task Manager will also develop, monitor, and fill project staffing needs, delegate specific responsibilities to project team members, and coordinate with administrative staff to maintain a coordinated and timely flow of all project activities.

2.4 SAIC QA/QC OFFICER

The SAIC QA/QC Officer, Glen Cowart, is responsible for project QA/QC in accordance with the requirements of the QAPP, other work plan documentation, and appropriate management guidance. This individual, in coordination with the SAIC Chemical Quality Control (CQC) Representative, will be

responsible for participating in the project field activity readiness review; approving variances during field activities before work continues; approving, evaluating, and documenting the disposition of Nonconformance Reports (NCRs); overseeing and approving any required project training; and designing audit/surveillance plans followed by supervision of these activities. The SAIC QA/QC Officer reports directly to the SAIC FUSRAP Contract Officer in Charge and indirectly to the SAIC FUSRAP Program Manager.

2.5 SAIC HEALTH AND SAFETY OFFICER

The SAIC Health and Safety Officer, Steve Davis, CIH, is responsible for ensuring that health and safety procedures designed to protect personnel are maintained throughout the field activities. This will be accomplished by strict adherence to the applicable Site Safety and Health Plan (SSHP), which is prepared as a separate document for each project. This individual, in conjunction with the SAIC Site Safety and Health Officer (SSHO), will have the authority to halt field work if health or safety issues arise that are not immediately resolvable in accordance with the applicable SSHP. The SAIC Health and Safety Officer reports directly to the SAIC FUSRAP Contract Officer in Charge and indirectly to the SAIC FUSRAP Program Manager.

2.6 SAIC RADIATION SAFETY OFFICER

The SAIC Radiation Safety Officer, Doug Haas, RRPT, is responsible for confirming that radiation safety procedures designed to protect personnel are maintained throughout the field activities conducted for the project. This will be accomplished by strict adherence to the project SSHP, which will be presented in the project sampling and analysis plan (SAP). This individual, in coordination with the SAIC HSO, will have the authority to halt field work if health and/or safety issues, as they apply to radiological issues, arise that are not immediately resolvable in accordance with the project SSHP. The SAIC Radiation Safety Officer reports directly to the SAIC Project Manager, but will inform the SAIC Field Manager of all information and decisions reported.

2.7 SAIC LABORATORY COORDINATOR

The SAIC Laboratory Coordinator, Nile Luedtke, is responsible for coordination of sample shipment to the analytical laboratory(s), and subsequent chemical and radiochemical analysis and reporting performed by the subcontract laboratory(s), in accordance with the requirements defined in the activity-specific QAPP. This individual will also coordinate the shipment of samples to the USACE QA Laboratory, which has been designated as the government QA laboratory for the project. This individual will be responsible for obtaining required sample containers from the laboratory(s) for use during field sample collection, resolving questions the laboratory may have regarding QAPP requirements and deliverables, and coordinating data reduction, validation, and documentation activities related to sample data package deliverables received from the laboratories. The SAIC Laboratory Coordinator reports directly to the SAIC Town of Tonawanda Landfill Task Manager.

2.8 SAIC FIELD OPERATIONS MANAGER

The SAIC Field Operations Manager (FOM) is responsible for implementing all field activities in accordance with the applicable SAP, this QAPP, and the activity-specific QAPP. This individual is responsible for ensuring proper technical performance of drilling operations and field sampling activities, adherence to required sample custody and other related QA/QC field procedures, coordination of field personnel activities, management of investigative-derived wastes, checks of all field documentation, maintenance of the field logbook, and preparation of Field Change Orders (FCOs), if required. The SAIC FOM reports directly to the SAIC Town of Tonawanda Landfill Task Manager except in regard to QA/QC matters that are reported directly to the SAIC QA/QC Officer.

2.9 SAIC FIELD PERSONNEL

In addition to the SAIC FOM, other SAIC field personnel participating in the implementation of field activities are anticipated to be site geologists, sampling technicians, and the sample manager. These individuals, in coordination with field subcontractor personnel, will be responsible for performance of Geoprobe® operations, collection of soil samples, collection of groundwater samples from existing wells, and preparation of field logbooks and other required documentation. These individuals will be responsible for performing all field activities in accordance with the applicable SAP, SSHP, and this QAPP. Field personnel report directly to the SAIC FOM.

2.10 SUBCONTRACTOR FIELD PERSONNEL

Subcontractor field personnel, under the supervision of the SAIC FOM, will be responsible for performing their specific scopes of work that have been derived from the applicable SAP. These individuals will be required to review applicable sections of the SAP, QAPP, and the SSHP, prior to field mobilization. All subcontractor field personnel report directly to the SAIC FOM who will be responsible for ensuring that all subcontractor activities comply with project requirements.

2.11 SUBCONTRACTOR LABORATORY SUPPORT

Analytical laboratory support specific to these investigations will be obtained from TBD. Chemical and radiochemical laboratory support for these investigations will be designated to this subcontractor based on their capacity, capability and competitive pricing. This selected subcontract laboratory is validated by the USACE HTRW CX, Omaha, Nebraska. Relevant QA Manual, laboratory qualification statements, certifications, and license documentation will be submitted to the Buffalo District for review and approval.

Organization charts outlining the key laboratory personnel and organization will be identified in their QA Plans. The responsibilities of key personnel are described in the following paragraphs. The assignment

of personnel to each position will be based on a combination of (1) experience in the type of work being performed, (2) experience working with USACE personnel and procedures, and (3) a demonstrated commitment to high quality and timely job performance.

Prior to commencement of field activities for each project, SAIC will send a complete copy of the work plan (e.g., SAP) including this QAPP to the subcontracted laboratory.

2.11.1 Laboratory QA/QC Manager

The subcontractor Laboratory QA/QC Manager is responsible for the laboratory QA/QC in accordance with the requirements of this QAPP in conjunction with the established laboratory QA Program. In coordination with the SAIC Laboratory Coordinator, this individual will be responsible for documenting that samples received by the laboratory are analyzed in accordance with required methodologies, that instrument calibration is performed properly and documented, that field and internal laboratory QC samples are analyzed and documented, and that all analytical results for both field and QC samples are reported to SAIC in the format required in the laboratory scope of work and this QAPP. This individual is also responsible for processing laboratory NCRs in a timely manner and for implementing Corrective Action Report recommendations and requirements. The Subcontractor Laboratory QA/QC Manager reports directly to the SAIC Laboratory Coordinator for issues related to this project.

2.11.2 Laboratory Project Manager

The responsibilities of each laboratory's Project Manager include the following: initiation and maintenance of contact with SAIC on individual job tasks; preparation of all laboratory-associated work plans, schedules, and manpower allocations; initiation of all laboratory-associated procurement for the project; provision of day-to-day direction of the laboratory project team including analytical department managers, supervisors, QA personnel, and data management personnel; coordination of all laboratory related financial and contractual aspects of the project; provision of formatting and technical review for all laboratory reports; provision of day-to-day communication with SAIC; provision of final review and approval on all laboratory analytical reports to SAIC; and response to all post project inquires.

2.11.3 Laboratory Manager

The responsibilities of the Laboratory Manager for each laboratory include the following: coordination of all analytical production activities conducted within the analytical departments; working with the Laboratory Project Manager to ensure all project objectives are met; provision of guidance to analytical department managers; and facilitation of transfer of data produced by the analytical departments to the report preparation and review staff for final delivery to the client.

2.11.4 Laboratory Section Heads, Department Managers, and Technical Leads

The responsibilities of each laboratory section or department include the following: coordination of all analytical functions related to specific analytical areas; provision of technical information to and oversight of all analysis being performed; review and approval of all analytical results produced by their specific analytical area of expertise; and maintenance of all analytical records and information pertaining to the analysis being performed.

3.0 DATA QUALITY OBJECTIVES

The overall objective is to develop and implement procedures for field sampling, chain of custody (COC), laboratory analysis, and reporting, which will provide information for site evaluation and assessment leading to and including remediation. Data must be technically sound and legally defensible. Procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the objectives for data precision, accuracy, representativeness, completeness, and comparability (PARCC). The FSP identifies specific task objectives as they relate to site action levels and remediation. This QAPP provides the details, in tabular form, of the analytical parameters, methods, and quantitation levels.

DQOs are the basic statements from which the project sampling and analysis requirements are developed. Data Quality Indicators (DQIs) are analytical DQOs that define the level of analytical effort employed in a project.

3.1 PROJECT OBJECTIVES

Project goals/DQOs for field sampling activities were established based on available site investigation information and applicable or relevant and appropriate requirements (ARARs) pertaining to the Site. The intent of the project goals/DQOs is to ensure compliance with applicable Federal, State, and local regulations in addressing the handling and assessment radiological contaminants present at the Site, evaluate potential remedial activities associated with the removal or handling of radiological impacted material, and determine potential responsible party/parties for the implementation of the selected remedial actions. The Project Goals/DQOs for the Site are as follows:

1. Verify MED-related material is present at the site;
2. Delineate the extent and concentration of the MED-related material, identify areas that would exceed removal criteria, and determine volume of MED-related material;
3. Evaluate the impact of MED-related material and related compounds (if present) to Site soil and groundwater;
4. Assess long term risks posed by leaving MED-related material in place including an assessment of the mobility and migration capabilities of the material to surrounding receptors.
5. Determine if chemical or non-MED wastes are commingled with the MED-related materials.
6. If radiological contamination is present, determine if it is due to MED-related material, naturally occurring radioactive material (NORM), Am-241 contamination, or other source(s).
7. Evaluate characteristics of disturbed material (soil and groundwater) for waste disposal.

A further elaboration on the DQO's are presented in the Data Needs Determination (DND) summary included as Table 1-1 of the FSP.

The DND for the Site indicated the existing Site characterization information presented in previous reports is sufficient to confirm the presence of MED-related material at the Site (ORNL 1992, BNI 1995) thus satisfying DQO No. 1. The reports conclude that MED-related material is suspected of being present in three areas (Areas A, B, and C) located in the Landfill and Mudflats portions of the Site. However, the information does not adequately define the areal and vertical extent of the MED-related contamination or its impact on the soil and groundwater at the Site.

Activities presented below are intended to provide the additional characterization information required to attain the DQOs Nos. 2-4. The field activities summarized below (a gamma walkover survey and soil sampling) will focus on the evaluation of surficial and subsurface soils within the three known areas where MED-like gamma activity was detected during previous investigations. The intent of the sampling activities is to provide enough information to accurately identify the contaminants, evaluate the contaminants chemical composition, and determine the leachability of contaminants from radiological impacted material. In addition, groundwater samples will be collected from existing groundwater monitoring wells and analyzed for isotopic uranium (U), radium (Ra), and thorium (Th), and gross alpha, to determine if MED material at the Site has already impacted groundwater at the Site and, if so, what is the potential for further MED-related contaminant's mobility.

The DQOs listed above will be satisfied by the data to be collected as listed in Table 1-1 of the FSP and as shown in the Table below:

DQO #	Data Quality Objective	Data to be Collected to Satisfy this Objective
1	Verify MED-related material is present at the site.	Gamma Surface Scan Soil Samples – Radiological Analyses Sediment Samples – Radiological Analyses Surface Water Samples – Radiological Analyses
2	Delineate the extent and concentration of the MED-related material, identify areas that would exceed removal criteria, and determine volume of MED-related material;.	Gamma Surface Scan Gamma Scans of Subsurface Cores Soil Samples – Radiological Analyses Physical Survey
3	Evaluate the impact of MED-related material and related compounds (if present) to Site soil and groundwater.	Soil Samples – Radiological Analyses Soil Samples – Geotechnical Analyses Groundwater Samples - Radiological Analyses Sediment Samples – Radiological Analyses Surface Water Samples – Radiological Analyses Physical Survey
4	Assess long term risks posed by leaving MED-related material in place including an assessment of	Soil Samples – Radiological Analyses Soil Samples – Geotechnical Analyses and isotopic chemical form

DQO #	Data Quality Objective	Data to be Collected to Satisfy this Objective
	the mobility and migration capabilities of the material to surrounding receptors.	Groundwater Samples - Radiological Analyses Sediment Samples – Radiological Analyses Surface Water Samples – Radiological Analyses
5	Determine if chemical or non-MED wastes are commingled with the MED-related materials.	Soil Samples – Chemical Analyses
6	If radiological contamination is present, determine if it is due to MED-related material, NORM, Am-241 contamination, or other source(s).	Soil Samples – Radiological Analyses Soil Samples – Chemical Analyses Visual Observation Soil Samples – Geotechnical Analyses
7	Evaluate characteristics of disturbed material (soil and groundwater) for waste disposal.	Waste Characteristics Sampling

3.2 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

An analytical DQI summary for this investigation is presented in Tables 3-1 and 3-2.

Laboratories are required to comply with all methods as written. The laboratory selected for the project will be required to submit all lab method standard operating procedures (SOPs) and references, and the actual method detection limits to be achieved in all analyses to SAIC.

As per the EPA guidance (1993a), a combination of Screening Level and Definitive Level data will be required for each project.

Definitive data represent data generated under laboratory conditions using EPA-approved procedures. Data of this type, both qualitative and quantitative, are used for determination of source, extent, or characterization and to support evaluation of remedial technologies and preliminary assessment memorandum.

3.2.1 Level of Quality Control Effort

To assess whether QA objectives have been achieved, analyses of specific field and laboratory QC samples will be required. These QC samples include field duplicates, laboratory method blanks, laboratory control samples, laboratory duplicates, rinsate blanks, field blanks, and matrix spike/matrix spike duplicate (MS/MSD) samples.

Field Duplicates will be submitted for analysis to provide a means to assess the quality of the data resulting from the field sampling program. Field duplicates are analyzed to determine sample heterogeneity and

sampling methodology reproducibility. Analytical criteria that are expected to apply to the Town of Tonawanda Landfill are found in Tables 3-1 through 3-3, and are discussed in Section 8.3. Rinsate blanks and field blanks will not be collected, as only dedicated sampling equipment will be used.

One field duplicate sample will be collected for every ten investigative samples.

Laboratory method blanks and laboratory control samples are employed to determine the accuracy and precision of the analytical method implemented by the laboratory. Matrix spikes provide information about the effect of the sample matrix on the measurement methodology. Laboratory sample duplicates and MSDs assist in determining the analytical reproducibility and precision of the analysis for the samples of interest. One MS/MSD sample will be designated in the field and collected for at least every 20 investigative samples.

The QC effort for in-field measurements including organic vapor concentrations, and radiation levels, will include daily calibration of instruments using National Institute of Standards and Technology (NIST) traceable standards and approved in-house SOPs (refer to Volume 3 of the SAP). Daily calibration checks will also be performed on all radiation detection field meters. Field instruments and their method of calibration are discussed further in Section 7.0 of this QAPP.

3.2.2 Accuracy, Precision, and Sensitivity of Analysis

The fundamental QA objectives for accuracy, precision, and sensitivity of laboratory analytical data are the QC acceptance criteria of the analytical protocols. The accuracy and precision required for each project's analytical parameters are incorporated in Table 3-1 and Table 3-2 and will be consistent with the analytical protocols. Typical sensitivities required for project analyses are provided in Table 3-3.

Analytical accuracy is expressed as the percent recovery of an analyte that has been added to a blank sample or environmental sample at a known concentration before analysis. Accuracy will be determined in the laboratory through the use of MS analyses, and laboratory control sample (LCS) analyses. The percent recoveries for specific target analytes will be calculated and used as an indication of the accuracy of the analyses performed.

Precision will be determined through the use of spike analyses conducted on duplicate pairs of environmental samples (MS/MSD) or comparison of positive duplicate pair responses. The relative percent difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

Sample collection precision will be measured in the laboratory by the analyses of field duplicates. Precision will be reported as the RPD for two measurements.

3.2.3 Completeness, Representativeness, and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. It is expected that laboratories will provide data meeting QC acceptance criteria for all samples tested. Overall project completeness goals are identified in Tables 3-1 and 3-2.

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that depends upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. During development of this plan, consideration was given to site history, past waste disposal practices, existing analytical data, physical setting and processes, and constraints inherent to this investigation. The rationale of the sampling design is discussed in detail in the SAP.

Representativeness will be satisfied by ensuring that the SAP is followed, proper sampling techniques are used, proper analytical procedures are followed, and holding times of the samples are not exceeded. Representativeness will be determined by assessing the combined aspects of the QA program, QC measures, and data evaluations.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends upon the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data are expected to provide comparable data.

4.0 SAMPLING LOCATIONS AND PROCEDURES

It is anticipated that investigations performed at the Town of Tonawanda Landfill will produce soil, groundwater and investigation-derived waste (IDW) samples for analyses as appropriate to the specific investigation. Additional samples will be collected to complete field QC duplicate and field blank analyses. [Estimated numbers of samples (including activities and analytes) are incorporated into the FSP.] Investigation samples will require chemical and radionuclide determinations, as represented in Tables 3-1 through 3-3.

Identification of the primary field equipment and supporting materials to be used for these investigations is presented throughout the FSP. Several different types of field measurements will be performed during these investigations. A description of the field instruments and associated calibration requirements and performance checks to be used for field measurements is presented in the FSP and Section 7.0 of this QAPP.

The locations of the sampling stations and sample media to be collected during these investigations, and the rationales for the selection of these stations, are presented in the SAP along with sampling procedures. (Refer to Volume 3 of the SAP – Field Operating Procedures).

4.1 GENERAL INFORMATION AND DEFINITIONS

Contractor Laboratory

The laboratories subcontracted to perform analysis of samples will be selected through the SAIC procurement and review process prior to field mobilization. The laboratory supporting this project's efforts is TBD.

QA and QC Samples

These samples are analyzed for the purpose of assessing the quality of the sampling effort and of the reported analytical data. QA and QC samples to be used are duplicates, equipment rinsate blanks, trip blanks and field blank samples. Analytical parameters, methods, and sample types are summarized in Tables 4-1 and 4-2.

Field Duplicate QC Samples

These samples are collected by the sampling team for analysis by the contract laboratory. The identity of duplicate QC samples is held blind to the analysts and the purpose of these samples is to provide field-originated information regarding the homogeneity of the sampled matrix and the consistency of the sampling effort. These samples are collected concurrently with the primary environmental samples and equally represent the medium at a given time and location. Duplicate samples will be collected from each medium addressed by this project, and submitted to the contractor laboratory for analysis.

4.2 SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Sample containers, chemical preservation techniques, and holding times for soil and groundwater collected during investigations are described in Table 4-3. The specific number of containers required for each study will be estimated and supplied by the analytical facilities. Additional sample volumes will be collected and provided, when necessary, for the express purpose of performing associated laboratory QC (laboratory duplicates, MS/MSD).

All sample containers will be provided by the analytical support laboratories, which will also provide the required types and volumes of preservatives with containers as they are delivered to SAIC. In the event that sample integrity, such as holding times, is compromised, resampling will occur as directed by the USACE Project Manager. Any affected data will be flagged and qualified per data validation instructions and guidance.

4.3 FIELD DOCUMENTATION

4.3.1 Field Logbooks

Sufficient information will be recorded in the field logbooks to permit reconstruction of all drilling and sampling activities conducted. Information recorded on other project documents will not be repeated in the logbooks except in summary form where determined necessary. All field logbooks will be kept in the possession of field personnel responsible for completing the logbooks, or in a secure place when not being used during field work. Upon completion of the field activities, all logbooks will be submitted to USACE to become part of the final project file.

4.3.2 Sample Numbering System

A unique sample numbering scheme will be used to identify each sample collected, following the general outline established in Table 4-4. The purpose of this numbering scheme is to provide a tracking system for the retrieval of analytical and field data on each sample. Sample identification numbers will be used on all sample labels or tags, field data sheets or logbooks, COC records, and all other applicable documentation used during each project. A listing of all sample identification numbers will be maintained in the field logbook. The project database will be prepopulated with sample numbers and information consistent with instructions found in the Data Management Plan (DMP), Appendix A.

The sample numbering scheme used for field samples will be employed for duplicate samples and other field QC such that they will not be readily discernable by the laboratory.

4.3.3 Documentation Procedures

Labels will be affixed to all sample containers during sampling activities. Information will be recorded on each sample container label at the time of sample collection. The information to be recorded on the labels will be as follows:

- contractor name,
- sample identification number,
- sample type (discrete or composite),
- site name and sample station number,
- analysis to be performed,
- type of chemical preservative present in container,
- date and time of sample collection, and
- sampler's name and initials.

Sample logbooks and COC records will contain the same information as the labels affixed to the containers along with sample location measurements. These records will be maintained and record all information related to the sampling effort and the process employed. The tracking procedure to be used for documentation of all samples collected during the project will involve the steps outlined in the Data Management Plan, Appendix A.

4.4 FIELD VARIANCE SYSTEM

Procedures cannot fully encompass all conditions encountered during a field investigation; therefore, variances from the operating procedures, field sampling plan, and/or safety and health plan may occur. All variances that occur during field investigations will be documented on a field change request (FCR) form or an NCR and will be noted in the appropriate field logbooks. Examples of the FCR (Figure 4-1) and NCR (Figure 4-2) forms to be used for these investigations are presented in this QAPP. If a variance is anticipated (e.g., because of a change in the field instrumentation), the applicable procedure will be modified and the change noted in the field logbooks.

FCRs are processed in accordance with SAIC Field Technical Procedure, FTP-1200, Field Quality Control. NCRs are processed in accordance with SAIC QA Administrative Procedure, QAAP 15.1, Control of Nonconforming Items and Services.

5.0 SAMPLE CUSTODY AND HOLDING TIMES

It is the policy of SAIC and the intent of these investigations to follow EPA policy regarding sample custody and COC protocols as described in *NEIC Policies and Procedures* (EPA 1985). This custody is in three parts: sample collection, laboratory analysis, and final evidence files. Final evidence files, including originals of laboratory reports and electronic files, are maintained under document control in a secure area. A sample or evidence file is under your custody when it is:

- in the sampler's possession;
- in the sampler's view, after being in the sampler's possession;
- in the sampler's possession and placed in a secured location; or
- in a designated secure area.

5.1 SAMPLE DOCUMENTATION

The sample packaging and shipment procedures summarized below will ensure that samples will arrive at the laboratory with the COC intact. The protocol for specific sample numbering using case numbers and traffic report numbers (if applicable) and other sample designations will be followed.

5.1.1 Field Procedures

The field sampler is responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples. Each sample container will be labeled with a sample number, date and time of collection, sampler, and sampling location. Sample labels are to be completed for each sample. The SAIC Task Manager, in conjunction with the USACE, will review all field activities to determine whether proper custody procedures were followed during the field work and to decide if additional samples are required.

5.1.2 Field Logbooks/Documentation

Samples will be collected following the sampling procedures documented in the SAP. When a sample is collected or a measurement is made, a detailed description of the location will be recorded. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. A sample identification number will be assigned before sample collection. Field duplicate samples and QA split samples, which will receive an entirely separate sample identification number, will be noted under sample description. Equipment employed to make field measurements will be identified along with their calibration dates.

5.1.3 Transfer of Custody and Shipment Procedures

Samples are accompanied by a properly completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record will document transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area. An example of the COC form to be used for these investigations is illustrated in Figure 5-1.

All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler for return to project management and the project file.

All shipments will be in compliance with applicable United States Department of Transportation (DOT) regulations for environmental samples

5.2 LABORATORY COC PROCEDURES

Custody procedures, along with the holding time and sample preservative requirements for samples, will be described in laboratory QA Plans. These documents will identify the laboratory custody procedures for sample receipt and log-in, sample storage, tracking during sample preparation and analysis, and laboratory storage of data.

5.2.1 Cooler Receipt Checklist

The condition of shipping coolers and enclosed sample containers will be documented upon receipt at the analytical laboratory. This documentation will be accomplished using the cooler receipt checklist presented in Table 5-1. One of these checklists will be placed into each shipping cooler along with the completed COC form or provided to the laboratory at the start of the project. A copy of the checklist will be faxed to the SAIC Task Manager immediately after it has been completed at the laboratory. The original completed checklist will be transmitted with the final analytical results from the laboratory.

5.2.2 Letter of Receipt

The laboratory will confirm sample receipt and log-in information through transmission of a Letter-of-Receipt (LOR) to SAIC. This will include returning a copy of the completed COC, a copy of the cooler receipt checklist, and confirmation of the analytical log-in indicating laboratory sample numbers.

5.3 FINAL EVIDENCE FILES CUSTODY PROCEDURES

SAIC is the custodian of the evidence file and will maintain the contents of evidence files for these investigations, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, correspondence, laboratory logbooks, and COC forms. The evidence file will be stored in a secure, limited-access area and under custody of the SAIC Task Manager or designee.

Analytical laboratories will retain all original raw data information (both hard copy and electronic) for a period of five years after the completion of the project. Analytical laboratories shall store all original raw data information in a secure, limited-access area and under custody of the Laboratory Project Manager.

6.0 ANALYTICAL PROCEDURES

All samples collected during these investigation activities will be analyzed by laboratories reviewed and validated by the USACE HTRW CX, Omaha, Nebraska. QA samples will be collected for groundwater and soil, and analyzed by the designated USACE QA Laboratory. Each laboratory supporting this work will provide statements of qualifications including organizational structure, QA Manual, and SOP.

6.1 LABORATORY ANALYSIS

Samples collected during these investigations will be consistent with nationally recognized methods such as EPA SW846 Test Methods and DOE Environmental Measurements Laboratory (EML), HASL Procedures Manual. Laboratory standard operating procedures are based on these or equivalent methods and will be submitted to the project for reference.

Principal laboratory facilities will not subcontract or transfer any portion of this work to another facility, unless expressly permitted to do so in writing by the USACE Project Manager.

If contaminant concentrations are high, or for matrices other than normal waters and soils, analytical protocols may be inadequate. In these cases, sample analysis may require modifications to defined methodology. Any proposed changes to analytical methods specified require written approval from SAIC and USACE. All analytical method variations will be identified in field change records. These may be submitted for regulatory review and approval when directed by the USACE Project Manager.

These SOPs must be adapted from and reference standard accepted methods and thereby specify:

- procedures for sample preparation,
- instrument start-up and performance check,
- procedures to establish the actual and required detection limits for each parameter,
- initial and continuing calibration check requirements,
- specific methods for each sample matrix type, and
- required analyses and QC requirements.

6.2 FIELD SCREENING ANALYTICAL PROTOCOLS

Procedures for field measurement of activity levels are described in Section 7.0 of this QAPP.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment that are used for conducting field tests and laboratory analyses. These instruments and equipment will be calibrated before each use or on a scheduled, periodic basis according to manufacturer instructions.

7.1 FIELD INSTRUMENTS/EQUIPMENT

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. All field instruments for this purpose will have unique identifiers, and each instrument will be logged in the Measuring and Testing Equipment (M&TE) Log Book before use in the field. The SSHO or his/her designate will be responsible for performing and documenting daily calibration/checkout records for instruments used in the field.

Equipment to be used during field sampling will be examined to certify that it is in operating condition. This will include checking the manufacturer's operating manual and instructions for each instrument to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notation on any prior equipment problems will not be overlooked, and all necessary repairs to equipment will be carried out. Spare parts or duplication of equipment will be available to the sampling effort.

Calibration of field instruments is governed by the SOP for the applicable field analysis method, and will be performed at the intervals specified in the SOP. If no SOP is available, calibration of field instruments will be performed at intervals specified by the manufacturer or more frequently as conditions dictate. Calibration procedures and frequency will be recorded in a field logbook.

Field instruments will include hand-held scintillation detectors for radioactivity screening levels and photoionization detectors (PIDs) for organic vapor detection. If an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service and a back-up instrument will be calibrated and used in its place. Field instrument uses, detection levels, and calibration are summarized in Table 7-1.

Detailed instructions on the proper calibration and use of each field instrument follow the guidelines established by the manufacturer. The technical procedures for each instrument used on this project include the manufacturer's instructions detailing the proper use and calibration of each instrument.

7.1.1 Organic Vapor Detection

Organic vapor detectors will be checked daily according to the manufacturer's instructions. Flame ionization detectors (FIDs) will be checked daily by using the internal calibration mechanism. PIDs will be calibrated daily with a gas of known concentration. All daily calibration information will be recorded in the M&TE Log Book.

7.1.2 Radiation Monitoring

Scintillation detectors will be checked daily according to the manufacturer's instructions. Meters will be checked daily by using sealed calibration source checks. Meters will be calibrated routinely, with calibration dates clearly identified on each instrument. All daily calibration check information will be recorded in the M&TE Log Book.

Section 2.4 of the FSP provides details on the gamma walkover survey instrumentation. Down-hole gamma scanning instrumentation is provided in Section 2.5 of the FSP.

7.2 LABORATORY INSTRUMENTS

Calibration of laboratory equipment will be based on approved written procedures. Records of calibration, repairs, or replacement will be filed and maintained by laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audit. Procedures and records of calibration will follow USACE and SAIC reviewed laboratory-specific QA Plans. For analyses governed by SOPs, refer to the appropriate SOP for the required calibration procedures and frequencies.

Records of calibration will be kept as follows:

- If possible, each instrument will have a record of calibration with an assigned record number.
- A label will be affixed to each instrument showing identification numbers, manufacturer, model numbers, date of last calibration, signature of calibrating analyst, and due date of next calibration. Reports and compensation or correction figures will be maintained with instrument.
- A written step-wise calibration procedure will be available for each piece of test and measurement equipment.
- Any instrument that is not calibrated to the manufacturer's original specification will display a warning tag to alert the analyst that the device carries only a "Limited Calibration."

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 FIELD SAMPLE COLLECTION

The assessment of field sampling precision and accuracy will be made by collecting field duplicates in accordance with the procedures described in the FSP. Trip blanks will accompany sample bottles at all times.

8.2 FIELD MEASUREMENT

QC procedures for most field measurements (i.e., activity levels, headspace, etc.) are limited to checking the reproducibility of the measurement by obtaining multiple readings on a single sample or standard and by calibrating the instruments. Refer to Section 7.0 of this QAPP for more detail regarding these measurements.

8.3 LABORATORY ANALYSIS

Analytical QC procedures for these investigations are specified in the individual method descriptions. These specifications include the types of QC checks normally required; method blanks, LCS, MS, MSD, calibration standards, internal standards, tracer standards, calibration check standards, and laboratory duplicate analysis

To ensure the production of analytical data of known and documented quality, laboratories associated with these investigations will implement all method QA and QC checks.

8.3.1 QA Program

All subcontracted analytical laboratories will have a written QA program that provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA program is coordinated and monitored by the laboratory's QA department, which is independent of the operating departments. For these investigations selected support laboratory QA Plans will be referenced and implemented in their entirety.

The stated objectives of the laboratory QA program are to:

- properly sub-sample, preserve, and store all samples;
- maintain adequate custody records from sample receipt through reporting and archiving of results;
- use properly trained analysts to analyze all samples by approved methods within holding times;

- produce defensible data with associated documentation to show that each system was calibrated and operating within precision and accuracy control limits;

- accurately calculate, check, report, and archive all data using the Laboratory Information Management System; and

- document all the above activities so that all data can be independently validated.

All laboratory procedures are documented in writing as SOPs, which are edited and controlled by the QA department. Internal QC measures for analysis will be conducted with their SOPs and the individual method requirements specified.

External QA will be provided by the USACE QA Laboratory. The external QA laboratory will receive QA sample splits as identified in this QAPP.

8.3.2 QC Checks

Implementation of QC procedures during sample collection, analysis, and reporting ensures that the data obtained are consistent with its intended use. Both field QC and laboratory QC checks are performed throughout the work effort to generate data confidence. Analytical QC measures are used to determine if the analytical process is in control, as well as to determine the sample matrix effects on the data being generated.

Specifications include the types of QC required (duplicates, sample spikes, surrogate spikes, reference samples, controls, blanks, etc.), the frequency for implementation of each QC measure, compounds to be used for sample spikes and isotopic tracers, and the acceptance criteria for this QC.

Laboratories will provide documentation in each data package that both initial and ongoing instrument and analytical QC functions have been met. Any nonconforming analysis will be reanalyzed by the laboratory, if sufficient sample volume is available. It is expected that sufficient sample volumes will be collected to provide for reanalyses, if required.

8.3.2.1 Analytical Process QC

8.3.2.1.1 Method Blanks

A method blank is a sample of a noncontaminated substance of the matrix of interest (usually distilled/de-ionized water or silica sand) that is then subjected to all of the sample preparation (digestion, distillation, extraction) and analytical methodology applied to the samples. The purpose of the method blank is to check for contamination from within the laboratory that might be introduced during sample preparation and analysis that would adversely affect analytical results. A method blank must be analyzed with each analytical sample batch.

Analytical sensitivity goals have been identified in this QAPP as practical quantitation limits (PQLs). The practical quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The PQL is generally 5 to 10 times the MDL. Method blank levels should be below these levels (quantitation limits) for all analytes. Method blank levels are considered acceptable if they are consistent with SW-846. Reporting limits for this project are specified in Table 3-3.

8.3.2.1.2 Laboratory Control Samples

The LCS contains known concentrations of analytes representative of the contaminants to be determined and is carried through the entire preparation and analysis process. Commercially available LCSs or those from EPA may be used. Each LCS analyte must be plotted on a control chart. The primary purpose of the LCS is to establish and monitor the laboratory's analytical process control. An LCS must be analyzed with each analytical sample batch.

8.3.2.2 Matrix and Sample-Specific QC

8.3.2.2.1 Laboratory Duplicates

Laboratory duplicates are separate aliquots of a single sample that are prepared and analyzed concurrently at the laboratory. This duplicate sample should not be a method blank or field blank. The primary purpose of the laboratory duplicate is to check the precision of the laboratory analyst, the sample preparation methodology, and the analytical methodology. If there are significant differences between the duplicates, the affected analytical results will be re-examined. A laboratory duplicate will be performed at a frequency of once per batch.

8.3.2.2.2 Surrogate Spikes

A surrogate spike is prepared by adding a pure compound to a sample before extraction. The compound in the surrogate spike should be of a similar type to that being assayed in the sample. The purpose of a surrogate spike is to determine the efficiency of recovery of analytes in the sample preparation and analysis. The percent of recovery of the surrogate spike is then used to gauge the total accuracy of the analytical method for that sample.

8.3.2.2.3 Isotopic Tracers

An isotopic tracer is prepared by adding a unique isotope of the same or similar element to a sample before preparation and analysis. The purpose of this isotopic tracer is to determine the efficiency of recovery of the targeted isotope or isotopes in the sample preparation and analysis. The percent of recovery of the tracer is then used to gauge the total accuracy of the analytical method for that sample and to compensate for the quantification of the analyte of interest.

8.3.2.2.4 Matrix Spikes and Matrix Spike Duplicates

An MS is an aliquot of a sample spiked with known quantities of analytes and subjected to the entire analytical procedure. It is used to indicate the appropriateness of the method for the matrix by measuring recovery or accuracy. Accuracy is the nearness of a result or the mean of a set of results to the true or accepted value. An MSD is a second aliquot of the same sample with known quantities of compounds added. The purpose of the MSD, when compared to the MS, is to determine the effect of the matrix on method precision. Precision is the measure of the reproducibility of a set of replicate results among themselves or the agreement among repeat observations made under the same conditions. MSs and MSDs are performed per 20 samples of similar matrix.

8.3.2.2.5 Method-Specific QC

The laboratory must follow specific quality processes as defined by the method. These will include measures such as calibration verification samples, instrument blank analysis, internal standards implementation, tracer analysis, method of standard additions utilization, serial dilution analysis, post-digestion spike analysis, chemical carrier evaluation, etc.

9.0 CALCULATION OF DATA QUALITY INDICATORS

9.1 FIELD MEASUREMENTS DATA

Field data will be assessed by the site CQC Representative. The site CQC Representative will review the field results for compliance with the established QC criteria that are specified in this QAPP, and SAP. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple reading of a single sample.

Field data completeness will be calculated using Equations (1a) and (1b).

Sample Collection (1a):

$$\text{Completene ss} = \frac{\text{Number of Sample Points Sampled}}{\text{Number of Sample Points Planned}} \times 100\% \qquad \textbf{(1a)}$$

Field Measurements (1b):

$$\text{Completene ss} = \frac{\text{Number of Valid Field Measurements Made}}{\text{Number of Field Measurements Planned}} \times 100\% \qquad \textbf{(1b)}$$

9.2 LABORATORY DATA

Laboratory results will be assessed for compliance with required precision, accuracy, completeness, and sensitivity as follows.

9.2.1 Precision

The precision of the laboratory analytical process will be determined through evaluation of LCS analyses. The standard deviation of these measurements over time will provide confidence that implementation of the analytical protocols was consistent and acceptable. These measurements will establish the precision of the laboratory analytical process.

Investigative sample matrix precision will be assessed by comparing the analytical results between MS/MSD for organic analysis and laboratory duplicate analyses for inorganic analysis. The RPD will be calculated for each pair of duplicate analysis using Equation (2) below and produce an absolute value for RPD. This precision measurement will include variables associated with the analytical process, influences related to sample matrix interferences, and sample heterogeneity.

$$RPD = \frac{|S - D|}{\frac{(S + D)}{2}} x\ 100, \qquad (2)$$

where

S = first sample value (original or MS value),
D = second sample value (duplicate or MSD value).

9.2.2 Accuracy

The accuracy of the laboratory analytical measurement process will be determined by comparing the percent recovery for the LCS to control charts.

Investigative sample accuracy will be assessed for compliance with the established QC criteria that are described in Section 3.0 of this QAPP using the analytical results of method blanks, reagent/preparation blank, MS/MSD samples, field blank, and trip blanks. The percent recovery (%R) of MS samples will be calculated using Equation (3) below. This accuracy will include variables associated with the analytical process, influences related to sample matrix interferences, and sample heterogeneity.

$$\%R = \frac{A - B}{C} x\ 100, \qquad (3)$$

where

A = the analyte concentration determined experimentally from the spiked sample,
B = the background level determined by a separate analysis of the unspiked sample,
C = the amount of the spike added.

9.2.3 Completeness

Data completeness of laboratory analyses will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using Equation (4) below.

$$\text{Completeness} = \frac{\text{Number of Valid Laboratory Measurements Made}}{\text{Number of Laboratory Measurements Planned}} \times 100\% \qquad (4)$$

9.2.4 Sensitivity

Achieving method detection limits depends on sample preparation techniques, instrument sensitivity, and matrix effects. Therefore, it is important to determine actual method detection limits (MDLs) and

minimum detectable concentration (MDC) through the procedures outlined in 40 *CFR* 136, Appendix B. MDLs and MDCs will be established for each major matrix under investigation (i.e., water, soil) through multiple determinations, leading to a statistical evaluation of the MDL/MDC. Sensitivity shall be adequate to ensure that the MDLs/MDCs are below the project quantitation levels specified in Table 3-3.

It is important to monitor instrument sensitivity through calibration blanks and low concentration standards to ensure consistent instrument performance. It is also critical to monitor the analytical method sensitivity through analysis of method blanks, calibration check samples, and LCSs, etc.

9.3 PROJECT COMPLETENESS

Project completeness will be determined by evaluating the planned versus actual data. Consideration will be given for project changes and alterations during implementation. All data not flagged as rejected by the review, verification, validation, or assessment processes will be considered valid. Overall, the project completeness will be assessed relative to media, analyte, and area of investigation. Completeness objectives are listed in Table 3-1 (soil) and Table 3-2 (groundwater).

9.4 REPRESENTATIVENESS/COMPARABILITY

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for the environmental media examined at the site. It is a qualitative term most concerned with the proper design of the sampling program. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences. Sample collection, preservation, analytical holding time, analytical method application, and matrix interferences will be evaluated by reviewing project documentation and QC analyses.

Comparability, like representativeness, is a qualitative term relative to a project data set as an individual. These investigations will employ narrowly defined sampling methodologies, site audits/surveillances, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through proper implementation and documentation of these standard practices, the project will establish confidence that data will be comparable to other project and programmatic information.

Additional input to determine representativeness and comparability may be gained through statistical evaluation of data populations, chemical charge balances, compound evaluations, or dual measurement comparisons.

10.0 CORRECTIVE ACTIONS

Corrective actions may be required for two major types of problems: analytical/equipment problems and noncompliance with criteria. Analytical and equipment problems may occur during sampling, sample handling, sample preparation, laboratory instrumental analysis, and data review.

Noncompliance with specified criteria and analytical/equipment problems will be documented through a formal corrective action program at the time the problem is identified. The person identifying the problem is responsible for notifying the SAIC Task Manager and the USACE Project Manager. When the problem is analytical in nature, information on these problems will be promptly communicated to the SAIC Analytical Laboratory Coordinator. Implementation of corrective action will be confirmed in writing.

Any nonconformance with the established QC procedures in the QAPP or SAP will be identified and corrected in accordance with the QAPP. The SAIC Task Manager or his/her designee will issue an NCR (Figure 4-2) for each nonconforming condition.

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are deemed insufficient, work may be stopped through a stop-work order issued by the SAIC Task Manager and the USACE Project Manager.

10.1 SAMPLE COLLECTION/FIELD MEASUREMENTS

Technical staff and project personnel will be responsible for reporting all suspected technical and QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the SAIC Project Manager or his/her designee. The manager will be responsible for assessing the suspected problems in consultation with the SAIC QA/QC Officer and SAIC Laboratory Coordinator to make a decision based on the potential for the situation to impact the quality of the data. When it is determined that the situation warrants a reportable nonconformance and corrective action, then an NCR will be initiated by the manager.

The manager will be responsible for ensuring that corrective actions for nonconformances are initiated by:

- evaluating all reported nonconformances,
- controlling additional work on nonconforming items,
- determining disposition or action to be taken,
- maintaining a log of nonconformances,
- reviewing NCRs and corrective actions taken, and
- ensuring that NCRs are included in the final site documentation project files.

If appropriate, the SAIC Task Manager will ensure that no additional work dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective action for field measurements may include:

- repeating the measurement to check the error,
- checking for all proper adjustments for ambient conditions such as temperature,
- checking the batteries,
- re-calibrating equipment,
- checking the calibration,
- modifying the analytical method including documentation and notification (i.e., standard additions),
- replacing the instrument or measurement devices, and
- stopping work (if necessary).

The SAIC Task Manager or his/her designee is responsible for all site activities. In this role, he/she may at times be required to adjust the site activities to accommodate activity-specific needs. When it becomes necessary to modify an activity, the responsible person notifies the SAIC Task Manager of the anticipated change and implements the necessary changes after obtaining the approval of the SAIC Task Manager and the USACE Project Manager. All such changes will be documented on an FCR that will be signed by the initiators and the SAIC Task Manager. The FCR for each document will be numbered serially as required. The FCR will be attached to the file copy of the affected document. The SAIC Task Manager must approve the change in writing or verbally before field implementation. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and action taken.

The SAIC Task Manager for the site is responsible for controlling, tracking, and implementing the identified changes. Reports on all changes will be distributed to all affected parties, including the USACE Project Manager. The USACE will be notified whenever program changes in the field are made.

10.2 LABORATORY ANALYSES

Laboratory QA plans will provide systematic procedures to identify out-of-control situations and corrective actions. Corrective actions will be implemented to resolve problems and restore malfunctioning analytical systems. Laboratory personnel will receive QA training and be made aware that corrective actions are necessary when:

- QC data are outside warning or control windows for precision and accuracy.
- Blanks contain target analytes above acceptable levels and must be investigated.
- Undesirable trends are detected in spike recoveries or RPD between duplicates.
- There are unusual changes in detection limits.

- Deficiencies are detected by internal audits, external audits, or from performance evaluation samples results.
- Inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the Laboratory Supervisor, Manager, and/or QA Department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with project records and the Laboratory QA Department, and the information is summarized within case narratives.

Corrective actions may include:

- re-analyzing the samples, if holding time criteria permit;
- evaluating blank contaminant sources, elimination of these sources, and reanalysis;
- modifying the analytical method (i.e., standard additions) with appropriate notification and documentation;
- resampling and analyzing;
- evaluating and amending sampling procedures; or
- accepting data and acknowledging the level of uncertainty.

If resampling is deemed necessary due to laboratory problems, the SAIC Task Manager will identify the necessary recovery approach to implement the additional sampling effort.

The following corrective action procedures will be required:

- Problems noted during sample receipt will be documented in the appropriate laboratory LOR. SAIC and USACE will be contacted immediately to determine problem resolution. All corrective actions will be thoroughly documented.
- When sample extraction/digestion or analytical holding times are not within method required specifications, SAIC and USACE will be notified immediately to determine problem resolution. All corrective actions will be thoroughly documented.
- All initial and continuing calibration sequences that do not meet method requirements will result in a review of the calibration. When appropriate, re-analysis of the standards or re-analysis of the affected samples back to the previous acceptable calibration check is warranted.
- All appropriate measures will be taken to prepare and clean up samples in an attempt to achieve the practical quantitation limits as stated. When difficulties arise in achieving these limits, the laboratory will notify SAIC and the USACE to determine problem resolution. All corrective actions will be thoroughly documented.
- Any dilutions impacting the practical quantitation limits will be documented in case narratives along with revised quantitation limits for those analytes affected. Analytes detected above the method detection limits, but below the practical quantitation limits, will be reported as estimated values.

- Failure of method-required QC to meet the requirements specified in this project QAPP shall result in review of all affected data. Resulting corrective actions may encompass those identified earlier. SAIC and USACE will be notified as soon as possible to discuss possible corrective actions, particularly when unusual or difficult sample matrices are encountered.
- When calculation and reporting errors are noted within any given data package, reports will be reissued with applicable corrections. Case narratives will clearly state the reasons for reissuance of reports.

11.0 DATA REDUCTION, VALIDATION, AND REPORTING

11.1 DATA REDUCTION

11.1.1 Field Measurements and Sample Collection

Raw data from field measurements and sample collection activities will be appropriately recorded in field logbooks. Data to be used in project reports will be reduced and summarized. The methods of data reduction will be documented.

The SAIC Task Manager or his/her designee is responsible for data review of all field-generated data. This includes verifying that all field descriptive data are recorded properly, that all field instrument calibration requirements have been met, that all field QC data have met frequency and criteria goals, and that field data are entered accurately in all applicable logbooks and worksheets.

11.1.2 Laboratory Services

All samples collected for these investigations will be sent to USACE HTRW CX qualified laboratories. Data reduction, evaluation, and reporting for samples analyzed by a laboratory will be performed according to specifications outlined in the laboratory's QA plan. Laboratory reports will specifically include documentation verifying analytical holding time compliance.

Laboratories will perform in-house analytical data reduction under the direction of the Laboratory QA Manager. The Laboratory QA Manager is responsible for assessing data quality and informing SAIC and USACE of any data which are considered unacceptable or require caution on the part of the data user in terms of its reliability. Data will be reduced, evaluated, and reported as described in the laboratory QA plan. Data reduction, review, and reporting by the laboratory will be conducted as follows:

- Raw data are produced by the analyst who has primary responsibility for the correctness and completeness of the data. All data will be generated and reduced following the QAPP- and the activity-specific QAPP-defined methods and implementing laboratory SOP protocols.
- Level 1 technical data review is completed relative to an established set of guidelines by a peer analyst. The review will ensure the completeness and correctness of the data while assuring all method QC measures have been implemented and were within appropriate criteria.
- Level 2 technical review is completed by the area supervisor or data review specialist. This reviews the data for attainment of QC criteria as outlined in the established methods and for overall reasonableness. It will ensure that all calibration and QC data are in compliance and check at least 10 percent of the data calculations. This review will document that the data package is complete and ready for reporting and archival.
- Upon acceptance of the raw data by the area supervisor, the report is generated and sent to the Laboratory Project Manager for Level 3 administrative data review. This review will ensure

consistency and compliance with all laboratory instructions, the laboratory QA plan, the project laboratory SOW, and this QAPP.

- The Laboratory Project Manager will complete a thorough review of all reports.
- Final reports will be generated and signed by the Laboratory Project Manager.
- Data will then be delivered to SAIC for data validation.

The data review process will include identification of any out-of-control data points and data omissions, as well as interactions with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Project Manager based on the extent of the deficiencies and their importance in the overall context of the project. The laboratory will provide flagged data to include such items as: (1) concentration below required detection limit, (2) estimated concentration due to poor spike recovery, and (3) concentration of chemical also found in laboratory blank.

Laboratories will prepare and retain full analytical and QC documentation for the project for a period of five years after completion of the project. Such retained documentation will be both hard (paper) copy and electronic storage media (e.g., magnetic tape) as dictated by the analytical methodologies employed. As needed, laboratories will supply hard copies of the retained information.

Laboratories will provide the following information to USACE and SAIC in each analytical data package submitted:

- cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis;
- tabulated results of inorganic, organic, radionuclide, and miscellaneous parameters identified and quantified;
- analytical results for QC sample spikes, sample duplicates, initial and continuous calibration verifications of standards and blanks, standard procedural blanks, LCSs, and other deliverables as identified in Section 11.3 of this QAPP; and
- method detection limits.

11.2 DATA VALIDATION

11.2.1 Data Validation Approach

A systematic process for data verification and validation will be performed to ensure that the precision and accuracy of the analytical data are adequate for their intended use. The greatest uncertainty in a measurement is often a result of the sampling process and inherent variability in the environmental media rather than the analytical measurement. Therefore, analytical data validation will be performed only to the level necessary to minimize the potential of using false positive or false negative results in the decision-making process (i.e., to ensure accurate identification of detected versus non-detected compounds). This approach is consistent with the DQOs for the project, with the analytical methods, and for determining contaminants of concern and calculating risk.

Samples will be analyzed through implementation of definitive analytical methods. Definitive data will be reported consistent with the deliverables identified in Section 11.4, and shown in Tables 11-1 and 11-2. This report content is consistent with what is understood as an EPA Level III deliverable (data forms including laboratory QC and calibration information). This definitive data will then be validated through the review process presented in Section 11.2.2. DQOs identified in Section 3.0 and method-specified criteria will be validated. Comprehensive analytical information will be retained by the subcontract laboratory.

Validation will be accomplished by comparing the contents of the data packages and QA/QC results to requirements contained in the requested analytical methods. The SAIC validation support staff will be responsible for these activities. The protocol for analyte data validation is presented in:

- SAIC Quality Assurance Technical Procedures, Volume I, Data Management;
- Laboratory Data Validation Guidelines For Evaluating Radionuclide Analyses, SAIC Document Number: 143-ARCS-00.08, Revision 06, June 2000 (SAIC, 2000)
- EPA National Functional Guidelines for Organic Data Review (EPA 1994b), modified for SW-846; and
- EPA National Functional Guidelines for Inorganic Data Review (EPA 1994c)), modified for SW-846.

SAIC validation support staff will conduct a systematic review of the data for compliance with the established QC criteria based on the following categories:

- holding times,
- blanks,
- LCSs,
- surrogate recovery (organic methods),
- internal standards (primarily organic methods),
- isotopic tracers (radionuclide methods),
- inductively coupled plasma (ICP) or atomic absorption QC,
- calibration,
- sample reanalysis,
- secondary dilutions, and
- laboratory case narrative.

Consistent with the data quality requirements as defined in the DQOs, all project data and associated QC will be evaluated on these categories and qualified as per the outcome of the review. Information gathered during this validation process will be consistent with the information demonstrated by the USACE Data Validation Form (Figure 11-1). Either these forms or SAIC validation forms containing equivalent documentation will be completed and presented with the Quality Control Summary Report (QCSR).

11.2.2 Primary Analytical Data Validation Categories

11.2.2.1 Holding Times

Evaluation of holding times ascertains the validity of results based on the length of time from sample collection to sample preparation or sample analysis. Verification of sample preservation must be confirmed and accounted for in the evaluation of sample holding times. The evaluation of holding times is essential to establishing sample integrity and representativeness. Concerns regarding physical, chemical, or biochemical alteration of analyte concentrations can be eliminated or qualified through this evaluation.

11.2.2.2 Blanks

The assessment of blank analyses is performed to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks apply to any blank associated with the samples, including field, trip, equipment, and method blanks. Contamination during sampling or analysis, if not discovered, results in false-positive data.

Blanks will be evaluated against quantitation limit goals as specified in this QAPP and established by SW-846.

11.2.2.3 Laboratory Control Samples

The LCS serves as a monitor of the overall performance of the analytical process, including sample preparation, for a given set of samples. Evaluation of this standard provides confidence in or allows qualification of results based on a measurement of process control during each sample analysis.

11.2.2.4 Surrogate Recovery

System monitoring compounds are added to every sample, blank, matrix spike, MS, MSD, and standard. They are used to evaluate extraction, cleanup, and analytical efficiency by measuring recovery on a sample-specific basis. Poor system performance as indicated by low surrogate recoveries is one of the most common reasons for data qualification. Evaluation of surrogate recovery is critical to the provision of reliable sample-specific analytical results.

11.2.2.5 Internal Standards

Internal standards are utilized to evaluate and compensate for sample-specific influences on the analyte quantification. They are evaluated to determine if data require qualification due to excessive variation in acceptable internal standard quantitative or qualitative performance measures. For example, a decrease or increase in internal standard area counts for organics may reflect a change in sensitivity that can be

attributed to the sample matrix. Because quantitative determination of analytes is based on the use of internal standards, evaluation is critical to the provision of reliable analytical results.

11.2.2.6 Isotopic Tracers

Isotopic tracers are utilized to evaluate and compensate for sample-specific influences and preparation aberrations on the radionuclide quantification. They are evaluated to determine if data require qualification due to excessive variation in acceptable tracer quantitative or qualitative performance measures. For example, a decrease or increase in tracer recovery for a given isotope may reflect a change in sensitivity that can be attributed to the sample matrix or preparation process. Because quantitative determination of many radionuclides is based on the use of tracers, evaluation is critical to the provision of reliable analytical results.

11.2.2.7 Calibration

The purpose of initial and continuing calibration verification analyses is to verify the linear dynamic range and stability of instrument response. Relative instrument response is used to quantitate the analyte results. If the relative response factor is outside acceptable limits, the data quantification is uncertain and requires appropriate qualification.

11.2.2.8 Sample Reanalysis

When instrument performance-monitoring standards indicate an analysis is out of control, the laboratory is required to reanalyze the sample. If the reanalysis does not solve the problem (i.e., surrogate compound recoveries are outside the limits for both analyses), the laboratory is required to submit data from both analyses. An independent review is required to determine which is the appropriate sample result.

11.2.2.9 Secondary Dilutions

When the concentration of any analyte in any sample exceeds the initial calibration range, a new aliquot of that sample must be diluted and reanalyzed. The laboratory is required to report data from both analyses. When this occurs, an independent review of the data is required to determine the appropriate results to be used for that sample. An evaluation of each analyte exceeding the calibration range must be made, including a review of the dilution analysis performed. Results chosen in this situation may be a combination of both the original results (i.e., analytes within initial calibration range) and the secondary dilution results.

11.2.2.10 Laboratory Case Narratives

Analytical laboratory case narratives are reviewed for specific information concerning the analytical process. This information is used to direct the data validator to potential problems with the data.

11.3 PROJECT ANALYTICAL DATA SET

Analytical data for each project will be verified electronically and validated by qualified chemists. Flags signifying the usability of data will be noted and entered into an analytical database. Deficiencies in data deliverables will be corrected through direct communication with the field or laboratory, generating immediate response and resolution. All significant data discrepancies noted during the validation process will documented through NCRs, which are sent to the laboratory for clarification and correction.

Decisions to repeat sample collection and analyses may be made by the USACE Project Manager or the SAIC Task Manager based on the extent of the deficiencies and their importance in the overall context of the project.

All data generated for investigations will be computerized in a format organized to facilitate data review and evaluation. The computerized data set will include data flags in accordance with the above-referenced protocols as well as additional comments of the Data Review Team. The associated data flags will include such items as: (1) estimated concentration below-required reporting limit; (2) estimated concentration due to poor calibration, internal standard, or surrogate recoveries; (3) estimated concentration due to poor spike recovery; and (4) estimated concentration of a chemical that was also determined in the laboratory blank.

SAIC data assessment will be accomplished by the joint efforts of the data validator, the data assessor, and the Task Manager. Data assessment by data management will be based on the criteria that the sample was properly collected and handled according to the SAP and Sections 4.0 and 5.0 of this QAPP. An evaluation of data accuracy, precision, sensitivity and completeness, based on criteria in Section 9.0 of this QAPP, will be performed by a data assessor and presented in the QCSR. This data quality assessment will indicate that data are: (1) usable as a quantitative concentration, (2) usable with caution as an estimated concentration, or (3) unusable due to out-of-control QC results.

Project investigation data sets will be available for controlled access by the SAIC Task Manager and authorized personnel. Each data set will be incorporated into investigation reports as required.

11.4 DATA REPORTING

Laboratories will prepare and submit analytical and QC data reports to USACE and SAIC in compliance with the requirements of this QAPP including data forms listed in Table 11-1. An electronic

copy of data will be provided in an ASCII data file or other compatible format for entry into the SAIC database. An acceptable configuration is presented in Table 11-2 with all QA/QC sample data being provided in a companion ASCII file.

The laboratory will be required to confirm sample receipt and log-in information. The laboratory will return a copy of the completed COC and confirmation of the laboratory's analytical log-in to SAIC within 24 hours of sample receipt.

The subcontract analytical laboratory will prepare and retain full analytical and QC documentation for a period of five years after completion of the project. Such retained documentation will include all hard copies and other storage media (e.g., magnetic tape). As needed, the subcontract analytical laboratory will make available all retained analytical data information.

12.0 PREVENTIVE MAINTENANCE PROCEDURES

12.1 FIELD INSTRUMENTS AND EQUIPMENT

The field equipment for each project may include alpha/beta and gamma survey meters; and organic vapor detectors (FID or PID). Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturers. These procedures are included in the technical procedures governing the use of these instruments.

Field instruments will be checked and/or calibrated before they are shipped or carried to the field. Each field instrument will be checked daily against a traceable standard or reference with a known value to ensure that the instrument is in proper calibration. Instruments found to be out of calibration will be recalibrated before use in the field. If an instrument cannot be calibrated, it will be returned to the supplier or manufacturer for recalibration, and a back-up instrument will be used in its place. Calibration checks and calibrations will be documented on the Field Meter/Calibration Log Sheets in the M&TE Log Book. Any maintenance conducted on field equipment must also be documented in the M&TE Log Book.

Critical spare parts such as tapes, papers, and batteries will be kept on site to minimize down time of malfunctioning instruments. Back-up instruments and equipment should be available on site or within 1-day shipment to avoid delays in the field schedules.

12.2 LABORATORY INSTRUMENTS

As part of their QA/QC Program, a routine preventive maintenance program will be conducted by all investigation-associated laboratories to minimize the occurrence of instrument failure and other system malfunctions. All laboratory instruments will be maintained in accordance with manufacturers' specifications and the requirements of the specific method employed. This maintenance will be carried out on a regular, scheduled basis and will be documented in the laboratory instrument service log book for each instrument. Emergency repair or scheduled manufacturer's maintenance will be provided under a repair and maintenance contract with factory representatives.

performance review audits would be conducted by SAIC only at the direction of and in conjunction with the USACE, when requested.

External audits may be conducted in conjunction with or at the direction of the EPA Region or the State of New York regulatory agency.

13.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the SAP, and QAPP. Audits of laboratory activities will include both internal and external audits.

13.1 FIELD AUDITS

Internal audits of field activities (sampling and measurements) will be conducted by the SAIC QA/QC Officer (or designee) and/or Field Team Leader. The audits will include examination of field sampling records, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, COC, etc. These audits will occur at the onset of the project to verify that all established procedures are followed (systems audit).

Performance audits will follow to ensure deficiencies have been corrected and to verify that QA practices/procedures are being maintained throughout the duration of the project work effort. These audits will involve reviewing field measurement records, instrumentation calibration records, and sample documentation.

External audits may be conducted at the discretion of the USACE, the EPA Region, or the State of New York.

13.2 LABORATORY AUDITS

The USACE HTRW CX conducts on-site audits and validates laboratories on a regular basis. These USACE independent on-site systems audits in conjunction with performance evaluation samples qualify laboratories to perform USACE environmental analysis every 24 months.

These system audits include examining laboratory documentation of sample receiving, sample log-in, sample storage, COC procedures, sample preparation and analysis, instrument operating records, etc. Performance evaluation samples are sent to USACE laboratories for on-going assessment of laboratory precision and accuracy. The analytical results of the analysis of performance evaluation samples are evaluated by USACE HTRW CX to ensure that laboratories maintain an acceptable performance.

Internal performance and system audits of laboratories will be conducted by the Laboratory QA Manager as directed in the laboratory QA plan. These system audits will include examination of laboratory documentation of sample receiving, sample log-in, sample storage, COC procedures, sample preparation and analysis, instrument operating records, etc. Internal performance audits are also conducted on a regular basis.

SAIC is not contracted to perform laboratory audits; however, additional audits of laboratories may be planned and budgeted within specific USACE task scopes. These project-specific laboratory

14.3 QUALITY CONTROL SUMMARY REPORTS

At the conclusion of field investigation activities and laboratory analysis, SAIC, in addition to any review conducted by the laboratory, will perform its own validation of the submitted data. This activity will include assignment of flags to data, documentation of the reason(s) for the assignments, and description of any other data discrepancies. SAIC will then prepare a QCSR, which will be included as an appendix to the final report. This report will be submitted to the USACE Project Manager as determined by the project schedule. The contents of the QCSR will include data validation documentation and discussion of all data that may have been compromised or influenced by aberrations in the sampling and analytical processes. Both field and laboratory QC activities will be summarized, and all DQCR information will be consolidated. Problems encountered, corrective actions taken, and their impact on project DQOs will be determined.

The following are examples of elements to be included in the QCSR as appropriate.

- Laboratory QC evaluation and summary of the data quality for each analytical type and matrix. Part of the accuracy, precision, and sensitivity summarized in the data quality assessment.
- Field QC evaluation and summary of data quality relative to data usability. Part of the accuracy, precision, and sensitivity summarized in the data quality assessment.
- Overall data assessment and usability evaluation.
- DQCR consolidation and summary.
- Summary of lessons learned during project implementation.

Specific elements to be evaluated within the QCSR include the following:

- sample results,
- field and laboratory blank results,
- laboratory control sample percent recovery (method dependent),
- sample matrix spike percent recovery (method dependent),
- MS/MSD or sample duplicate RPD (method dependent),
- analytical holding times, and
- surrogate recovery, when appropriate.

An example of the format that will be used by SAIC for preparation of the project QCSR is presented in Figure 14-2.

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FIGURES

FIGURE 2-1
FUSRAP-TONAWANDA LANDFILL SITE
RI/FS
ORGANIZATION CHART

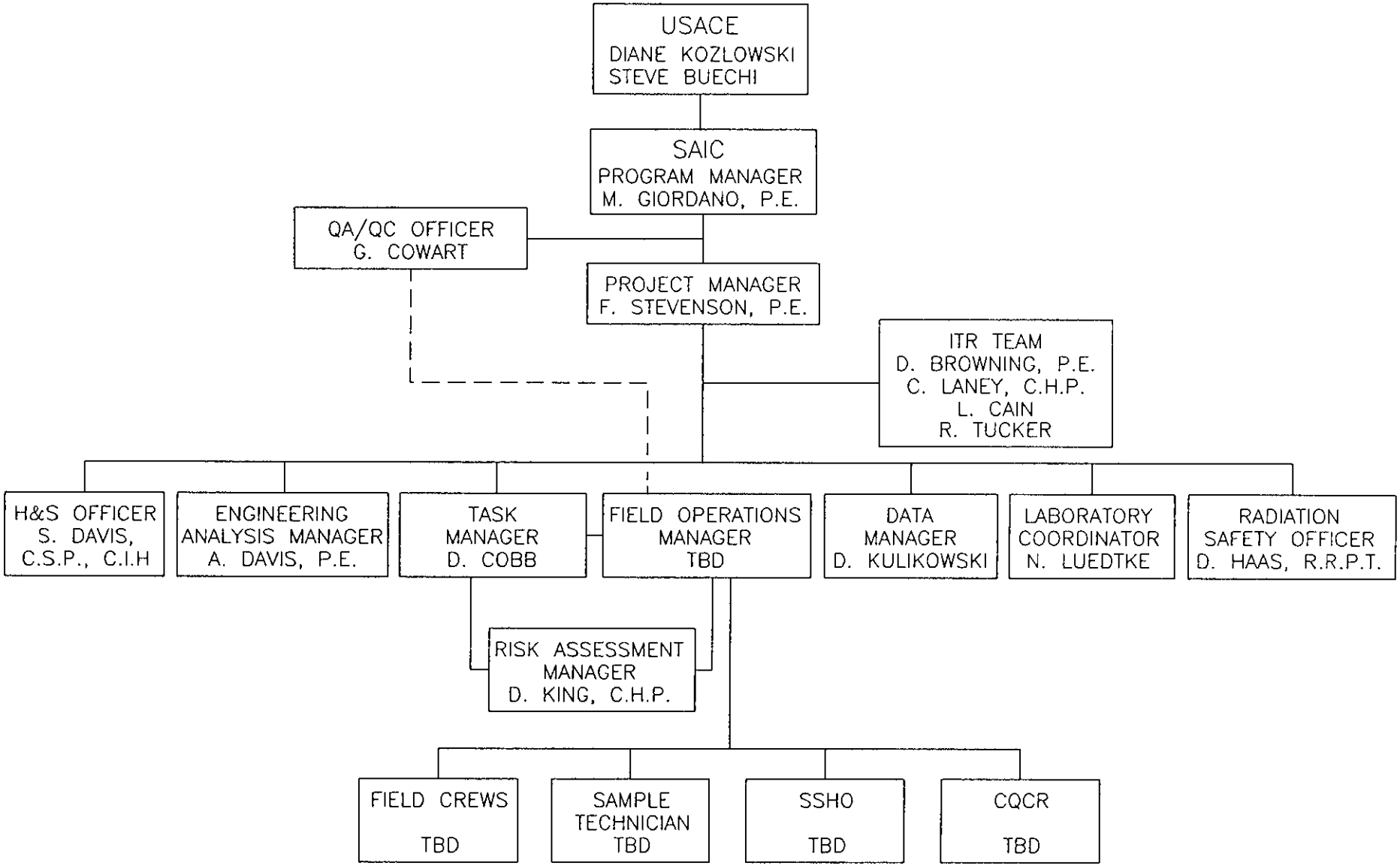

Figure 4-1. Example of a Field Change Request Form

FCO NO _____ DATE INITIATED _____

PROJECT _____

CONTRACT NO. PRIORITY

REQUESTER IDENTIFICATION

NAME _____ ORGANIZATION _____ PHONE _____

TITLE _____ SIGNATURE _____

BASELINE IDENTIFICATION

BASELINE(S) AFFECTED ○ COST ○ SCOPE ○ MILESTONES ○ METHOD OF ACCOMPLISHMENT

AFFECTED DOCUMENT (TITLE, NUMBER AND SECTION)

DESCRIPTION OF CHANGE:

JUSTIFICATION:

IMPACT OF IMPLEMENTING REQUEST:

PARTICIPANTS AFFECTED BY IMPLEMENTING REQUEST:

COST ESTIMATE ($) _____ ESTIMATOR SIGNATURE _____

PHONE _____ DATE _____

PREVIOUS FC AFFECTED ○ YES ○ NO

CLIENT PROJECT MANAGER _____ DATE _____

CLIENT QA SPECIALIST _____ DATE _____

SAIC H&S MANAGER SIGNATURE (IF APPLICABLE) _____ DATE _____

Figure 4-2. Example of a Nonconformance Report

NONCONFORMANCE REPORT

DATE OF NCR

NCR NUMBER

LOCATION OF NONCONFORMING

PAGE 1 OF 1

INITIATOR

FOUND BY

DATE FOUND

RESPONSIBLE ORGANIZATION/INDIVIDUAL

PROGRAM

PROJECT

DESCRIPTION OF NONCONFORMANCE

CATEGORY ____ ____ ____ ____ ____

A

INITIATOR _____ Date _____ QA/QC OFFICER _____ Date _____

YES NO

CAR REQ'D ☐ ☐

B

PROPOSED _____ NAME _____ Date _____

JUSTIFICATION FOR ACCEPTANCE

C

INITIATOR: _____ NAME _____ Date _____

VERIFICATION OF DISPOSITION AND CLOSURE APPROVAL

REINSPECT/RETEST REQUIRED YES ☐ NO ☐ IF YES: _____ Date _____ Result

D

QUALITY ASSURANCE: _____ NAME _____ Date _____

Revision 3, 3/15/96, QAPP 15.1

Figure 5-1. Example of a Chain-of-Custody Form

Science Applications International Corporation
An Employee-Owned Company

800 Oak Ridge Turnpike, Oak Ridge, TN (423) 481-4800

CHAIN OF CUSTODY RECORD

COC NO:

PROJECT NAME:

PROJECT NUMBER:

PROJECT MANAGER:

Sampler (Signature) (Printed Name)

REQUESTED PARAMETERS

LABORATORY NAME:

LABORATORY ADDRESS:

PHONE NO:

Sample ID	Date Collected	Time Collected	Matrix											No. of Bottles/Vials	OVA SCREENING	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS,

RELINQUINSHED BY:	Date/Time	RECEIVED BY:	Date/Time	TOTAL NUMBER OF CONTAINERS:	Cooler Temperature:
COMPANY NAME:		COMPANY NAME:		Cooler ID:	
RECEIVED BY:	Date/Time	RELINQUISHED BY:	Date/Time		
COMPANY NAME:		COMPANY NAME:			
RELINQUINSHED BY:	Date/Time	RECEIVED BY:	Date/Time		
COMPANY NAME:		COMPANY NAME:			

Figure 11-1 Data Validation Form, USACE

DATE: _____

REVIEWER NAME: _____

SIGNATURE: _____

TITLE: _____

DATA VALIDATION CHECKLIST

PROJECT NAME:	
PROJECT NUMBER:	
SAMPLE ID (NUMBERS):	
SAMPLING TEAM:	
SAMPLE MATRIX:	
ANALYSES PERFORMED:	
CESAS DATA REPORTING LEVEL	

FIELD DATA DOCUMENTATION:

FIELD SAMPLING LOGS:	REPORTED		ACCEPTABLE		NOT REQUIRED
	NO	YES	NO	YES	
1. SAMPLING DATES NOTED					
2. SAMPLING TEAM INDICATED					
3. SAMPLE ID TRACEABLE TO LOCATION					
4. SAMPLE LOCATION					
5. SAMPLE DEPTHS FOR SOILS					
6. COLLECTION TECHNIQUE (BAILER, PUMP, ETC.)					
7. SAMPLE TYPE (GRAB, COMPOSITE)					
8. SAMPLE CONTAINER					
9. SAMPLE PRESERVATION					
10. CHAIN OF CUSTODY FORM COMPLETED					
11. REQUIRED ANALYTICAL METHODS					
12. FIELD WATER AND SOIL SAMPLE LOGS					
13. NUMBER OF QA & QC SAMPLES COLLECTED					
14. FIELD EQUIPMENT CALIBRATION					
15. FIELD EQUIPMENT DECONTAMINATION					
16. SAMPLE SHIPPING					

COMMENTS:

_____

_____

_____

_____

Figure 11-1. Data Validation Form, USACE (continued)

LABORATORY DATA VALIDATION:	REPORTED		ACCEPTABLE		NOT REQUIRED
	NO	YES	NO	YES	
1. SAMPLING RESULTS					
2. PARAMETERS ANALYZED					
3. ANALYTICAL METHOD					
4. SAMPLE RECEIPT DATE					
5. SAMPLE PREPARATION DATE					
6. HOLDING TIMES					
7. CALIBRATION					
8. MS/MSD RPD OR SAMPLE LD RPD					
9. SURROGATE SPIKE RESULTS					
10. BLANKS					
A. RINSATES					
B. FIELD BLANKS					
C. TRIP BLANKS					
11. SAMPLE pH					
12. SAMPLE TEMPERATURE					
13. DETECTION LIMITS					
14. QC DATA					
A. INORGANIC					
B. ORGANIC					

ANALYTE: _____

FLAG: _____

REMARKS: _____

OVERALL COMMENTS: _____

DEFINITIONS:

U	Analyte not detected
J	Analyte identified, concentration is estimated value
UJ	Analyte not detected above estimated detection limits
B	Blank contaminated
R	Rejected value, presence or absence of analyte cannot be verified
UR	Rejected detection limits
MS	Matrix Spike
MSD	Matrix Spike Duplicate
RPD	Relative Percent Difference
LD	Laboratory Duplicate

Figure 14-1. Example of the Daily Quality Control Report

DAILY QUALITY CONTROL REPORT

DATE _____

DAY	S	M	T	W	TH	F	S

WEATHER	Bright Sun	Clear	Overcast	Rain	Snow
TEMP	To 32°	32-30°	30-70°	70-85°	85° up
WIND	Still	Moder.	High	Report No.	
HUMIDITY	Dry	Moder.	Humid		

COE PROJECT MANAGER _____

PROJECT _____

JOB NO. _____

CONTRACT NO. _____

SUB-CONTRACTORS ON SITE:

EQUIPMENT ON SITE:

WORK PERFORMED (INCLUDING SAMPLING):

Figure 14-1. (continued)

PROJECT _____ REPORT NO. _____

JOB NO. _____ DATE: _____

QUALITY CONTROL ACTIVITIES (INCLUDING FIELD CALIBRATIONS):
HEALTH AND SAFETY LEVELS AND ACTIVITIES:
PROBLEMS ENCOUNTERED/CORRECTION ACTION TAKEN:
SPECIAL NOTES:
TOMORROW'S EXPECTATIONS:

_____ QA Check by: _____

(Signature and date) (Signature and date)

Figure 14-2 Quality Control Summary Report Format

1. Introduction

    1.1 Project Description
    1.2 Project Objectives
    1.3 Project Implementation
    1.4 Purpose of this Report

2. Quality Assurance Program

    2.1 Monthly Progress Reports
    2.2 Daily Quality Control Reports (DQCRs)
    2.3 Laboratory "Definitive" Level Data Reporting

3. Data Validation

    3.1 Field Data Validation
    3.2 Laboratory Data Validation
    3.3 Definition of Data Qualifiers (Flags)
    3.4 Data Acceptability

4. Data Evaluation

    4.1 Accuracy
        - Metals
        - Radionuclides
        - Water Quality
        - etc.

    4.2 Precision
        - Laboratory Precision
        - Field Precision

    4.3 Sensitivity
    4.4 Representativeness and Comparability
    4.5 Completeness

5. Data Quality Assessment Summary

6. References

TABLES

Table 3-1
Surface Soil/Subsurface Soil DQI Summary

Data Use	Sample Type	Analytical Method	Precision Field Dups	Lab Dups (RPD)[b] / (DER)[a]	Accuracy Laboratory (LCS/MS)[c]	Completeness
Screening for sample site selection	Field	FID/PID Volatile Organics	+/- comparison	NA	+/- 0.1 ppm	95%
	Field	Radiological monitoring	+/- 100 cpm[d]	NA	NA	95%
Gamma Walkover Survey	Field	Radiological monitoring	+/- 100 cpm[d]	NA	NA	95%
Downhole Gamma Scanning	Field	Radiological monitoring	+/- 100 cpm[d]	NA	NA	95%
Confirmation of contamination extent and risk assessment, and determination of waste characteristics	Discrete	Radiochemical various	<50 RPD	<1 DER or <±35% RPD	75-125% recovery	90%
	Discrete	TAL Metals 6010B 7471 (Hg)	<50 RPD	<35 RPD	75-125% recovery	90%
	Discrete	TCL Volatiles 8260B	<50 RPD	<35 RPD	75-125% recovery	90%
	Discrete	TCL SemiVolatiles 8270C	<50 RPD	<35 RPD	75-125% recovery	90%
	Discrete	TCL Pesticides 8081A	<50 RPD	<35 RPD	75-125% recovery	90%
	Discrete	TCL PCBs 8082	<50 RPD	<35 RPD	75-125% recovery	90%
	Discrete	Other Waste Characteristics[e]	NA RPD	<40 RPD	50-150% recovery	90%
	Discrete	Physical Testing[f] ASTM	NA	<40 RPD	NA	90%

DQI = data quality indicator
LCS = laboratory control sample
MS = matrix spike
FID = flame ionization detector
TAL = Target Analyte List
PID = photoionization detector
NA = not applicable
ppm = parts per million
PCBs = polychlorinated biphenyls
TCL = Target Compound List

[a] DER = Duplicate Error Ratio is the ratio of the difference between the duplicate results to the propagated 2 standard deviations uncertainties for the sum of the duplicate results. This is used instead of the RPD for rad results near the detection limit.
[b] RPD = Relative Percent Difference; at values within five times the reporting level, comparison is acceptable when values are plus or minus three times the reporting level.
These DQIs will also apply to waste, investigation-derived waste, air filter, soil gas absorbent, and other solid sample media.
[c] Sample matrix spike percent recovery evaluation is considered applicable only when the spike concentration is at least 25% of the initial sample concentration.
[d] cpm = counts per minute
[e] Other waste characteristics will be delineated in an activity-specific Sampling and Analysis Plan.
[f] Physical testing requirements = moisture content, Atterburg limits, and grain size analysis.

Table 3-2
Groundwater DQI Summary

Data Use	Sample Type	Analytical Method	Precision Field Dups	Lab Dups (RPD)[b] / (DER)[a]	Accuracy Laboratory (LCS/MS)[c]	Completeness
Determination of presence of, and extent of contamination in groundwater. Use for risk assessment.	Discrete	Radiochemical various (Total)	<35 RPD	<1 DER or <±25% RPD	75-125% recovery	90%
Determination of Waste Characteristics for disposal options	Discrete	Waste Characteristics[d]	N/A	<±25% RPD	75-125% recovery	90%

DQO = data quality objective
MS = matrix spike
TCL = Target Compound List
LCS = laboratory control sample
ppm = parts per million
NA = not applicable

[a]DER = Duplicate Error Ratio is the ratio of the difference between the duplicate results to the propagated 2 standard deviations uncertainties for the sum of the duplicate results. This is used instead of the RPD for rad results near the detection limit.
[b]RPD = Relative Percent Difference; at values within five times the reporting level, comparison is acceptable when values are plus or minus three times the reporting level.
[c]Sample matrix spike percent recovery evaluation is considered applicable only when the spike concentration is at least 25% of the initial sample concentration.
[d]Other waste characteristics will be delineated in an activity-specific Sampling and Analysis Plan.

Table 3-3
Analytical/Methods, Parameters, and Project Quantitation Limits

Parameters	Analytical Methods*		Project Quantitation Levels[a]	
	Water	Soil/Solid	Water	Soil
TAL Metals (Total)				
Aluminum	N/A	6010B	N/A	10 mg/kg
Antimony	N/A	6010B	N/A	0.5 mg/kg
Arsenic	N/A	6010B	N/A	0.5 mg/kg
Barium	N/A	6010B	N/A	1 mg/kg
Beryllium	N/A	6010B	N/A	0.1 mg/kg
Cadmium	N/A	6010B	N/A	0.1 mg/kg
Calcium	N/A	6010B	N/A	10 mg/kg
Chromium	N/A	6010B	N/A	0.5 mg/kg
Cobalt	N/A	6010B	N/A	0.5 mg/kg
Copper	N/A	6010B	N/A	0.5 mg/kg
Cyanide, Total	N/A	9012	N/A	0.5 mg/kg
Iron	N/A	6010B	N/A	10 mg/kg
Lead	N/A	6010B	N/A	0.3 mg/kg
Magnesium	N/A	6010B	N/A	10 mg/kg
Manganese	N/A	6010B	N/A	1 mg/kg
Mercury	N/A	7470	N/A	0.1 mg/kg
Nickel	N/A	6010B	N/A	10 mg/kg
Potassium	N/A	6010B	N/A	10 mg/kg
Selenium	N/A	6010B	N/A	0.5 mg/kg
Silver	N/A	6010B	N/A	0.5 mg/kg
Sodium	N/A	6010B	N/A	10 mg/kg
Thallium	N/A	6010B/6020	N/A	0.2 mg/kg
Vanadium	N/A	6010B	N/A	1 mg/kg
Zinc	N/A	6010B	N/A	1 mg/kg
TCL Volatiles				
Acetone	N/A	5035 - 8260B	N/A	1 mg/kg
Benzene	N/A	5035 - 8260B	N/A	1 mg/kg
Bromochloromethane	N/A	5035 - 8260B	N/A	1 mg/kg
Bromodichloromethane	N/A	5035 - 8260B	N/A	1 mg/kg
Bromoform	N/A	5035 - 8260B	N/A	0.1 mg/kg
Bromomethane/Methyl Bromide	N/A	5035 - 8260B	N/A	1 mg/kg
2-Butanone/MEK	N/A	5035 - 8260B	N/A	0.1 mg/kg
Carbon Disulfide	N/A	5035 - 8260B	N/A	1 mg/kg
Carbon Tetrachloride	N/A	5035 - 8260B	N/A	1 mg/kg
Chlorobenzene	N/A	5035 - 8260B	N/A	1 mg/kg
Chloroethane	N/A	5035 - 8260B	N/A	1 mg/kg
Chloroform	N/A	5035 - 8260B	N/A	0.1 mg/kg

Table 3-3
Analytical/Methods, Parameters, and Project Quantitation Limits

Parameters	Analytical Methods*		Project Quantitation Levels[a]	
	Water	Soil/Solid	Water	Soil
Chloromethane/Methyl Chloride	N/A	5035 - 8260B	N/A	1 mg/kg
Dibromochloromethane	N/A	5035 - 8260B	N/A	1 mg/kg
1,2-Dibromo-3-chloropropane	N/A	5035 - 8260B	N/A	1 mg/kg
1,2-Dibromoethane	N/A	5035 - 8260B	N/A	1 mg/kg
1,2-Dichlorobenzene	N/A	5035 - 8260B	N/A	1 mg/kg
1,3-Dichlorobenzene	N/A	5035 - 8260B	N/A	1 mg/kg
1,4-Dichlorobenzene	N/A	5035 - 8260B	N/A	1 mg/kg
1,1-Dichloroethane	N/A	5035 - 8260B	N/A	1 mg/kg
1,2-Dichloroethane	N/A	5035 - 8260B	N/A	1 mg/kg
1,1-Dichloroethene	N/A	5035 - 8260B	N/A	1 mg/kg
cis-1,2-Dichloroethane	N/A	5035 - 8260B	N/A	1 mg/kg
trans-1,2-Dichloroethane	N/A	5035 - 8260B	N/A	1 mg/kg
1,2-Dichloropropane	N/A	5035 - 8260B	N/A	0.1 mg/kg
cis-1,3-Dichloropropene	N/A	5035 - 8260B	N/A	0.01 mg/kg
trans-1,3-Dichloropropene	N/A	5035 - 8260B	N/A	0.01 mg/kg
Ethylbenzene	N/A	5035 - 8260B	N/A	1 mg/kg
2-Hexanone	N/A	5035 - 8260B	N/A	1 mg/kg
Methylene Chloride	N/A	5035 - 8260B	N/A	0.1 mg/kg
4-Methyl-2-Pentanone/ MIBK	N/A	5035 - 8260B	N/A	0.1 mg/kg
Styrene	N/A	5035 - 8260B	N/A	1 mg/kg
1,1,2,2-Tetrachloroethane	N/A	5035 - 8260B	N/A	0.01 mg/kg
Tetrachloroethene	N/A	5035 - 8260B	N/A	0.1 mg/kg
Toluene	N/A	5035 - 8260B	N/A	1 mg/kg
1,1,1-Trichloroethane	N/A	5035 - 8260B	N/A	1 mg/kg
1,1,2-Trichloroethane	N/A	5035 - 8260B	N/A	0.1 mg/kg
Trichloroethene	N/A	5035 - 8260B	N/A	0.1 mg/kg
Vinyl Chloride	N/A	5035 - 8260B	N/A	0.1 mg/kg
Xylenes (total)	N/A	5035 - 8260B	N/A	1 mg/kg
TCL Semivolatiles				
Acenapthene	N/A	8270C	N/A	1 mg/kg
Acenapthylene	N/A	8270C	N/A	1 mg/kg
Anthracene	N/A	8270C	N/A	1 mg/kg
Benzo(a)anthracene	N/A	8270C	N/A	0.1 mg/kg
Benzo(b)fluoranthene	N/A	8270C	N/A	0.1 mg/kg
Benzo(k)fluoranthene	N/A	8270C	N/A	0.1 mg/kg
Benzo(ghi)perylene	N/A	8270C	N/A	0.1 mg/kg
Benzo(a)pyrene	N/A	8270C	N/A	0.1 mg/kg
bis(2-Chloroethoxy)methane	N/A	8270C	N/A	1 mg/kg

Table 3-3
Analytical/Methods, Parameters, and Project Quantitation Limits

Parameters	Analytical Methods*		Project Quantitation Levels[a]	
	Water	Soil/Solid	Water	Soil
bis(2-Chloroethyl)ether	N/A	8270C	N/A	1 mg/kg
bis(2-Ethylhexyl)phthalate	N/A	8270C	N/A	1 mg/kg
4-Bromophenyl phenyl ether	N/A	8270C	N/A	1 mg/kg
Butyl Benzyl Phthalate	N/A	8270C	N/A	1 mg/kg
4-Chloroaniline	N/A	8270C	N/A	1 mg/kg
p-Chloro-m-Cresol	N/A	8270C	N/A	1 mg/kg
2-Chloronapthalene	N/A	8270C	N/A	1 mg/kg
2-Chlorophenol	N/A	8270C	N/A	1 mg/kg
4-Chlorophenyl Phenyl Ether	N/A	8270C	N/A	1 mg/kg
Chrysene	N/A	8270C	N/A	1 mg/kg
o-Cresol/2-Methylphenol	N/A	8270C	N/A	1 mg/kg
p-Cresol/4-Methylphenol	N/A	8270C	N/A	1 mg/kg
Di-n-butyl Phthalate	N/A	8270C	N/A	1 mg/kg
Dibenz(a,h)anthracene	N/A	8270C	N/A	0.1 mg/kg
Dibenzofuran	N/A	8270C	N/A	1 mg/kg
3,3'-Dichlorobenzidine	N/A	8270C	N/A	1 mg/kg
2,4-Dichlorophenol	N/A	8270C	N/A	1 mg/kg
Diethyl Phthalate	N/A	8270C	N/A	1 mg/kg
2,4-Dimethylphenol	N/A	8270C	N/A	1 mg/kg
Dimethyl Phthalate	N/A	8270C	N/A	1 mg/kg
4,6-Dinitro-2-methylphenol	N/A	8270C	N/A	1 mg/kg
2,4-Dinitrophenol	N/A	8270C	N/A	1 mg/kg
2,4-Dinitrotoluene	N/A	8270C	N/A	1 mg/kg
2,6-Dinitrotoluene	N/A	8270C	N/A	1 mg/kg
Di-n-octyl phthtalate	N/A	8270C	N/A	1 mg/kg
Fluoranthene	N/A	8270C	N/A	1 mg/kg
Fluorene	N/A	8270C	N/A	1 mg/kg
Hexachlorobenzene	N/A	8270C	N/A	1 mg/kg
Hexachlorobutadiene	N/A	8270C	N/A	1 mg/kg
Hexachlorocyclopentadiene	N/A	8270C	N/A	1 mg/kg
Hexachloroethane	N/A	8270C	N/A	1 mg/kg
Indeno(1,2,3-cd)pyrene	N/A	8270C	N/A	1 mg/kg
Isophorone	N/A	8270C	N/A	1 mg/kg
2-Methylnapthalene	N/A	8270C	N/A	1 mg/kg
Napthalene	N/A	8270C	N/A	1 mg/kg
2-Nitroaniline	N/A	8270C	N/A	1 mg/kg
3-Nitroaniline	N/A	8270C	N/A	1 mg/kg
4-Nitroaniline	N/A	8270C	N/A	1 mg/kg
Nitrobenzene	N/A	8270C	N/A	1 mg/kg
2-Nitrophenol	N/A	8270C	N/A	1 mg/kg

Table 3-3
Analytical/Methods, Parameters, and Project Quantitation Limits

Parameters	Analytical Methods*		Project Quantitation Levels[a]	
	Water	Soil/Solid	Water	Soil
4-Nitrophenol	N/A	8270C	N/A	1 mg/kg
n-Nitrosodiphenylamine	N/A	8270C	N/A	1 mg/kg
n-Nitrosodipropylamine	N/A	8270C	N/A	1 mg/kg
2-2'-Oxybis(1-chloropropane)	N/A	8270C	N/A	1 mg/kg
Pentachlorophenol	N/A	8270C	N/A	1 mg/kg
Phenanthrene	N/A	8270C	N/A	1 mg/kg
Phenol	N/A	8270C	N/A	1 mg/kg
Pyrene	N/A	8270C	N/A	1 mg/kg
1,2,4-Trichlorobenzene	N/A	8270C	N/A	1 mg/kg
2,4,5-Trichlorophenol	N/A	8270C	N/A	1 mg/kg
2,4,6-Trichlorophenol	N/A	8270C	N/A	1 mg/kg
TCL Pesticides/PCBs				
Aldrin	N/A	8081A	N/A	0.01 mg/kg
alpha-BHC	N/A	8081A	N/A	1 mg/kg
beta-BHC	N/A	8081A	N/A	0.1 mg/kg
gamma-BHC (Lindane)	N/A	8081A	N/A	1 mg/kg
delta-BHC	N/A	8081A	N/A	1 mg/kg
alpha-Chlordane	N/A	8081A	N/A	1 mg/kg
gamma-Chlordane	N/A	8081A	N/A	1 mg/kg
4,4'-DDT	N/A	8081A	N/A	1 mg/kg
4,4'-DDE	N/A	8081A	N/A	1 mg/kg
4-4'-DDD	N/A	8081A	N/A	1 mg/kg
Dieldrin	N/A	8081A	N/A	0.01 mg/kg
Endosulfan I	N/A	8081A	N/A	0.01 mg/kg
Endosulfan II	N/A	8081A	N/A	0.01 mg/kg
Endosulfan Sulfate	N/A	8081A	N/A	0.01 mg/kg
Endrin	N/A	8081A	N/A	0.01 mg/kg
Endrin Aldehyde	N/A	8081A	N/A	1 mg/kg
Endrin Ketone	N/A	8081A	N/A	0.1 mg/kg
Heptachlor	N/A	8081A	N/A	0.1 mg/kg
Heptachlor Epoxide	N/A	8081A	N/A	0.1 mg/kg
Methoxychlor	N/A	8081A	N/A	1 mg/kg
Aroclor 1016	N/A	8082	N/A	1 mg/kg
Aroclor 1221	N/A	8082	N/A	1 mg/kg
Aroclor 1232	N/A	8082	N/A	1 mg/kg
Aroclor 1242	N/A	8082	N/A	1 mg/kg
Aroclor 1248	N/A	8082	N/A	1 mg/kg
Aroclor 1254	N/A	8082	N/A	1 mg/kg

Table 3-3
Analytical/Methods, Parameters, and Project Quantitation Limits

Parameters	Analytical Methods*		Project Quantitation Levels[a]	
	Water	Soil/Solid	Water	Soil
Aroclor 1260	N/A	8082	N/A	1 mg/kg
Toxaphene	N/A	8081A	N/A	1 mg/kg
Radiochemical Parameters				
Iso-Uranium 234, 235, 238	Radiochemical Separation/Alpha Spectrometry [b]	Radiochemical Separation/Alpha Spectrometry [b]	1 pCi/L	1 pCi/g
Iso-Thorium 228, 230, 232	Radiochemical Separation/Alpha Spectrometry [b]	Radiochemical Separation/Alpha Spectrometry [b]	1 pCi/L	1 pCi/g
Radium 226	EPA 903.1 Rn Emanation Method[b]	Radiochemical Separation/Rn Emanation Method[b] or Gamma Spectrometry[b]	0.5 pCi/L	0.5 pCi/g
Radium 228	EPA 904.0 Method or equivalent[b]	Radiochemical Separation/Beta Count[b]	1 pCi/L	1 pCi/g
Gross Alpha and Gross Beta	EPA 900.0 method or equivalent[b]	Gas Proportional or Liquid Scintillation Counting[b]	1 pCi/L	1 pCi/g
Gamma Spectroscopy (Isotope identification) (Including Am-241)	Gamma Spectrometry[b]	Gamma Spectrometry[b]	1 pCi/L (Not including Am-241)	1 pCi/g
Total Activity	Liquid Scintillation/^{99}Tc Calibration[b]	Liquid Scintillation/^{99}Tc Calibration[b]	10 pCi/L	10 pCi/g
Total Uranium	KPA or Fluorometry	N/A	10 μg/L	N/A

Table 3-3
Analytical/Methods, Parameters, and Project Quantitation Limits

[a]These are expected quantitation limits based on reagent-grade water or a purified solid matrix. Actual quantitation limits may be higher depending upon the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample volume or weight, percent solids (where applicable), and the dilution factor, if any. The quantitation limits for additional analytes to this list may vary, depending upon the results of laboratory studies. All solids will be reported on a dry-weight basis, with the associated sample percent moisture reported separately.

[b]Laboratory-specific procedures, shall be conducted in accordance with the specified EPA-600/4-80-032 *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, August 1980; EPA SW-846 *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, December 1987; EPA 520/5-84-006 *Eastern Environmental Radiation Facility Radiochemistry Procedures Manual*, August 1984; EML HASL-300 *Environmental Measurements Laboratory Procedure Manual*, 26th or 27th editions; LA-10300-M *Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance*, October 1996; ISBN-157477-021-7 *DOE Methods for Evaluating Environmental and Waste Management Samples - 1997 edition*; any appropriate ASTM methods; or any additional project-approved methods.

* SW-846 Methods unless otherwise specified

Table 4-1a
Sample Numbers and Types – Surface/Subsurface Soil and Sediment
TOTAL

Parameters	Field Samples	Field Duplicate Samples	Site Source Water	Sampler Rinsates	Trip Blanks	Total A&E Samples
Radiochemical – various (soil)	702	70	2	5	0	779
Radiochemical – various (sediment)	3	1	0	1	0	5
TAL Metals – various	70	7	2	5	0	84
TCL Volatiles – 8260B	70	7	2	5	28	112
TCL SemiVolatiles – 8270C	70	7	2	5	0	84
TCL Pesticides/ PCBs - 8080	70	7	2	5	0	84
Other Waste Characteristics [a]	2	N/A	N/A	N/A	1	3
Physical Testing [b] ASTM	10	1	N/A	N/A	N/A	11

[a]Other waste characteristics will be delineated in an activity-specific Sampling and Analysis Plan
[b]Atterburg limits, Grain Size, Moisture Content.
Additional QA samples for analysis by USACE QA Laboratory to be designated by USACE

Table 4-1b
Sample Numbers and Types – Surface/Subsurface Soil and Sediment
LANDFILL OPERABLE UNIT

Parameters	Field Samples	Field Duplicate Samples	Site Source Water	Sampler Rinsates	Trip Blanks	Total A&E Samples
Radiochemical – various (soil)	441	44	1	3	0	489
Radiochemical – various (sediment)	3	1	0	1	0	5
TAL Metals – various	44	4	1	3	0	52
TCL Volatiles – 8260B	44	4	1	3	18	70
TCL SemiVolatiles – 8270C	44	4	1	3	0	52
TCL Pesticides/ PCBs - 8080	44	4	1	3	0	52
Other Waste Characteristics[a]	1	N/A	N/A	N/A	1	2

[a]Other waste characteristics will be delineated in an activity-specific Sampling and Analysis Plan
Additional QA samples for analysis by USACE QA Laboratory to be designated by USACE
Physical testing listed on Table 4-2.

Table 4-1c
Sample Numbers and Types – Surface/Subsurface Soil and Sediment
MUDFLATS OPERABLE UNIT

Parameters	Field Samples	Field Duplicate Samples	Site Source Water	Sampler Rinsates	Trip Blanks	Total A&E Samples
Radiochemical – various (soil)	261	26	1	2	0	290
TAL Metals – various	26	3	1	2	0	32
TCL Volatiles – 8260B	26	3	1	2	10	42
TCL SemiVolatiles – 8270C	26	3	1	2	0	32
TCL Pesticides/ PCBs - 8080	26	3	1	2	0	32
Other Waste Characteristics[a]	1	N/A	N/A	N/A	0	1

[a]Other waste characteristics will be delineated in an activity-specific Sampling and Analysis Plan
Additional QA samples for analysis by USACE QA Laboratory to be designated by USACE

Table 4-2
Sample Numbers and Types – Groundwater and Surface Water /Geotech

Parameters	Field Samples	Field Duplicate Samples	Site Source Water	Sampler Rinsates	Trip Blanks	Total A&E Samples
Radiochemical various (Total)	16*	2	1	1	0	20
Radiochemical various (Dissolved)**	16*	2	1	0	0	19
Other Waste Characteristics [a]	1	N/A	N/A	N/A	1	2
Soil – Physical Testing ASTM[b]	10	1	N/A	N/A	N/A	11

[a]Other waste characteristics will be delineated in an activity-specific Sampling and Analysis Plan
Additional QA samples for analysis by USACE QA Laboratory to be designated by USACE
[b]Atterburg limits, Grain Size, Moisture Content.
*13 groundwater, 3 surface water
**0.45 mm field filters

Table 4-3.
Container Requirements for Samples

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Surface/Subsurface Soil/Sediment				
TCL Volatiles	2 - 40 mL VOA or Encore Sampler	5 g	MeOH (VOCs > 200 μg/kg) Sodium Bisulfide (VOCs < 200 μg/kg) or None, 4°C (if use Encore)	30 d 30 d 48 h (extract)
TCL Semivolatiles	1 - 4 oz wide mouth glass jar with Teflon lined cap	100 g	Cool, 4°C	40 d
TCL Pesticides/PCBs	1 - 8 oz glass jar with Teflon-lined cap	90 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
TAL Metals - Total	1 - 4oz wide mouth plastic or glass jar	20 g	Cool, 4°C	180 d, Hg at 28 d
Radionuclides	1 - 16 oz wide mouth glass jar with Teflon-lined cap	200 g	Cool, 4°C	180 d (isotope dependant)
Geotechnical Parameters	1 - 16 oz wide mouth glass jar with Teflon lined cap	500 g	None	N/A
Groundwater/Surface Water				
Radiochemical Parameters - Total	1 - 1 gal polybottle (unfiltered)	1000 mL	HNO_3 to pH <2 Cool, 4°C	180 d (isotope dependant)
Radiochemical Parameters - Dissolved	1 - 1 gal polybottle (0.45 μm filter)	1000 mL	HNO_3 to pH <2 Cool, 4°C	180 d (isotope dependant)
Total Alpha	4 - 1 L glass (unfiltered)	1 gallon	HNO_3, 4°C	180 d
Dissolved Alpha	4 - 1 L glass (0.45 μm filter)	1 gallon	HNO_3, 4°C	180 d

Table 4-4
Sample Numbering Scheme for the Town of Tonawanda Landfill

Sample Identification: XXX-AAAAmmNNNNnnz	
XXX = Site Designator	Site designators used for the project will be as follows: Town of Tonawanda Landfill = TLF Town of Tonawanda Mudflats = TMF
AAAA = Project Designator	The Project Designator used for this project will be TLSC-Tonawanda Landfill Site Characterization
mm = Sample Media	Examples Soil Sample = SS Groundwater Sample = GW
NNNN = Sample Number	The Field Manager will maintain a listing of four digit station identifiers and correlate them to specific sampling/station locations. Numbers from 0 to 8999 indicate regular samples. Numbers from 9001 to 9999 indicate duplicates.
nnn = Sample Interval	Examples 005 = 0 to 0.5 foot sample interval (surface sample) 010 = 0.5 to 1 foot sample interval 040 = 3.5 to 4 foot sample interval 075 = 7 to 7.5 foot sample interval 100 = 9.5 to 10 foot sample interval For groundwater samples, the interval shall be specified as "000".
z = Sample Type	Examples 0 = Regular 1 = Duplicate 2 = Split 3 = Trip Blank 4 = Equipment Rinsate 5 = Site Source Water Blank

Table 5-1. Example of a Cooler Receipt Checklist

COOLER RECEIPT CHECKLIST

LIMS number _____ Chain-of-Custody No. _____

Project: _____ Date received: _____

A. Preliminary Examination Phase Date cooler(s) opened: _____

by (print) _____ (signature) _____

Circle response below as appropriate

1. Did cooler(s) come with a shipping slip (airbill, etc.)? ..... Yes No NA

If YES, enter courier name & airbill number here: _____

2. Were custody seals on outside of cooler(s)? ..... Yes No NA

How many & where: _____ Seal date: _____ Seal name: _____

3. Were custody seals unbroken and intact at the date and time of arrival? ..... Yes No NA

4. Did you screen samples for radioactivity using a Geiger Counter? ..... Yes No NA

5. Were custody papers sealed in a plastic bag & taped inside the cooler lid? ..... Yes No NA

6. Were custody papers filled out properly (ink, signed, etc.)? ..... Yes No NA

7. Did you sign custody papers in the appropriate place for acceptance of custody? ..... Yes No NA

8. Was project identifiable from custody papers? ..... Yes No NA

9. If required, was enough ice present in the cooler(s)? ..... Yes No NA

Identify type of ice used in cooler and temperature reading upon receipt: _____

Source of temperature reading (check one): Temperature Vial ( ) Sample Material ( )

10. Initial and date this form to acknowledge receipt of cooler(s): (initial) _____ (date) _____

B. Log-In-Phase Date samples were logged in: _____

by (print) _____ (signature) _____

11. Describe type of packing in cooler(s): _____

12. Were all bottles sealed in separate plastic bags? ..... Yes No NA

13. Did all bottles arrive unbroken & were labels in good condition? ..... Yes No NA

14. Was all required bottle label information complete? ..... Yes No NA

15. Did all bottle labels agree with custody papers? ..... Yes No NA

16. Were correct containers used for the analyses indicated: ..... Yes No NA

17. Were correct preservatives placed into the sample containers? ..... Yes No NA

18. Was a sufficient amount of sample sent for the analyses required? ..... Yes No NA

19. Were bubbles absent in VOA vials? ..... Yes No NA

If no, list by sample number: _____

20. Has a copy of this Cooler Receipt Checklist been faxed to the SAIC Laboratory Coordinator? ..... Yes No NA

Table 11-1 Summary of Analytical Hard-Copy Data Deliverables

Method Requirements	Deliverables
Requirements for all methods:	
- Holding time information and methods requested	Signed chain-of-custody forms
- Discussion of laboratory analysis, including any laboratory problems	Case narratives
Wet Chemistry	
- Sample results	Report result
- Matrix spike recovery	%Recovery
- Matrix spike duplicate or duplicate	%Recovery and %RPD
- Method blank	Report results
- Initial calibration	Calibration curve and correlation coefficient
- Continuing calibration check	Recovery and % difference
- LCS	LCS result and control criteria
- Run log	Copy of run log
Radiochemical Analysis	
- Sample results	Report results
- Initial calibration	Efficiency determination
- Efficiency check	%Difference from calibration
- Background determinations	Report results
- Spike recover results	Report results
- Internal standard results (tracers or carriers)	Report results
- Duplicate results	Spike added and %Recovery
- Self-absorption factor (α,β)	Standard added and %Recovery
- Cross-talk factor (α,β)	Report results and %RPD
- LCS	Report factors
- Run log	Report factors and control criteria
	LCS results and control criteria
	Copy of run log

CLP = contract laboratory program
GFAA = graphite furnace atomic absorption
LCS = laboratory control sample
RPD = relative percent difference
RSD = relative standard deviation

Table 11-2 Standard Electronic Data Deliverables

Column Position	Length	Field Description
Header Record		
1-20	20	SAIC Project Number
21-28	8	Data Submission Date (MM/DD/YY)
29-33	6	Number of Records (Rows) in the file including header and terminating records
34-74	40	Submitting Laboratory Name
Detail Record		
1-20	20	SAIC Sample Identification Number
21-28	8	Date of Sample Collection (MM/DD/YY)
29-33	5	Time of Sample Collection (HH:MM military format)
34-48	15	Laboratory Analytical Batch/Sample Delivery Group (SDG) Number
49-56	8	Sample Matrix
57-76	20	Laboratory Sample Identification Number
77-84	8	Sample Extraction/Preparation Date (MM/DD/YY)
85-92	8	Sample Analysis Date (MM/DD/YY)
93-97	5	Sample Analysis Time (HH:MM military format)
98-100	3	Analysis/Result Type - This field is used to designate the type of analysis performed. Valid values are as follows: REG = Regular Sample Analysis DUP = Laboratory Duplicate Analysis DIL = Secondary Dilution Analysis REn = Re-analysis where "n" is a sequential number
101-112	12	Chemical Abstract Services (CAS) Number
113-142	30	Analysis Name
143-157	15	Analysis Method (Method numbers shall be the EPA, SW-846, NIOSH, etc. method number)
158-167	10	Result (Report detection limit if not detected)
168-177	10	Radiological Counting Error
178-182	5	Result Qualifier (U, J, etc.)
183-190	8	Unit of measure
191-200	10	Instrument Detection Limit
201-205	5	Percent Solids (Report "0" for water matrices)
206-300	5	Sample Weight/Volume
301-302	2	Sample Weight/Volume Units
303-307	5	Dilution
Termination Record		
1-3	3	$$$

Electronic deliverables must have file structure defined in this table. The deliverable file may be either an ASCII text file, a dBASE compatible file (.DBF file extension), or an Excel spread sheet file (.XLS file extension). All fields must be presented. Fields that are not applicable for the reported method shall be reported as blank. Data shall be provided on a CD-ROM in a searchable PDF format.

APPENDIX A

DATA MANAGEMENT PLAN

A.1.0 INTRODUCTION

This appendix to the Town of Tonawanda Landfill Quality Assurance Project Plan (QAPP) represents the Data Management Plan (DMP) for project activities to be performed by Science Applications International Corporation (SAIC) for the Town of Tonawanda Landfill. This plan describes the data management process to be implemented for this project. The DMP presents the process used for the planning, collection, tracking, verification, validation, analysis, presentation, and storage of data. The plan identifies required data documentation materials and procedures, as well as project file requirements. The plan also provides the reporting requirements for presenting the raw data and conclusions of the investigation.

The characterization activities planned for these sites will produce a large amount of information. The information collected is critical for several reasons. Because the proposed work plan is a dynamic work plan, information collected during the course of the site characterization will influence the course of the characterization work. All data will be maintained in electronic files. The information collected will provide the foundation for determining the nature and extent of contamination at the site, for assessing the risks associated with potential contaminants of concern at the site, and for evaluating potential remedial actions. This section describes the data acquisition, management, and analysis requirements for the site investigation efforts.

Project activities will generate data, including sample locations, measurements of field parameters, and results of sample analyses and data reviews. Important records regarding the collection and analysis of the samples and data will also be generated. The data management process requires the proper flow of data from field collection and processing by the analytical laboratory to those involved in the project evaluation and decision making. This DMP will ensure the validity and accessibility of data to support environmental data analysis and the evaluation of corrective measures.

A.2.0 INVESTIGATION DATA

A.2.1 DATA TYPES

Data acquisition activities associated with site characterizations fall into ten broad categories:

1. Existing historical information, including photographs and the results from any previous characterization activities at the site.
2. Mapping data (including survey data from surveying crews).
3. Gradation walkover data.
4. Discrete sample results.

5. Organic screening data.

6. Secondary borehole information.

7. Gamma exposure measurement data.

8. Critical project records.

A.2.1.1 Historical Information

Significant historical information exists for this site. This information is included in reports documenting past investigations and discrete soil analytical results. Most of the analytical results exist in electronic format. SAIC has reviewed the historical data reports.

A.2.1.2 Mapping Data

Mapping data will be collected during the course of the program. These data will be input into the geographical database along with previously created mapping data. The primary issue associated with mapping data is the issue of ensuring that the various data sets that include spatial location information are consistent relative to each other.

The base coordinate system for the characterization work is NY State Plane. All data produced by this characterization effort will be delivered in NY State Plane. Elevation data (e.g., ground surface elevations) will be in feet above mean sea level. Depth data (e.g., depth to water table measurements, or depth to samples) will be in feet below a known elevation reference point.

Survey monuments will be established at key locations across the site to facilitate the establishment of local grids and the implementation of spatial accuracy quality assurance/quality control (QA/QC) techniques. These monuments may be based on established site features (i.e., building corners, large rocks, trees, etc.) or may be introduced. All monuments will be appropriately marked in the field so that they are readily identifiable, will be tagged with their name and NY State Plane location, and will have their positions in NY State Plane recorded electronically. The subcontractor responsible for the civil survey will provide the project with a hard-copy report and an electronic copy of the civil survey.

In certain instances (i.e., nonintrusive geophysical surveys and gamma walkover surveys), it may be advantageous to work with local coordinate systems. In the event that local coordinate systems are used, these local coordinate systems will be tied to at least three established monuments and the final data deliverables will be transformed into the NY State Plane requirement.

The base level of accuracy for all mapping work at the site is 0.1 ft for horizontal coordinates and 0.1 ft for general vertical measurements. If methodologies are used to determine locations that cannot guarantee a locational error of less than 0.1 ft horizontally or 0.1 ft vertically, these data will be

recorded by field staff at the time of probe completion. These data typically are hand entered in field notebooks during the completion of the probe.

These field notebooks will be maintained in a logical and reasonable manner. All data collected in the field log books (i.e., screening results, depth-to-water table data, soils information, etc.) will be entered directly into an appropriate FEIMS table. These data will be used for archiving and dissemination purposes.

A.2.1.5 Gamma Exposure Measurement Data

Limited gamma exposure measurement data will be collected from locations identified in the site SAP Addendum prior to the commencement of intrusive field sampling activities. The results from these data will be entered into the appropriate FEIMS data table and made available to the investigating team. Maps indicating the locations where the measurements were taken will also be provided. Locations will be provided in NY State Plane.

A.2.1.6 Critical Project Records

Critical project records such as survey reports, COC forms, laboratory data packages, and validation results will be maintained in accordance with Section A.4.8.

A.2.2 KEY IDENTIFIERS

The key identifiers for project sampling data will be the sample location/station and a unique sample identification number. All samples will be assigned an area and station to identify the specific point where the field measurements or samples were collected. Descriptions, geographic coordinates, and elevations will be obtained for these sampling stations.

Unique sample numbers are derived from the location, sampling station within the location, sample medium, and sample type, plus a sequential number. Field duplicates represent a separate sample type, and distinct depths receive different sequential numbers so no duplication of sample numbers will occur. The sample identification will appear on the sample collection log sheet, sample label, COC form, and on any correspondence related to the sample. Additional information regarding sample identification is presented in the SAP.

Measurements not associated with physical samples (walkover surveys) will be identified by the coordinates of the measurement location NY State Plane and the date and time of measurement.

A.3.0 DATA MANAGEMENT SYSTEM

The data management system facilitates the information flow by providing a means of tracking, organizing, reporting, and archiving data and information. The system has four primary components:

(1) A multi-disciplinary team of data management professionals.

(2) A process model that integrates activities relevant to ensuring that data are complete, consistent, and fully qualified, and minimizes the uncertainties associated with the data, data products, or interpretations of results.

(3) Guidance provided in the SAIC *Quality Assurance Technical Procedures Volume I: Data Management*.

(4) A standardized database structure to support the collection, management, analysis, and presentation of site characterization data.

To facilitate management of the data collected a table, such as Table A-1, which identifies each data type, data source, location, and responsible person, should be completed.

Table A-1. Data Matrix

Data Type	Data Source	Location	Responsibility[a]

[a]Person managing the Formerly Utilized Sites Remedial Action Program data set.

A.4.0 DATA MANAGEMENT AND TRACKING PROCESS

To meet the regulatory requirements for the acquisition of technically sound and legally admissible data, a traceable audit trail will be established from the development of the project work plan through the archiving of information and data. Each step or variation of the sampling and analytical process will be documented. Standardized formats for electronic transfer and reporting will be used. To meet this requirement, the following data management process will be followed throughout the collection, management, storage, analysis, and presentation of the site environmental data.

A.4.1 SAMPLING AND ANALYSIS PLANNING

Plans for the collection of field and laboratory quality control samples are detailed in the FSP and QAPP. These plans together specify all applicable sampling and analytical data that will be entered into the database.

The interface with the analytical laboratory is crucial for achieving the goal of generating technically sound data. Based upon the laboratory data quality objectives presented in the QAPP, the laboratory statement of work details analytical methods, validation criteria, deliverables, and deliverable formats required of the analytical laboratory. The analytical laboratories that have been contracted for chemical and radiological testing are identified in the QAPP.

Prior to initiating field work, an activity-specific project database will be populated with sample locations, sample numbers, analytical parameters and detection limits, and associated sampling and laboratory information based on the requirements of the SAP. A report of all planned samples will be generated for review by the SAIC Field Operations Manager (FOM). After approval of this report, the data coordinator will generate field sampling forms including preprinted sample information, bind and number the logbooks, and print and organize the required sample labels. This process will increase the accuracy of the final database and minimize the amount of information samplers must record in the field.

A.4.2 FIELD SAMPLE COLLECTION AND MEASUREMENT

Prior to beginning field sampling, field personnel will be trained as necessary and participate in a project-specific readiness review. These activities ensure that standard procedures will be followed in sample collection and in completing field logbooks, COC forms, labels, and custody seals. Documentation of training and readiness is submitted to the project file.

The master field investigation document will be site field logbooks. The primary purpose of these documents is to record each day's field activities; personnel on each sampling team; and any administrative occurrences, conditions, or activities that may have affected the field work or data quality of any environmental samples for any given day.

Each field sampling team will have a field logbook in which it will record data collected in the field. To the extent possible, preprinted field logbook sheets will be generated from the data management system. If preprinted logbook sheets are not used for a given sample, required information will be recorded manually. As samples are collected in the field, the field sampling team members will complete the logbooks with sample collection data and required field measurements as specified in the SAP and QAPP. Standardized reporting formats will be used to document this information.

The field logbooks will be signed and dated by the data recorder and will specify whether field methods and procedures were followed. Entries will be verified by a sampling team member other than the

recorder, or by the SAIC FOM, who will perform a quality assurance (QA) review and sign and date the logbook to document the review.

Backup photocopies of the field logbooks will be made and submitted to the project file. Sample collection and measurement information from the logbooks and data forms will be manually entered into the database and checked for accuracy. Entries will be verified by using double entry and comparing protocols. As necessary, the actual forms used will be modified to include the appropriate information codes to facilitate data entry. Completed logbooks and appropriate field forms will be submitted to the project file upon completion of the project.

At any point in the process of sample collection or data or document review, a Nonconformance Report (NCR) may be initiated if nonconformances are identified, and data entered into the database may be flagged accordingly. Additional information regarding NCRs is presented in Section 10.0 of the QAPP and the SAP.

A.4.3 CHAIN-OF-CUSTODY DOCUMENTATION

Sample containers will be tracked from field collection activities to the analytical laboratory following proper COC protocols and using standardized COC forms.

When the samples are received at the laboratory, the laboratory receiving staff will check and document the condition of the samples upon arrival, check that the sample identification numbers on containers and COC forms match, and assign laboratory sample identification numbers traceable back to the field identification numbers. Within 24 hours of receipt of the sample containers, the laboratory will send a letter of receipt (LOR) to the SAIC Laboratory Coordinator or his designee. This letter will provide the following information:

- sample receipt date,
- problems noted at the time of receipt,
- list of sample identification numbers and corresponding laboratory identification numbers for all samples received,
- analyses requested for each sample received, and
- completed cooler receipt checklists for each cooler received.

The LOR will be accompanied by the completed and signed COCs for the samples, and both documents will be submitted to the project file. Sample information recorded on the COC form and in the LOR will be entered into the sample tracking database. This database will allow for tracking of the status of samples from the time of collection through analysis and validation. The database tracking program will produce reports that will inform the project team of potential delays or problems related to sample analysis and validation.

A.4.4 ANALYTICAL LABORATORY DOCUMENT AND DATA SUBMISSION

Prior to release of a data package, the Laboratory Project Manager will review the data package for precision, accuracy, and completeness and will attest that it meets all data analysis and reporting requirements for the specific method used. The Laboratory Project Manager will then sign the hard copy forms certifying that the data package and any electronic format deliverables were reviewed and are approved for release.

Analytical results will be submitted to the SAIC Laboratory Coordinator, or designee, on standardized forms in data packages in accordance with the scope of work for analytical services. These forms will contain results and required QA/QC information applicable to the analytical laboratory method used for analysis. In addition, as required by the scope of work, results of analyses will also be provided in electronic format on diskettes. The data coordinator receiving laboratory deliverables will make a copy of each data package and/or diskette and submit the originals to the project file. Results will be transferred to the database either electronically by diskette or manually from the hard copy into appropriate data tables within the database.

A.4.5 DATA VERIFICATION AND VALIDATION

All data packages received from the analytical laboratory will be reviewed, verified, and validated by SAIC data management personnel. Details regarding the data verification and validation processes are presented in SAIC validation procedures.

With regard to data reduction, any replicate measurements associated with a single sample will be averaged prior to further data reduction. Correction of extreme (outlier) values will be attempted if the cause for the outlier value can be documented. This type of data will be corrected if the outliers are caused by incorrect transcription and the correct values can be obtained and documented from valid records. If the values can be documented as resulting from a catastrophic event or a problem in methodology, the values will be appropriately qualified. Documentation and validation of the cause of outliers will accompany any attempt to correct or delete these data values. Outlier values will not be omitted from the raw data reported to the USACE District, and valid values will be included in data summary tables. Analytical values determined to be at or below the detection limit will be reported numerically (e.g., </= 0.1 mg/L). The data presentation procedures will cite analytical methods used including appropriate detection limits.

A.4.6 DATA CENTRALIZATION AND STORAGE

Once the data for a given sample or group of samples are complete and entered into the database, the data coordinator will check that logbooks, other field records, and all analytical data are complete and properly stored, including both the electronic form and associated data packages. Each piece of information will be documented as to its source, and hard-copy information will be appropriately indexed and filed.

Procedure-based routines for establishing data security, backup, archival, and maintaining proper database changes are also used to maintain database integrity. Classes of users will be defined with access levels approved and controlled by the SAIC Data Manager. Once loaded, the database will be secured from physical corruption (i.e., hardware or software failure) or from unauthorized access and illegal updating. Physical security requires recovery procedures, time-stamping, and other related standard operating processes and controls. Any changes made to the completed database will be documented on standardized forms which will be placed into the project file.

A.4.7 DATA SUMMARIZATION AND REPORTING

When field sampling has been completed and the analytical data have been received, validated, and transferred into the project database, the project report and Quality Control Summary Report (QCSR) will be generated. Information regarding the format and content for QCSRs is presented in Section 14.0 of the QAPP.

Project data will be screened for potential data errors, compared to activity-specific background values and applicable regulatory limits, summarized in both tabular and graphical form to facilitate data interpretation. Data reduction and summation will be accomplished using quality-controlled and documentable reporting programs. Data summaries will be generally produced using predefined report formats available within the data management system. Statistical summaries will be generated by transferring data to an SAS dataset and adapting exiting data analysis programs to include project-specific aggregation or screening criteria. Any new programs developed under this project will be tested, reviewed, and documented as error-free following SAIC QA technical procedures. Data presented on maps, figures, or tables will be transferred electronically as far as possible to avoid introducing typographical errors.

A.4.8 RECORDS MANAGEMENT AND DOCUMENT CONTROL

Hard copies of all original site and field logbooks, COC forms, data packages with analytical results and associated QA/QC information, data verification and validation forms, and other project-related information will be indexed, catalogued into appropriate file groups and series, and archived. Permanent record copies will be submitted to the SAIC Central Records Facility, in accordance with SAIC procedure QAAP 17-1, "Records Management," when complete.

The SAIC Data Manager will archive the project data to the appropriate electronic media. A data archive information package will be prepared that describes the data system, file format, and method of archival. Sufficient documentation will accompany the archived data to fully describe the source, contents, and structure of the data to ensure future usability. Computer programs used to manipulate or report the archived data will also be included in the data archive information package to further enhance the data's future usability.

APPENDIX B

RADIOLOGICAL DATA VALIDATION GUIDELINES

Laboratory Data Validation Guidelines For Evaluating Radionuclide Analyses

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APPENDIX I

NOTE: Data validation worksheets (Appendix II) the data report forms from the laboratory (Appendix III) are not included in this copy of the procedure.

APPENDIX II

APPENDIX III

TABLE OF FORMS

FORM 1: Radiometric Analysis Results

FORM 2: Blank Summary

FORM 3: Chemical Recovery

FORM 4: Laboratory Control Sample

FORM 5: Matrix Spike Sample Recovery

FORM 6: Duplicates

FORM 7: Preparation Log

INTRODUCTION[1]

This document is designed to offer guidance in laboratory evaluation and validation of radioanalytical data. It is the intent of this document to provide data validation guidelines for radioanalytical data equivalent to those provided by the Environmental Protection Agency (EPA) under its Contract Laboratory Protocol (CLP) guidance. Therefore, the format used is similar to that contained in reference 2. In some aspects, it is equivalent to a standard operating procedure (SOP). In more subjective areas, only general guidance is offered due to the complexities and uniqueness of data relative to specific samples.

Four terms are used throughout this document: shall indicates a requirement for the data validator, must indicates a requirement for the data, should indicates a recommendation, and may indicates an acceptable practice (neither a requirement nor a recommendation).

Those areas where specific SOPs are possible are primarily areas in which definitive performance requirements are established. These requirements are concerned with specifications that are not sample dependent; they specify performance requirements on matters that should be completely under a laboratory's control. These specific areas include blanks, calibration standards, calibration verification standards, laboratory control standards, and interference check standards. In particular, mistakes such as calculation and transcription errors must be rectified by submission of corrected data sheets.

This document is intended to be used for technical review of radiological data. Some areas of overlap between technical review and contract compliance screening (CCS) exist; however, determining contract compliance is not intended to be a goal of these guidelines. It is assumed that CCS is available and can be utilized to assist in the data review procedure.

At times, there may be an urgent need to use data that do not meet all contract requirements and technical criteria. Use of these data does not constitute either a new requirement standard or full acceptance of the data. Any decision to utilize data for which performance criteria have not been met is strictly to facilitate the progress of projects requiring the availability of the data. A laboratory submitting out-of-specification data may be required to rerun or resubmit data even if the previously submitted data have been utilized due to urgent program needs; data that do not meet specified requirements are never fully acceptable. The only exception to this requirement is in the area of requirements for individual sample analysis; if the nature of the sample itself limits the attainment of specifications, appropriate allowances should be made. The overriding concern is to obtain data that are technically valid and legally defensible.

1 Largely adapted from reference 2's introduction.

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All data reviews shall have a data validation narrative (Appendix I). If mandatory actions are required, they should be specifically noted on this sheet. In addition, this sheet is to be used to summarize overall deficiencies requiring attention, as well as general laboratory performance and any discernible trends in the quality of the data. (This sheet is not a replacement for the data review.) Data validation worksheets (Appendix II) and a flagged copy of the data report forms from the laboratory (Appendix III) shall accompany the narrative to clearly identify the problems associated with a case.

PRELIMINARY REVIEW[2]

In order to use this document effectively, the reviewer should have a general overview of the case at hand. The exact number of samples, their assigned numbers, and their matrix are essential information. Background information on the site is helpful, but often this information is very difficult to locate. The site project officer is the best source for answers or further direction.

CCS is a source of a large quantity of summarized information. It can be used to alert the reviewer of problems in the case or of what may be sample-specific problems. This information may be utilized in data validation. If CCS is unavailable, those criteria affecting data validity shall be addressed by the data reviewer.

Cases routinely have unique samples that require special attention by the reviewer. Field blanks, field duplicates, and performance audit samples need to be identified. The sampling records should provide at least the following information:

1. Project officer for site
2. Complete list of samples with notations on
    a) sample matrix
    b) blanks*
    c) field duplicates*
    d) field spikes*

2 Largely adapted from reference 2's preliminary review.

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e) quality control (QC) audit sample*

f) shipping dates

g) labs involved

* If applicable

The chain-of-custody record includes sample descriptions and date of sampling. Although the sampling date is not addressed by contract requirements, the reviewer shall take into account lag time between sampling and shipping while assessing sample holding times.

RADIONUCLIDE PROCEDURE

The requirements to be checked in validation are listed below ("CCS" indicates that the contractual requirements for these items will also be checked by CCS; CCS requirements are not always the same as the data review criteria).

1. Holding times (CCS - Lab holding times only)
2. Calibration
   - Initial and Continuing (CCS)
   - Routine Performance Check (CCS)
3. Blanks (CCS)
4. Sample specific chemical recovery (CCS)
5. Laboratory control sample (CCS)
6. Matrix spike (CCS)
7. Field duplicates
8. Duplicate sample (CCS)
9. Radionuclide quantitation and implied detection limits

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10. Chemical separation specificity

11. Target radionuclide list identification

12. Tentatively identified radionuclides

13. System performance (CCS)

14. Overall assessment of data for a case

I. HOLDING TIMES

A. Objective

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis.

Note: The holding time is based on the date of collection (rather than verified time of sample receipt) and date of digestion/distillation. It is a technical evaluation rather than a contractual requirement.

B. Criteria

The following technical requirements for sample holding times and preservation have only been established for water matrices. Due to limited information concerning holding times for soil samples, it is left to the professional judgment of the data reviewer whether to apply water holding time criteria to soil samples.

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1. Tritium solutions: 6 months, with no preservative and stored in glass.

2. Carbon-14: 6 months, cool to 4□C and slightly basic with NaOH.

3. Iodine solutions: 6 months, with no preservatives.

4. Radon-222: 4 days, cool to 4□C and stored in glass with teflon-lined septum.

5. Cesium: 6 months, when preserved to pH <2 in hydrochloric acid.

6. Plutonium: 6 months, when preserved in 2M nitric acid.

7. Other radionuclides: 6 months, when preserved to pH <2 in nitric or hydrochloric acid.

C. Evaluation Procedure

Actual holding times are established by comparing the sampling date on the sample traffic report with the dates of analysis found in the laboratory raw data (digestion logs and instrument run logs). Examine the sample receiving logs or chain-of-custody to determine if samples were preserved at the proper pH.

Analyte Holding Times (Days) = Analysis Date - Sampling Date

D. Action

1. If criteria for holding times and preservation are not met, qualify all results as estimated (J).

2. If holding times are exceeded, the reviewer shall use professional judgment to determine the reliability of the data and the effects of additional storage on the sample results. The expected bias would be low and the reviewer may determine that results less than the critical level (CL) are unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the professional judgment of the data reviewer whether to apply water holding time criteria to soil samples. If the data are qualified when water holding time criteria are applied to soil samples, it shall be clearly

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documented in the review.

II. CALIBRATION

A. Objective

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial and continuing calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the calibration period and routine calibration verification and system checks document that the initial calibration is still valid.

B. Criteria

Calibrations and routine system checks are to be performed according to the following schedule:

1. Initial and Continuing Calibration

   a. Gas Flow Proportional and Other Gross Counting Measurements

      The gross counting systems must be efficiency calibrated for each alpha and beta counting geometry at least annually or when the daily performance check indicates an unacceptable change in system efficiency. Self-absorption curves must be developed at least annually, or if the absorption correction is included in an efficiency curve, a new curve must be developed when the daily performance check indicates an unacceptable change in system efficiency. A plateau curve and alpha/beta cross-talk factors must be established, and a performance check must be made after each P-10 counting gas bottle change. If an unacceptable change has occurred due to the new counting gas, then the new gas must be replaced. If, out of necessity, counting is performed using undesirable counting gas, a special calibration must be performed for that gas.

      The counter background must be established quarterly or when the routine performance check indicates an unacceptable change in

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instrument background. If desired, matrix or batch blanks may be used for background subtraction rather than counter background.

b. Liquid Scintillation Spectrophotometer

Efficiency quench curves must be established for the liquid scintillation spectrophotometer for each radionuclide to be counted at least annually or when the daily performance check indicates an unacceptable change in system efficiency. Instrument high voltage, gain, energy calibration, or quench indicator calibration must be adjusted using standard instrument calibration sources prior to calibration and routinely (usually daily) thereafter in order to maintain valid quench calibrations over the year. An efficiency calibration is not required when comparative measurement or internal standardization is used. However, calibration verification shall be performed.

The counter background must be established quarterly or when the routine performance check indicates an unacceptable change in instrument background. Background quench curves must be established for each radionuclide to be counted unless matrix or batch blanks are used for background subtraction.

c. Spectroscopy Measurements

Energy versus channel calibration must be established for spectroscopy systems at least quarterly or when the daily performance check indicates an unacceptable change in energy gain or zero offset.

Resolution versus energy calibration must be established for gamma spectroscopy systems quarterly or when the daily performance check indicates an unacceptable change in system resolution.

Spectroscopy systems must be efficiency calibrated for each counting geometry at least annually or when the daily performance check indicates an unacceptable change in system efficiency. Efficiency versus energy curves must be established for gamma

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spectroscopy systems for the energy region of interest with particular attention to energy regions where the efficiency depends strongly on energy. Single efficiency values may be used for alpha spectroscopy systems for alpha energies between 4.0 and 6.0 MeV. An efficiency calibration is not required when comparative measurement or internal standardization is used. However, calibration verification must be performed.

Spectroscopy system background determinations must be established quarterly or when the routine performance check indicates an unacceptable change in system background.

d. Lucas Cells and Radon Flask Counting Systems

Each Lucas Cell and radon flask counting system must be efficiency calibrated with the Department of Energy Environmental Measurements Laboratory Radon Program at least annually or when calibration verification shows an unacceptable change in efficiency. A high voltage plateau curve must be established at least annually or if there are any unusual events affecting the power supply or the counting instrument.

The Lucas Cell and radon bubbler background must be established before each use.

2. Routine Calibration Performance Check

a. Gas Flow Proportional and Other Gross Counting Measurements

The efficiency calibration of gross counting systems must be checked using alpha and beta (if applicable) check sources each day that the system is used. The net alpha and beta counts (corrected for decay) and the alpha/beta cross-talk must be recorded and should be plotted on a QC chart daily.

The counter background must be checked each day that the system is used. The background alpha and beta counts must be recorded and should be plotted on a QC chart daily.

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Acceptable tolerances must be established for each QC chart based on system performance and analytical requirements. Maximum tolerance limits of ± 10% of the value determined at time of calibration are recommended for efficiency verification control charts; otherwise, tolerance limits of ± 3 standard deviations are recommended. When tolerance limits are exceeded, recalibration is required.

b. Liquid Scintillation Spectrophotometers

The efficiency of liquid scintillation spectrophotometers must be checked using a calibration source each day that the system is used. The net counts (corrected for decay) must be recorded and should be plotted on a QC chart daily.

The counter background must be checked each day that the system is used. The background alpha and beta counts must be recorded and should be plotted on a QC chart daily.

Acceptable tolerances must be established for each QC chart based on system performance and analytical requirements. Maximum tolerance limits of ± 10% of the value determined at time of calibration are recommended for efficiency verification control charts; otherwise, tolerance limits of ± 3 standard deviations are recommended. When tolerance limits are exceeded, recalibration is required.

c. Spectroscopy Systems

The energy, resolution, and efficiency must be monitored using a calibration source each day that the system is used and must be compared against the initial calibration values. The check source must have both low- and high-energy peaks. The centroid energy, full width at half maximum (FWHM), and net counts under each calibration peak (corrected for radioactive decay) must be recorded and should be plotted on a QC chart daily.

The counter background must be checked at least once every

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20 counting periods. The net count rate in each background peak (gamma) or region (alpha) must be recorded and should be plotted on a QC chart. The background check count rate is compared to the established background spectra used for background subtraction. Acceptable tolerances must be established for each background peak or region. When tolerance limits are exceeded or when new background peaks are identified, a new background must be established for the system.

Acceptable tolerances must be established for each QC chart based on system performance and analytical requirements. Maximum tolerance limits of ± 10% are recommended for efficiency calibration verification control charts and ± 1 FWHM for energy calibration verification control charts; otherwise, tolerance limits of ± 3 standard deviations are recommended. All control limits are relative to the value determined at time of calibration. When tolerance limits are exceeded, recalibration must be performed.

d. Lucas Cells and Radon Flask Counting Systems

The efficiency calibration of the Lucas Cells must be checked using a NIST traceable radium source in a radon bubbler once every 20 times it is used. The counts (corrected for decay) must be recorded and should be plotted on a QC chart.

The dark current background must be checked at least weekly or when a new high voltage plateau has been established. The dark current background must be recorded and should be plotted on a QC chart.

Acceptable tolerances must be established for each QC chart based on system performance and analytical requirements. Maximum tolerance limits of ± 10% of the value determined at time of calibration are recommended for efficiency verification control charts; otherwise, tolerance limits of ± 3 standard deviations are recommended. When tolerance limits are exceeded, recalibration is required.

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C. Evaluation Procedure

1. Verify that the instrument was calibrated each time the instrument was setup and at the required frequency as stated above. Evaluate the shape and smoothness of high voltage plateaus, efficiency versus energy curves, and quench curves. Evaluate the standard counting statistics to verify that the counting uncertainty (1σ) was less than or equal to 1%.

2. Observe the QC charts and verify that proper limits have been established and that recalibration was performed whenever the limits were exceeded. Also, evaluate the check source counting statistics to verify that the counting uncertainty (1σ) was less than or equal to 1%.

3. Verify, at a minimum, 10% of the calibration calculations. If errors are found in the calculations, verify more calculations by using professional judgment to see the extent of the errors.

D. Action

1. If the specified calibration and/or verification frequency is not followed, the efficiency or quench curves are not smooth, or the QC results fall outside the appropriate tolerance limits, qualify the results for all samples analyzed between acceptable calibration verifications as estimated (J).

2. When significant errors are found in the calculations, flag all affected results that allow a bias of between 10-20% as estimated (J), and greater than 20% as unusable (R).

III. BLANKS

A. Objective

Blank analysis results are assessed to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks applies to any blank associated with the samples. If problems with <u>any</u> blank exist, all data associated with the case shall be carefully evaluated to determine whether or not there is an inherent variability in the data for the case, or if the problem is an isolated occurrence not affecting other data.

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B. Criteria

At least one blank must be analyzed for every matrix, every batch, or for every 20 samples (5% of samples), whichever is more frequent. The result of all blanks must be recorded and should be plotted on a QC chart at least daily for each method. Acceptable tolerances must be established for each QC chart based on system performance and analytical requirements. Tolerance limits of ± 3 standard deviations are recommended.

When average blanks or instrument backgrounds are subtracted to determine net counts, the net blank result must be less than the associated uncertainty. Contamination shall be suspected when the net blank result is larger than the associated uncertainty.

C. Evaluation Procedures

Review the results reported on the Blank Summary (Form 2) and evaluate the blank control charts as well as the raw data for all blanks. Verify that the results were accurately reported and that tolerance limits were not exceeded. Verify that net blank results are less than the associated uncertainty.

D. Action

If the blank QC results fall outside the appropriate tolerance limits or if the net blank results are not less than the associated uncertainty, qualify the results for all associated samples that are less than 10 times the blank value as estimated (J).

IV. SAMPLE SPECIFIC CHEMICAL RECOVERY

A. Objective

A tracer or carrier is used to measure and correct for losses that may have occurred during separation and quantification of the analyte (in a specific sample). Abnormally high or low recoveries may be indicative of inappropriate separation methods for certain matrix interferences, instrument problems, calibration errors, or errors in the preparation of the tracer or carrier.

Both tracer and carrier yields are expressed as a percentage value. Abnormally low recoveries can cause large uncertainly in affected sample results. Recoveries greater than 100% may add negative

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bias of at least the amount greater than 100%. Limits for both high and low chemical recovery are established by the MQOs.

B. Criteria

1. Sample specific recoveries must be within limits as per applicable scope of work (SOW). Generally, recoveries of 50-100% are considered acceptable. However, lower recoveries may be typical for some matrices and the acceptable lower limit may be lowered in such instances. Each chemical tracer percent recovery (CT %R) must be recorded and should be plotted on a QC chart for each radionuclide and method and fall within the prescribed limits.

2. The quantity of tracer material used must be adequate to provide a maximum of 10% uncertainty at the 95% confidence level in the measured recovery.

C. Evaluation Procedure

1. Review Form 3 and verify that sample specific recoveries fall within the control limits.

2. Check the raw data to verify that sample specific recoveries are accurately reported on Form 3. Recalculate, at a minimum, 10% of the sample specific recoveries (CT %R) using the following equation:

$$CT\,\%R = \frac{CT_{Found}}{CT_{True}} * 100$$

Where:

CT_{Found} = amount of tracer or carrier (in pCi or mg) measured in the sample.

CT_{True} = amount of tracer or carrier (in pCi or mg) added to the sample.

3. Check spike levels to verify that sufficient levels are used to provide adequate precision for recovery determination.

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4. Evaluate recovery to verify that limits specified in SOW are met.

D. Action

For sample specific recoveries out of specification, the following approaches are suggested based on a review of all data from the case, especially considering the apparent complexity of the sample matrix:

If the uncertainty (2 sigma) is > 10% (or other limits as specified by the MQOs), qualify the sample result as estimated (J). If tracer recovery is greater than 110%, qualify the sample result as estimated (J) or unusable (R) based on the amount of bias allowed by the MQOs.

2. When significant errors are found in the calculations, flag all affected results that allow a bias of between 10-20% as estimated (J), and greater than 20% as unusable (R).

V. LABORATORY CONTROL SAMPLE

A. Objective

The laboratory control sample (LCS) serves as a monitor of the overall accuracy and performance of all steps in the analysis, including the sample preparation. For the following limits to apply, the LCS must contain greater than 10 times the radionuclide's detection limit activity.

B. Criteria

1. At least one LCS must be analyzed for every matrix, every batch, or for every 20 samples (5% of samples), whichever is more frequent.

2. All aqueous LCS results must fall within the control limits of 80-120% recovery of the standard value.

3. All solid LCS results must fall within the control limits of 70-130% recovery of the standard value.

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4. All LCS results must be recorded and should be plotted on a QC chart according to sample type and radionuclide and fall within the prescribed limits.

C. Evaluation Procedure

1. Review Form 4 and verify that results fall within the control limits.

2. Check the raw data (counter printout, strip charts, bench sheets, etc.) to verify the reported recoveries on Form 4. Recalculate, at a minimum, 10% of the LCS percent recoveries (LCS %R) using the following equation:

$$LCS\ \%R = \frac{LCS_{Found}}{LCS_{True}} * 100$$

Where:

LCS_{Found} = concentration (in pCi/L for aqueous; pCi/kg for solid) of each analyte measured in the analysis of LCS solution

LCS_{True} = concentration (in pCi/L for aqueous; pCi/kg for solid) of each analyte in the LCS source.

D. Action

1. Aqueous LCS

a. If LCS %R are <80% or >120%, qualify results for that radionuclide in all associated samples as estimated (J).

2. Solid LCS

a. If LCS %R are <70% or >130%, qualify results for that radionuclide in all associated samples as estimated (J).

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VI. MATRIX SPIKE SAMPLE ANALYSIS

A. Objective

The matrix spike sample (MSS) analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. MSSs are required when sample specific chemical recovery mechanisms are not available and the samples undergo a chemical process.

B. Criteria

1. At least one MSS must be analyzed for every matrix, every batch, or for every 20 samples (5% of samples), whichever is more frequent, when sample specific chemical recovery mechanisms are not available and the samples undergo a chemical process.

2. Samples identified as field blanks must not be used for spiked sample analysis.

3. Matrix spike sample percent recovery (MSS %R) must be within the limits of 80-120% for aqueous matrix and 70-130% for solid matrix samples. However, spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of 4 or more.

4. The MSS %R of the matrix spike must be recorded and should be plotted on a QC chart and fall within the prescribed limits.

C. Evaluation Procedure

1. Review Form 5 and verify that results fall within the specified limits.

2. Check raw data and recalculate, at a minimum, 10% of the %R using the following equation to verify that the results were correctly reported on Form 5.

$$MSS\ \%R = \frac{(SSR - SR)}{SA} * 100$$

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Where:

SSR = Spiked Sample Result

SR = Sample Result

SA = Spike Added

3. Verify that the field blank was not used for spike analysis.

D. Action

1. If spike recovery is <50% (<40% for solids) or >120% (>130% for solids), qualify the results for that radionuclide for associated samples as estimated (J).

2. If the field blank was used for matrix spike analysis, all other QC data shall be carefully checked and professional judgment exercised when evaluating the data.

VII. DUPLICATE ANALYSIS SAMPLES

A. Objective

Duplicate analyses are indicators of laboratory precision based on each sample matrix.

B. Criteria

1. Samples identified as field blanks must not be used for duplicate sample analysis.

2. At least one duplicate must be analyzed for every matrix, every batch, or for every 20 samples (5% of samples), whichever is more frequent.

3. The duplicate analyses results must not be significantly different from each other based on a 95% confidence level. For this to be true, the duplicate error ratio (DER) as defined in the following equation must be less than 1. The DER must be recorded and should be plotted on QC charts with a control limit set at 1.

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$$DER = \frac{|S - D|}{\sqrt{\left((2\sigma_S)^2 + (2\sigma_D)^2\right)}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_S$ = First Sample 2σ Uncertainty

$2\sigma_D$ = Second Sample 2σ Uncertainty.

C. Evaluation Procedure

1. Review Form 6 and verify that DER results are less than 1.

2. Check, at a minimum, 10% of the duplicate results and recalculate the DER values. Use the above equation to verify that DER results have been correctly reported on Form 6.

3. Verify that the field blank was not used for duplicate analysis.

D. Action

1. If DER for a particular radionuclide is greater than 1, qualify the results for that radionuclide in all associated samples of the same matrix as estimated (J).

2. If the field blank was used for duplicate analysis, all other QC data shall be carefully checked and professional judgment exercised when evaluating the data.

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VIII. FIELD DUPLICATES ANALYSIS

A. Objective

Field duplicate samples may be taken and analyzed as an indication of overall precision. These analyses measure both field and lab precision; therefore, the results may have more variability than lab duplicates that measure only lab performance. It is expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples.

B. Criteria

There are no review criteria for field duplicate analyses comparability.

C. Evaluation Procedures

Samples that are field duplicates should be identified using sample field sheets. The reviewer should compare the results reported for each sample and calculate the DER.

D. Action

Any evaluation of the field duplicates shall be provided with the reviewer's comments.

IX. RADIONUCLIDE QUANTITATION AND IMPLIED DETECTION LIMITS

A. Objective

The objective is to ensure that the reported quantitation results are accurate and that the required detection limits have been met. When detection limit requirements are not met, the data quality objectives may not have been met. All results shall be evaluated relative to the uncertainty associated with the analysis.

B. Criteria

1. Radionuclide quantitation must be calculated according to the appropriate procedures specified in the contractual SOW.

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2. Detection limits specified in the specific procedures must be met unless other detection limits are specified in the SOW.

3. Analytical uncertainties must be reported with all results in order to qualify the data. Results and uncertainties must be reported for all required analyses regardless of the size or sign of the result. The reported uncertainty must include all uncertainties associated with the analysis. If the reported uncertainty only includes counting uncertainty, this fact must be documented in the case narrative.

4. For solid samples a minimum of 100 grams must be homogenized prior to subsampling an aliquot for analysis. Homogenization of the entire sample is recommended for all samples and is required for liquid samples with more than one phase. The minimum homogenized sample aliquot size used for analysis must be 1 g for dry solids or 1 ml for liquid samples, although further dilution may be performed after chemical dissolution or extraction.

5. When samples are dry mounted for counting, mounting aliquots must be selected in order to keep the dry mounted weight to ± 5 mg/cm^2 for alpha analyses and ± 10 mg/cm^2 for beta analyses.

6. An analyte will be considered as positively detected if the result is above the sample specific decision level (L_c). The *a posteriori* decision level or critical value, L_c, should be set at a ninety-five percent probability. The decision level, to be calculated for each measurement result, determines the minimum activity or concentration result that can be considered as statistically different from blank results. Therefore, the L_c is the level at which blank results will not exceed more than 5% of the time. Information and guidance on the calculational methods used to estimate the MDC and L_c are available from several sources (Currie, ANSI N42.23).

C. Evaluation Procedures

1. The raw data shall be examined to verify the correct calculation of sample results reported on Form 1 by the laboratory.

   a. Examine the raw data for any anomalies (i.e., omissions, legibility,

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etc.). Recalculate, at a minimum, 10% of the results to verify proper calculation. If calculation errors are found, recalculation of more results may be required in order to determine the extent of the error.

b. Verify that there are no transcription or reduction errors (e.g., dilutions, percent solids, sample weights) on one or more samples.

c. Verify that all analytical uncertainties have been propagated and reported or otherwise documented.

d. Verify that appropriate aliquot sizes have been used for sample preparation (Form 7) and mounting.

2. Verify that uncertainties (Form 1) have been reported for all results.

3. Check that the obtained detection limits the required detection limits by verifying that, for blanks or any other samples that have a 2σ uncertainty greater than the result, the 2σ uncertainty multiplied by 1.65 is less than or equal to the specified required detection limit.

4. **For sample results close to or less than the L_c, the L_c can be estimated by the following equation:**

$$L_c = 1.65\ TPU$$

where: L_c = decision level (dpm/unit)
TPU_R = total propagated uncertainty of the result, R (dpm/unit)

Even though the TPU will be larger for samples larger than the L_c, this equation can always be used for the positive detection decision since the result will grow larger faster than the TPU. Using this equation actually evaluates the 95% probability that the true result is greater than zero.

When the detector background or appropriate blank information is available, the critical level may be estimated by the following equation:

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$$L_c = ((t \cdot S_B) + R_B) / (E \cdot R \cdot IDF \cdot W)$$

where:	L_c	=	decision level (dpm/unit),
	S_B	=	standard deviation of a set of appropriate blank net count rates after background subtraction for blanks counted for the same length of time as the sample,
	R_B	=	average blank count rate,
	t	=	student t factor for appropriate degree of freedom,
	E	=	fractional detector efficiency (c/d) for the sample,
	R	=	fractional chemical recovery for the sample,
	IDF	=	ingrowth or decay factor for the sample,
	W	=	weight or volume of sample.

D. Action

1. When significant errors are found in the calculations, flag all affected results that allow a bias of between 10-20% as estimated (J), and greater than 20% as unusable (R). If errors are found in the calculation of the uncertainties or they have been rounded improperly, flag the uncertainty as estimated (JE).

2. When inappropriate aliquot sizes are used, flag all affected results as estimated (J).

3. For net negative results that have uncertainties smaller than their absolute value, flag the data as unusable (R). This is an indication of improper blank subtraction.

4. When detection limits are not met, flag the data as detection limit exceeded (DL).

5. When analytical uncertainties are not reported, flag the results as estimated

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(J).

If any discrepancies are found, the laboratory may be contacted by the designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer may determine that qualification of the data is warranted based on the reviewer's professional judgment.

X. CHEMICAL SEPARATION SPECIFICITY (Alpha Spectrometry)

A. Objective

Chemical separation specificity is the contract laboratory's ability to separate various radionuclides by chemical separation techniques. The chemical separation specificity can be verified for alpha spectroscopy measurements by observation of the alpha energy spectrum.

B. Criteria

1. There are not to be any radionuclides that interfere with the quantitation of the radionuclide of interest once the chemical separation process has been completed.

2. Energy of the radionuclide of interest must be within 40 keV of the observed peak energy.

C. Evaluation

1. Check that the energy of the observed peak of interest is within 40 keV of the energy for the radionuclide of interest.

2. Check the energy spectra for any peaks that overlap or that have associated peaks that may interfere with the peak of the radionuclide of interest.

3. When interfering radionuclides are present and can be corrected for from associated peaks in the spectrum, check to see if the peak area for the radionuclide of interest has been properly corrected.

D. Action

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1. If the energy of the peak of interest is more than 40 keV from the energy for the radionuclide of interest, qualify the results as unusable (R).

2. If the alpha energy spectra contains any peaks that overlap with or have associated peaks that may interfere with the peak of the radionuclide of interest and it is impossible to correct for the interference, qualify the results as unusable (R).

3. If the results have not been properly corrected for the interfering radionuclide, qualify the data as unusable (R).

XI. TARGET RADIONUCLIDE LIST IDENTIFICATION (Gamma Spectroscopy)

A. Objective

The target radionuclide list (TRL) contains those radionuclides for which a quantitative analysis is required. Therefore, net quantitation with uncertainties must be provided for all TRL radionuclides (whether or not the radionuclide is identified in the peak search and identification). This is accomplished by determining the net area in the region associated with the radionuclide when the radionuclide is not detected by the computerized peak search routine. When a peak is detected for the radionuclide, positive identification is achieved through the use of the following criteria.

B. Criteria

1. The target radionuclide energy must be within 2 keV of the observed peak.

2. There are not to be any radionuclide gamma peaks that interfere with the quantitation of the radionuclide of interest. If there is an interference, the radionuclide of interest result must be corrected to negate the interfering radionuclide's contribution to the radionuclide of interest's gamma peak.

C. Evaluation Procedure

1. Check that the energy of the identified peaks is within 2 keV of the standard library energy for the identified radionuclide.

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2. Verify that net peak areas and associated uncertainties have been obtained for all TRL radionuclides not meeting the above criteria.

3. Check the energy spectra for any peaks that overlap or that have associated peaks that may interfere with the peak of the radionuclide of interest.

4. When interfering radionuclides are present and can be corrected for from associated peaks in the spectrum, check to see if the peak area for the radionuclide of interest has been properly corrected.

D. Action

Qualify the data according to the following:

1. For TRL radionuclides that are not detected in the computerized peak search, qualify the net peak area results as described in Section IX.

2. For TRL radionuclide peaks that are detected but fail to meet the positive identification criteria, flag the data as unusable (R).

3. If improper methods are used, flag the data as estimated (J).

4. If the gamma energy spectra contains any peaks that overlap with or have associated peaks that may interfere with the peak of the radionuclide of interest and it is impossible to correct for the interference, qualify the results as unusable (R).

5. If the results can be and have not been properly corrected for the interfering radionuclide, qualify the data as unusable (R).

If any discrepancies are found, the laboratory may be contacted by the designated representative to obtain additional information that may resolve any differences. If a discrepancy remains unresolved, the reviewer shall decide which value is the best value. Under these circumstances, the reviewer may determine whether qualification of data is warranted.

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XII. TENTATIVELY IDENTIFIED RADIONUCLIDES (Gamma Spectroscopy)

A. Objective

One of the objectives of the criteria for gamma spectroscopy qualitative analysis is to minimize the number of erroneous identifications of radionuclides. An erroneous identification can either be a false positive (reporting a radionuclide present when it is not) or a false negative (not reporting a radionuclide that is actually present). It is much easier to detect false positives than false negatives, because more information is available due to the requirement for submittal of data supporting positive identification. Negatives, or nondetected radionuclides, on the other hand, represent an absence of data and are, therefore, much more difficult to assess.

Gamma spectra peaks in radionuclide analyses that are not TRL isotopes are potential tentatively identified radionuclides (TIRs). TIRs must be qualitatively identified by a radionuclide spectra library computer search and the identifications assessed by the data reviewer.

B. Criteria

1. Identified radionuclide energy must be within 2 keV of the observed peak.

2. Gamma spectra of the sample radionuclide and the standard radionuclide library must match according to the following criteria:

   a. 50% of total abundance of all gamma peaks listed in the standard radionuclide library <u>must</u> be present in the sample spectrum.

   b. The sampling to count time must not be greater than 10 half lives of the identified radionuclide.

3. Radionuclide concentrations present in the gamma spectra must be consistent with related radionuclides (e.g., when daughter radionuclides are expected to be in equilibrium with parents, detection of both provides confirmation of identification).

4. All peaks greater than three standard deviations of the background identified radionuclides spectrum shall be considered and accounted for.

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5. Guidelines for tentative identification are as follows:

   a. Peaks present in the sample spectrum but not in the reference spectrum shall be reviewed for possible background contamination or interference.

   b. When the above criteria are not met, but the data reviewer or gamma spectral interpretation specialist judges the identification to be correct, the data reviewer may report the identification.

   c. If the data reviewer judges the identification to be uncertain or there are extenuating factors affecting radionuclide identifications, the TIR result may be reported as "unknown."

C. Evaluation Procedure

1. Check the raw data to verify that the laboratory has generated a computer library search for all required peaks in the spectra (samples and blanks).

2. Examine the blank spectra to verify that TIR peaks present in samples are not found in blanks. When a low-level non-TRL radionuclide that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank spectra may require examining for peaks that are less than the critical level but present in the blank spectra at similar counting time.

3. Examine all gamma peaks in every sample and blank spectra.

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4. Check that expected related radionuclides are present.

   Note: Since TIR computer library searches often yield several candidate radionuclides having close matching peaks, consider all reasonable choices.

   Note: The reviewer should be aware of common laboratory artifacts/contaminants and their sources (e.g., radon and thoron daughters in the air, etc.). These may be present in blanks and not reported as sample TIRs.

D. Action

1. All verified TIRs shall be listed in the evaluation report.

2. All TIRs shall be flagged as tentatively identified (N).

3. General actions related to the review of TIR results are as follows:

   a. If it is determined that a tentative identification of a non-TRL radionuclide is not acceptable, the tentative identification shall be flagged as unusable (R) or changed to an appropriate identification.

   b. If all peaks were not library searched, the designated representative could request these data from the laboratory.

4. TIR results that are not sufficiently above the level in the blank should not be reported. (Dilutions, sample size, and counting times shall be taken into account when comparing the amounts present in blanks and samples).

5. When a radionuclide is not found in any blanks, but is a suspected artifact of common laboratory contamination, the result may be flagged as unusable (R).

6. In deciding whether a library search result for a TIR represents a realistic identification, professional judgment shall be exercised. If there is more than one reasonable match, the result may be reported as "either radionuclide X or radionuclide Y."

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7. Other case-specific factors may influence TIR judgments. If a sample TIR match is poor but other samples have a TIR with a good library match and similar gamma peaks, identification information may be inferred from the other sample TIR results.

8. Physical constants, such as half life, shall be factored into professional judgment of TIR results.

XIII. SYSTEMS PERFORMANCE

A. Objective

During the period following instrument performance QC checks (e.g., blanks, tuning, calibration, etc.), changes may occur in the system that degrade the quality of the data. While this degradation would not be directly shown by QC checks until the next required series of analytical QC runs, a thorough review of the ongoing data acquisition may yield indicators of instrument performance.

B. Criteria

Some examples of instrument performance indicators for various factors are shown below. (Note: This is not an exhaustive list.)

1. Abrupt, discrete shifts in background or detector response may indicate contamination and/or gain or threshold changes.

2. Poor spectroscopy performance affects both qualitative and quantitative results. Indications of substandard performance include:

   a. High background levels or shifts in energy calibration.

   b. Extraneous peaks.

   c. Loss of resolution.

   d. Peak-tailing or peak splitting that may result in inaccurate quantitation.

C. Evaluation Procedure

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Evaluate the raw data for each sample to determine if unexpected activity, extraneous peaks, loss of resolution, or loss of expected background peaks has occurred.

D. Action

Continued analytical activity with degraded performance suggests lack of attention or professional experience. Based on the instrument performance indicators, the data reviewer shall decide if the system has degraded to the point of affecting data quality or validity. If data quality may have been affected, data shall be qualified using the reviewer's best professional judgment.

XIV. OVERALL ASSESSMENT OF DATA FOR A CASE[3]

"It is appropriate for the data reviewer to make professional judgments and express concerns and comments on the validity of the overall data for a case. This is particularly appropriate when there are several QC criteria out of specification. The additive nature of QC factors out of specification is difficult to assess in an objective manner, but the reviewer has a responsibility to inform the user concerning data quality and data limitations in order to assist that user in avoiding inappropriate use of the data, while not precluding any consideration of the data at all. If qualifiers other than those used in this document are necessary to describe or qualify the data, it is necessary to thoroughly document/explain the additional qualifiers used. The data reviewer would be greatly assisted in this endeavor if the data quality objectives were provided. The cover form and supplementary documentation shall be included with the review."

3 This section was taken from the "Overall Assessment of Data for a Case" section of reference 2.

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GLOSSARY A

Data Qualifier Definitions

The qualifiers listed below can be used simultaneously to qualify a result for different reasons.

J - The associated numerical value is an estimated quantity.

N - Presumptive evidence of the presence of the radionuclide.

DL - Detection limit requirements not met. Data quality objectives may not be met.

R - The data are unusable (radionuclide may or may not be present). Resampling and reanalysis is necessary for verification.

JE - Uncertainty is an estimated quantity. This estimated flag applies only to the uncertainty and has no reflection on the quality of the result.

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GLOSSARY B

Additional Terms

Calibration Curve - An analytical curve based on the pulse energy, detector efficiency, energy absorbance, or other measured characteristic obtained from standard sources and a reagent blank.

Calibration Source - A radionuclide source counted daily to verify the calibration of a counting system.

Case - A finite (usually predetermined) number of samples collected over a given time period for a particular site. A case consists of one or more sample delivery group(s).

Chemical Tracer - A trace quantity of a different radioisotope of the same element or a carrier quantity of an inactive isotope of the same or a chemically similar element.

Contract Compliance Screening (CCS) - A process in which the analytical data is reviewed for contractual compliance.

Critical Level (CL) - The net count rate that must be exceeded before there is a specific degree of confidence that the sample contains any measurable radioactive material above background.

Customer Required Detection Limit (CRDL) - The minimum concentration in a given matrix type that a customer will accept of a radionuclide that can be measured and reported with a specific degree of confidence that the radionuclide activity is greater than zero.

Duplicate - Two aliquots taken from a homogenized sample and analyzed as individual samples. These are used to determine the precision of the method.

Duplicate Error Ratio - The ratio of the difference between the duplicate results to the sum of the two standard deviation uncertainties for duplicate results.

Field Blank - A sample of radionuclide-free media which is taken to the field in sealed containers and transferred from one vessel to another at the sampling site and preserved with the appropriate reagents. This serves as a check on reagent and environmental contamination. These blanks are treated as actual samples but may not be used for matrix spikes or sample duplicates.

Field Duplicate - Independent samples that are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently. These duplicates are useful in documenting the precision

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of the sampling process.

Full Width at Half Maximum (FWHM) - the width of the distribution at a level which is half the maximum ordinate of the peak.

Holding Times - The time between the date of collection of sample and the date of sample analysis.

Laboratory Control Sample (LCS) - A control sample of known composition. Aqueous and solid laboratory control samples are analyzed using the same sample preparation, reagents, and analytical methods employed for the unknown samples being analyzed. The results from the analysis of the controls are plotted and compared to control limits to determine the usability of the data.

Matrix Spike Sample (MSS) - An aliquot of sample spiked with a known concentration of target radionuclide(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. (Some Federal Regulations require that data be corrected for spike recovery prior to reporting. Environmental Protection Agency recommends a minimum of 10 times the method detection limit or 2 to 4 times the measured quantity.)

Method Blank - A radionuclide-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process and should not be used for matrix spikes or sample duplicates.

Method Detection Limit (MDL) - The minimum concentration of a radionuclide that can be measured and reported with a specific degree of confidence that the radionuclide's activity is greater than zero and is determined for analysis of a sample in a given matrix type. MDL is equivalent to LLD, MDA, etc.

Percent Recovery (%R) - The fractional amount of the known activity of the radionuclide of interest that was obtained in the analysis.

Quality Control (QC) - An aggregate of activities designed to ensure adequate quality of analytical data.

QC Chart - A graphic representation on which the values obtained on the analysis of backgrounds, blank, calibrations, and laboratory control samples are plotted sequentially. The chart usually

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consist of a central line and two control limit lines parallel to the central line. The distribution of the plotted values with respect to the control limits provide valuable visual and statistical information on the quality of the analyses.

Quench Curve - A plot of efficiency versus degree of quenching for quenched standards.

Quenching - A reduction in the pulse height from the output of the photomultiplier tube due to physical or chemical processes occurring during or after the deposition of energy by the ionizing particle in the scintillator. Quenching reduces the scintillation efficiency and hence produces a loss in counting efficiency.

Standard Operating Procedure (SOP) - Established or prescribed methods to be followed routinely for the performance of designated operations or in designated situations.

Scope of Work (SOW) - A detailed description of work to be performed by a contracted laboratory or facility.

Target Radionuclide List (TRL) - A listing of radionuclides for which a quantitative analysis is required. Therefore, net quantitation with uncertainties must be provided for all TRL radionuclides whether or not the radionuclide is identified in the computerized peak search and identification routine.

Tentatively Identified Radionuclide (TIR) - A detected radionuclide not on the Target Radionuclide List.

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APPENDIX I

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RADIOLOGICAL
DATA VALIDATION NARRATIVE

Case#:_____

SDG #:_____

The identified radiological data package has been reviewed and validated in accordance with *Laboratory Data Validation Functional Guidelines for Evaluating Radionuclide Analyses* - Revision 06.

DATA VALIDATION QUALIFIERS

The qualifiers listed below can be used simultaneously to qualify a result for different reasons.

J - The associated numerical value is an estimated quantity.

N - Presumptive evidence of the presence of the radionuclide.

DL - Detection limit requirements not met. Data quality objectives may not be met.

R - The data are unusable (radionuclide may or may not be present). Resampling and reanalysis is necessary for verification.

JE - Uncertainty is an estimated quantity. This estimated flag applies only to the uncertainty and has no reflection on the quality of the result.

RADIOLOGICAL DATA VALIDATION CRITERIA AND REMARKS

1. Holding Times: Sample holding times exceeded
2. Holding Times: Sample improperly preserved
3. Initial and continuing calibration: Frequency not met
4. Initial and continuing calibration: Errors in calculations
5. Calibration verification: Frequency not met
6. Calibration verification: Unacceptable change in efficiency
7. Calibration verification: Unacceptable change in system energy gain or offset

8. Calibration verification: Unacceptable change in resolution
9. Calibration verification: Unacceptable change in absorption factor
10. Calibration verification: Unacceptable change in background
11. Calibration verification: Unacceptable change in plateau voltage
12. Calibration verification: Unacceptable change in cross talk factors
13. Calibration verification: Unacceptable change in dark current
14. Calibration verification: Errors in calculations
15. Blanks: Frequency not met
16. Blanks: Value > associated uncertainty
17. Blanks: $\pm 3\sigma$ exceeded
18. Chemical Recovery: Sample-specific recovery outside limits
19. Laboratory Control Sample: Frequency not met
20. Laboratory Control Sample: Recovery of standards outside limits
21. Matrix Spike: Frequency not met
22. Matrix Spike: Recovery of standard spikes outside limits
23. Duplicate Analysis: Frequency not met
24. Duplicate Analysis: Duplicate Error Ratio > 1.0
25. Field Duplicate Analysis Duplicates not in agreement
26. Quantitation: Errors in calculation of activity
27. Quantitation: Errors in calculation of uncertainty
28. Quantitation: Negative result with absolute value > uncertainty
29. Quantitation: Uncertainty not reported
30. Quantitation: Less than minimum amount of sample homogenized
31. Quantitation: Less than minimum homogenized sample aliquot used
32. Quantitation: Exceeded maximum mass/area on planchet for alpha, beta counting
33. Quantitation: Detection limits not exceeded
34. Identification: Energy difference > 40 keV (alpha)
35. Identification Energy difference > 2 keV (gamma)
36. Identification: Interference peak in region of interest
37. Identification: < 50% total gamma abundance found
38. System Performance: Degraded system performance

A summary of the review and validation findings is outlined below:

Holding Times and Preservation

Calibration

Blanks

Sample-Specific Chemical Recovery

Laboratory Control Sample

Matrix Spike

Duplicates

Field Duplicate Analysis

Radionuclide Quantitation and Implied Detection Limit

Chemical Separation Specificity

Target Radionuclide List Identification

Tentatively Identified Radionuclides

System Performance

Nonconformances/Deficiencies

I certify that the data review and validation of samples included in this package have been conducted in accordance with the guidance document specified above.

NAME
TITLE
COMPANY REPRESENTED
ADDRESS

_____ _____

NAME Date