QUALITY ASSURANCE PROJECT PLAN

INTERIM REMOVAL ACTION
TNT PIPELINE AND
CHEMICAL WASTE SEWER LINES
FORMER LAKE ONTARIO ORDNANCE WORKS
LEWISTON/PORTER, NEW YORK

PREPARED FOR

UNITED STATES ARMY CORPS OF ENGINEERS
BUFFALO ~~BALTIMORE~~ DISTRICT

RADIAN INTERNATIONAL
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1.0 PROJECT DESCRIPTION

This document is the Quality Assurance Project Plan (QAPP) for sampling and analysis activities associated with the Interim Removal Actions at the TNT Pipeline and Chemical Waste Sewer Lines at the former Lake Ontario Ordnance Works (LOOW) in Lewiston/Porter, New York. Field sampling activities and procedures are described in the Chemical Sampling and Analysis Plan (CSAP) for the site.

This QAPP presents the overall quality assurance and quality control program to be used during chemical sampling and analysis to ensure the generated data meet the standards of definitive data as specified in USEPA Data Quality Objectives Process for Superfund Interim Final Guidance, USEPA 540-R-93-071, September 1993.

The QAPP describes the policy, organization, functional activities, and quality assurance/quality control (QA/QC) protocols necessary to achieve the data quality objectives (DQOs) as summarized below. The QAPP primarily focuses on the analytical methods and QA/QC procedures that are used to collect and analyze samples. Issues addressed by the QAPP include:

Project description
Project laboratory organization and responsibilities of key laboratory personnel
QA objectives
Sampling locations and procedures
Sample handling, custody, preservation, and holding time requirements
Analytical procedures
Equipment calibration
Internal quality control procedures for the laboratory
Assessment of the data for precision, accuracy, and completeness
Corrective actions
Data reduction, review, validation, and reporting
Preventative maintenance
Performance/system audits
QC reports to management.

1.1 Quality Assurance Project Plan Objectives

The procedures in this QAPP document the QA/QC procedures that will be used during data collection and data analysis for the project. The QAPP has been developed in accordance with USACE Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3, September 1994. These procedures will ensure that the data generated under this program are

scientifically sound, legally defensible, and are of sufficient quality and quantity to support the needs of the data users. Data collected under this program will be used to:

- Identify areas of contamination that exceed target cleanup levels to support decisions on the limits of the removal action;

- Confirm that site cleanup criteria have been met following the interim removal action; and

- Characterize wastes for disposal.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization and responsibilities of key chemical sampling project personnel are described in Section 3.0 of the CSAP.

2.1 Analytical Laboratories

The analytical work will be performed by ~~Radian Analytical Services (RAS) of Austin, Texas~~ Waste Stream Technology, Inc.(WST), and by Ecology & Environment, Inc. (E&E) of Lancaster, New York or will be distributed to a contracted laboratory based on competitive procurement. All laboratories to be used will maintain a current validation from the USACE MRD and will be approved as Hazardous Waste Testing Laboratories in support of USACE environmental investigations. Proof of current USACE validation will be required from the lab and will be verified with USACE. The laboratories also will have the appropriate state certifications for the analyses performed, if necessary.

Key Contract Laboratory Personnel

	RAS	WST	E&E
Laboratory Project Manager:	David Maxwell	Paul Morrow	Tony Bogolin
Laboratory QC Officer:	Don Burrows	Dan Vollmer	Ray Piccione

2.2.1 Laboratory Organization and Responsibilities

The contract laboratory will have an organization with well-defined responsibilities for each individual in the management system to ensure that sufficient resources are available to maintain a successful operation. Charts showing the laboratory's organization and lines of authority are included as figures in the laboratory's Quality Assurance Plan (QAP).

2.2.2 Laboratory Personnel Requirements

The analytical laboratory will maintain a staff of qualified personnel such that project quality requirements and schedules can be met. At a minimum, the Contract Laboratory will retain individuals to function in the following roles:

- Laboratory Management,
- Laboratory Quality Assurance Officer,
- Inorganic Section Manager(s),
- Organic Section Manager(s),

- Sample Custodian, and
- Data Management personnel.

The educational and experience requirements of laboratory project personnel will be as specified in USACE EM 200-1-3.

Quality Assurance Laboratory

QA split samples will be collected and sent to the USACE QA laboratory in Omaha, Nebraska at a to be determined location. The QA laboratory may perform the following functions:

- Inspection of QA samples to insure that sampling procedures correspond to applicable USACE and EPA documents with regard to sample container, preservation, holding times, labeling, and chain-of-custody;

- Analysis of QA samples;

- Evaluation of data deliverables specified; and

- Comparison of the analytical results obtained by the contract laboratory from split or replicate samples.

3.0 DATA QUALITY OBJECTIVES

The purpose of a quality assurance/quality control (QA/QC) program is to produce analytical measurement data of known quality that satisfy the project data quality objectives (DQOs). Data quality objectives are data quality planning and evaluation tools for all sampling and analysis activities. A consistent and comprehensive approach for developing and using these tools is necessary to ensure that sufficient, valid data are produced and that the data are of sufficient quality to make decisions for all types of sites and phases of investigation. The DQO process and Quality Assurance Objectives (QAOs) for program planning are presented in this section. An overall QA/QC program must be integrated with the DQOs to assure that data of known quality are produced and that the project DQOs have been satisfied.

3.1 The Data Quality Objective (DQO) Process

Mr. Fred Kozminski, Chemist, USACE-Buffalo District, and Mr. Steve Falatko, Project Chemist, Radian International, developed Tables 4-2 and 4-4 of the Chemical Sampling and Analysis Plan (CSAP). The sampling and analysis approach presented in these tables was prepared to support the remediation of the TNT Pipelines and Chemical Waste Sever/Lift Stations and was systematically developed using EPA's Data Quality Objectives Process for Superfund (540R-93-071) and USACE Technical Project Planning (TPP) Process (EM 200-1-2). Criteria considered for the development of the site-specific DQOs included:

a. Reviewing prior sampling and analytical results and associated documents, i.e, historical search;
b. Comments and responses to comments, provided by various agencies, for the current CSAP document;
c. Soil cleanup objectives (NYSDEC TAGM HWR-94-4046);
d. Waste acceptor criteria;
e. Media to be sampled and the spatial and temporal aspects of the media to be sampled;
f. Chemical and physical properties of the analytes of concern;
g. Analytical techniques and methodologies;
h. Necessary turnaround times to support the project;
i. Required QA/QC samples per USACE ER 1110-1-263; and
j. Statistical analysis to determine the number of samples required to effectively represent stockpiles.

The data use for the sampling and analysis summarized in Tables 4-2 and 4-3 have been organized into two major categories, critical and non-critical. The critical data use category includes the following subcategories:

1. ~~Investigative~~ Pre-excavation soil samples (homogenized 12-inch core samples collected from ~~0-12 inches beneath~~ the midpoints between the surface and the pipelines); ~~and~~

2. ~~Remediation soil/backfill samples (homogenized samples collected from the stockpiles).~~ Samples collected from the stockpiles will be analyzed for characterization and waste disposal purposes.

~~The investigative soil sample data will be used to identify areas of contamination that exceed target cleanup levels and to confirm that site cleanup criteria have been met after the removal action. The remediation soil/backfill~~ The pre-excavation sample data will be used ~~either~~ to determine whether the soil is appropriate for use as backfill. ~~or to characterize the soil for disposal~~. The non-critical data use category includes remediation sludge and aqueous samples. These sample data will be used to characterize the material for disposal.

3.1.1 DQOs and Data Use Planning

Data quality objectives specify the data type, quality, quantity, and uses needed to make decisions and are the basis for designing data collection activities. Guidance for the DQO process is provided in the *Data Quality Objectives Process for Superfund* (U.S. EPA, September 1993). Development of the DQOs occurs during the planning phase for each investigation and is site specific. Data collected during the interim removal actions will be used to:

Identify areas of contamination that exceed target cleanup levels to support decisions on the limits of the removal action;

Confirm that site cleanup criteria have been met following the removal action; and

Characterize waste for disposal.

The type, quantity, and quality of data needed vary among these uses, therefore, specifying a single sampling and analysis design or approach for all field activities and sites is not feasible. Instead, anticipated field, sampling, and analytical procedures are included in this QAPP, along with guidance and recommendations for selecting among the alternatives. This approach encourages efficient and cost-effective use of resources, reduces redundancy in the QAPP, and promotes consistency in delivery order implementation. It also promotes consistency and comparability among various suppliers and laboratories using the same procedures.

The data for the LOOW interim removal actions will be validated according to the procedures outlined in Section 7.0. The data will be evaluated for compliance with the QC objectives listed in Section 8.0, and flagged according to the data validation flags presented in Section 7.0.

3.2 Quality Assurance Objectives (QAOs)

Quality Assurance objectives are the detailed QC specifications for precision, accuracy, representativeness, comparability, and completeness. The QAOs established in this QAPP should be used for both sampling and analysis plan development and data quality review.

The chemical measurement data collected at the LOOW sites will be used to determine the extent of soil/sediment removal needed to remediate the site and to confirm that cleanup standards have been met following the removal action. Data acquired during the sample collection phase must be defensible. The quality objectives for the chemical measurement data specify the "quality" of the data needed to enable project personnel to make decisions (e.g., limits of removal). As such, the data quality objectives (DQOs) determine the type and quantity of data needed to make a decision, as well as the measurement objectives (precision, accuracy) for each type of measurement data collected.

The following sections discuss the steps that will be taken to ensure the validity of the data acquired during the LOOW Interim Removal Action. The representativeness of the measurement data is a function of the sampling strategy and will be achieved by following the procedures discussed in the CSAP. The quality of the analytical results is a function of the analytical system and will be achieved by using standard methods and the quality control system discussed in this section. The basis for assessing precision, accuracy, completeness, representativeness, and comparability is discussed in the following subsections. Specific calculations for data quality measurements, and the data assessment procedure, are presented in Section 9.0.

3.3 Definition of Criteria

This section defines how the chemical measurement data will be assessed during the LOOW Interim Removal Action.

3.3.1 Precision

Precision measures the reproducibility of repetitive measurements and is usually expressed in terms of relative percent difference. Precision is strictly defined as the degree of mutual agreement among independent measurements as the result of the repeated application of the same process under similar conditions. Analytical precision is a measurement of the variability

associated with duplicate (2) or replicate (more than 2) analyses of the same sample in the laboratory and is determined by analysis of matrix spike duplicates or laboratory control sample duplicates. Total precision is a measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and includes all possible sources of variability. Imprecision will be estimated for this project using the relative percent difference (RPD) between duplicate measurements of laboratory control samples.

Precision goals are contained in the laboratory's SOPs or protocol specifications. Precision goals will be met if duplicate analyses of laboratory control samples agree within the laboratory-derived specifications. Precision measurements for laboratory control samples outside specified criteria indicate the analytical system is out of control and require batch-related samples to be reanalyzed. Precision of the analytical measurement system will not be assessed by matrix spike duplicates or by field duplicates, both of which contain matrix effects which cannot be controlled. Results of these duplicate determinations will be used to evaluate the total imprecision possible in natural-matrix sample results.

3.3.2 Accuracy

Accuracy is a statistical measurement of correctness, and includes components of random error (variability due to imprecision) and systematic error (bias). It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value. Analytical method accuracy is typically measured by determining the percent recovery of known target analytes that are spiked into a field sample (a matrix spike) or reagent water or soil (laboratory control sample) before extraction, at known concentrations. Surrogate compound recovery is another spiking technique used to assess method accuracy for each sample analyzed for organic compounds. The stated accuracy objectives apply to spiking levels at five times the method detection limits or higher. The individual methods provide equations for acceptance criteria at lower spiking levels.

Both accuracy and precision are calculated for specific sampling or analytical batches, and the associated sample results must be interpreted considering these specific measures. Application of calculated precision and accuracy to measurement sample results is discussed in Section 9.0. An additional consideration in applying accuracy and precision is the concentration level of the samples; a procedure capable of producing the same value within 50 percent would be considered precise for low-level (near the detection limit) analyses of minor constituents, but would be unacceptable, and possibly useless, for major constituents at high concentrations.

Accuracy goals for laboratory control samples are contained in the laboratory's SOPs or protocol specifications. Accuracy goals will be met if individual laboratory control sample recoveries are within listed criteria. Laboratory control sample recoveries outside criteria indicate the analytical system is out of control and require samples to be reanalyzed.

3.3.3 Completeness

Completeness is calculated from the aggregation of data for each method for any particular sampling event. For each method and each site, the number of valid results, divided by the number of individual analyte results initially planned for, expressed as a percentage, determines the completeness for the data set. The objective for completeness is 90 percent. If there are any instances of samples that could not be analyzed for any reason (e.g., holding time violations in which resampling and reanalysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid possible results.

Valid results used to meet completeness objectives are those results which provide defensible estimates of the true concentration of an analyte in a sample. These valid results include data which are not qualified and data for which QC results indicate qualification is necessary but which may still be used to meet project objectives. Invalid results are those data for which there is an indication that the prescribed sampling or analytical protocol was not followed.

3.3.4 Representativeness

Representativeness is achieved through the use of standard sampling and analytical procedures described in the CSAP and this QAPP as well as the selection of appropriate sampling locations. The site-specific program design which includes sampling locations and procedures is described in the CSAP.

3.3.5 Comparability

Comparability is the confidence with which one data set can be compared to other data sets. The objectives for this QA/QC program are to produce data with the greatest degree of comparability possible. The number of matrices that will be sampled and the range of field conditions encountered must be considered in ultimately determining comparability. Comparability will be achieved by using standard methods for sampling and analysis, reporting data in standard units, and using standard and comprehensive reporting formats. Analysis of reference samples may also be used to provide additional information that can be used to assess comparability of analytical data produced within the laboratory and among laboratories if more than one laboratory is used on the project.

3.4 Overall Quality Assurance Objectives

The quality assurance objective (i.e., goal) for the LOOW Interim Removal Action is to have all analyses performed on analytical systems that are in statistical control and meet method specifications. The results for all field samples must be traceable to a laboratory control sample whose recovery (for both precision and accuracy) is within method-specified limits. Method specifications will be used as tolerance limits for the project. Laboratory derived limits used to statistically monitor analytical system control will be within method specifications. The method-specified limits for laboratory control samples are supplied in Section 8.0 along with method-specified limits for spike recoveries in natural matrix samples. Inaccurate or imprecise recovery of laboratory control samples will potentially invalidate results. Inaccurate or imprecise recovery of spikes in natural-matrix samples will not necessarily invalidate results. Poor recoveries of spikes in natural-matrix samples indicates the potential for matrix effects. A conclusion of matrix effects must be supported by laboratory control sample results within acceptance criteria for the analytical batch for which the matrix spike was performed.

4.0 SAMPLING PROCEDURES

This section describes the components of the sampling procedures that will be performed to meet the quality assurance objectives for the Interim Removal Actions at LOOW.

4.1 Sampling Protocols

Detailed sampling protocols are provided and discussed in the CSAP; these include the sampling locations, quality control (QC) specifications, documentation requirements, field forms, sampling procedures, and any special conditions or precautions that must be considered in the field. The CSAP also includes the experimental design, rationale for the design, and measurement parameters.

Prior to beginning each sampling event, the Chemical Quality Control Coordinator will ensure that the field personnel understand the purpose and objectives of the event. Topics of review and discussion with the team may include schedules, responsibilities, sampling locations, types of samples to be collected (both field samples and QC samples), number of samples collected, sample identification numbering schemes, preservation requirements, parameter(s) to be analyzed, sampling procedures, equipment decontamination procedures, and chain-of-custody requirements. All field activities must adhere to health and safety procedures described in the Site Safety and Health Plan for Interim Removal Actions at LOOW. Other facility-wide documents, including the Work Plan and Contractor Quality Control Plan (CQCP) should also be read and understood by all sampling personnel.

The specific site selection criteria, number of samples to be collected and parameters of interest are addressed in the CSAP.

4.2 Sampling Method Requirements

Sampling methods to be used for each sample type and location are described in the CSAP. During the project, the project manager, chemical quality control coordinator, remedial construction manager, and sampling team members must ensure that all measurement and field procedures specified in the CSAP are followed. If a problem arises, prompt action to correct the problem is imperative. Corrective action procedures are described in Section 10.0 of this QAPP.

4.3 Sample Custody and Holding Times

In order to preserve the quality and integrity of samples from time of collection until time of analysis, sample preparation, preservation, storage and shipment procedures have been established. Additionally, to accurately track all samples collected, a logical sample numbering system has been developed. Procedures and methods for accomplishing these activities are described in Section 4.0 of the CSAP.

5.0 CALIBRATION PROCEDURES AND FREQUENCY FOR FIELD TEST EQUIPMENT

This section contains brief descriptions of the analytical methods and calibration procedures for the field measurements collected during the LOOW Interim Removal Actions. Calibration procedures for field instrumentation are performed to ensure that the instruments are operating properly and produce data that can satisfy the objectives of the sampling program. Several types of real-time instruments are used to monitor and evaluate the physical parameters of water and soil. This screening level data is used to monitor worker health and safety and to assist sample collection. Field instruments/test kits used for this program may include:

pH meter
Conductivity meter,
Thermometer or temperature sensor
Real-time organic vapor monitoring instruments:

- Photoionization detectors (PIDs), such as HNU®, organic vapor monitor (OVM), and Micro TIP®, and
- ~~Flame ionization detectors (FIDs) or organic vapor analyzer (OVA).~~

To ensure that the instruments are operating properly and producing accurate and reliable data, routine calibration must be performed prior to and during use. Factory calibrations should be performed at a frequency recommended by the manufacturer. Field calibrations should be performed at the beginning and end of each day. Calibrations should be checked throughout the sampling day. If field calibration reveals that the instrument is outside established accuracy limits, the instrument should be serviced in the field. If necessary, return the instrument to the manufacturer for immediate repair and servicing. A backup instrument should be available for each of the critical real-time instruments used in the field.

5.1 Water Sampling Instrument Calibration

~~Field pH, conductivity, and turbidity meters, as well as thermometers may be used to measure water quality parameters when collecting waste water samples. The meters are calibrated prior to purging well water or collecting surface water. The pH, conductivity, and turbidity meters are calibrated with at least two standard calibration solutions that bracket the expected range of measurements. The calibration solutions are supplied by the manufacturer or are commercially available.~~

~~The instruments will be calibrated according to manufacturers' specifications before and after each field use, or as otherwise described below. Instruments will be calibrated, at a minimum, each day during field use~~. No onsite instrumentation will be used during water sampling.

~~5.1.1 pH Meter~~

~~Sample pH will be measured on site according to the requirements of method SW9040A. A pH sensor with the Hydrolab probe will be used for determining pH (to ± 0.1 pH unit) in ground water and for other water quality applications. This instrument will be calibrated according to the manufacturer's specifications daily with a two point calibration prior to sample analysis. If the drift exceeds 0.2 pH units, a new multipoint calibration will be performed.~~

~~5.1.2 Specific Conductance~~

~~Specific conductance will be measured on site according to the requirements of method SW9050. A specific conductance sensor on the Hydrolab probe can be used to measure specific conductance of the ground water. The instrument will be calibrated before analysis of the field samples using KCl solutions of known conductance. The calibration is checked at a frequency of 5% (at least once a day) with a single point calibration standard. If the response varies less than ±10% of the calibration check sample, calibration of the instrument is considered valid and any meter drift insignificant. A correction for any temperature deviation from 25°C can be made using recorded field temperature.~~

~~5.1.3 Temperature~~

~~Temperature will be measured according to the requirements of EPA Method 170.1. Onsite water temperature can be measured using a temperature sensor Hydrolab® probe. This sensor will be checked against a National Institute of Standards and Technology (NIST) reference thermometer. Temperature readings will be measured to the nearest °C or °F.~~

~~5.1.4 Turbidity Meter~~

~~Turbidity will be measured according to the requirements of EPA Method 180.1. Turbidity will be measured using the turbidity meter on the Hydrolab probe. A standard suspension of Formazin with turbidity within the expected range of sample turbidities will be used to calibrate the instrument daily to check the instrument's precalibrated scale. The instrument range is 0.1 to 200 nephelometric turbidity units (NTUs). The instrument will be calibrated daily with a 4.0 NTU standard. A new stock standard should be prepared monthly.~~

5.2 Real-Time Organic Vapor Monitoring Instrument Calibration

Real-time OVMs are routinely used to monitor total airborne organic vapors during field operations; measurements are used to evaluate worker health and safety. Personal protective equipment (PPE) requirements and site control decisions are based upon the results of real-time measurements. Real-time instruments also provide screening level data for volatile organic compound (VOC) concentrations in environmental media. Several types of OVMs are available. Generally, these instruments utilize one of two primary detection methods for quantifying total airborne VOCs: a FID or a PID. Calibration frequencies for each commonly used instrument are presented in the following subsections. Due to the rigors of field use, backup instruments should always be available. Detailed procedures for calibration and operation of these instruments are available from the distributors.

~~5.2.1 Flame Ionization Detector (FID)~~

~~Flame ionization detectors can measure total concentrations of hydrocarbon vapors. The instruments are generally calibrated using methane in air, and the instrument response for each specific compound is proportional to its response factor relative to methane.~~

~~The Century Systems Foxboro OVA (Models 88, 108, and 128) is the most commonly used FID field instrument. The recommended calibrations for field OVAs are:~~

Factory calibration and service once per year;

Five-point calibration using four methane-in-air standards and ultra-high purity (UHP) air performed once each quarter;

Three-point calibration using two methane-in-air standards and UHP air prior to daily use; and

Single-point calibration check using a representative methane-in-air standard after every four hours of operation and at the end of each working day.
No FID will be utilized at the Site.

5.2.2 Photoionization Detector (PID)

Photoionization detectors can measure total organic vapors and are highly sensitive to aromatic compounds, moderately sensitive to unsaturated chlorinated compounds, and less sensitive to aliphatic hydrocarbons. The instrument can respond to organic compounds with ionization potentials (IPs) less than the rated electron voltage (eV) of the ultraviolet (UV) bulb in the unit.

Due to its longevity and range of detectable contaminants, the most frequently used UV bulb is a 10.2 eV. Other bulbs are available from the manufacturer (e.g., 9.5 eV, and 11.7 eV). Field personnel must know which bulb is installed in the unit to ensure that the instrument is capable of detecting the particular contaminant of interest.

Several manufacturers produce instruments with PIDs for field monitoring of airborne VOCs. ~~The more common PIDs are HNU® Systems (PI-101), Thermo Environmental OVM (580 B), and Photovac MicroTIP® (Total Ionizables Present).~~ A Multiray PID will be utilized at the Site. Follow the manufacturer's calibration requirements. General guidance for PID calibration includes:

Factory service and calibration once per year;

The HNU Systems PI-101 requires a three-point calibration on a quarterly basis using UHP air and two representative concentrations of isobutylene-in-air standards;

For any PID instrument, a two-point calibration prior to daily use (UHP air and a representative concentration of isobutylene in air standard); and

Single-point calibration at the end of each day of use.

6.0 ANALYTICAL PROCEDURES

This section contains descriptions of analytical methods used for the analysis of soil, sludge, and liquid waste samples that will be collected during various phases of the LOOW Interim Removal Action.

6.1 Identification of Methods

The analytical methods identified in this document were published by the United States Environmental Protection Agency (U.S. EPA *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846,* Update III, or *Methods for Chemical Analysis of Water and Wastes*, (U.S. EPA, 1983). The analytical methods are presented in Table 6-1, and corresponding quantitation limits are presented in Tables 6-2 to 6-10.

6.2 Method Detection and Quantitation Limits

This section presents and defines limits to be used in describing detectable concentrations.

Table 6-1
Analytical Methods

Parameter	Analytical Method	
	Water	Soil
~~Moisture Content~~	~~NA~~	~~ASTM D2216 (modified)~~
PH	SW9040A[a]	SW9045B
~~Specific Conductance~~	~~SW9050~~[a]	~~NA~~
~~Temperature~~	~~EPA 170.1~~[a]	~~NA~~
~~Turbidity~~	~~EPA 180.1~~[a]	~~NA~~
Mercury	SW7470A	SW7471A
ICP Metals	SW6010B	SW6010B
~~Petroleum (Fuel) Hydrocarbons Purgeables (GRO)~~	~~SW8015B~~	~~SW8015B~~
~~Petroleum (Fuel) Hydrocarbons Extractables (DRO)~~	~~SW8015B~~	~~SW8015B~~
Organochlorine Pesticides	SW8081A	SW8081A
Polychlorinated Biphenyls (PCBs)	SW8082	SW8082
Volatile Organic Compounds	SW8260B	SW8260B
Semivolatile Organic Compounds	SW8270C	SW8270C
Explosives – Confirmation	SW8330	SW8330

[a]~~Field analyses~~.

SW= Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996.

EPA= Methods for Chemical Analysis of Water and Wastewater, EPA-600/4-79-020.

ICP= Inductively Coupled Plasma

NA= Not Applicable

ASTM= American Society for Testing and Materials

Table 6-2

Quantitation Limits for Indicator Methods

Method	Parameter	Quantitation Limits	
		Water (mg/L)	Soil (mg/Kg)
SW9040A(w) SW9045B(s)	PH	NA -0.01 pH Unit	NA 0.01 pH Unit
SW4050	Explosives	NA	1.0
ASTM D2216 (modified)	Percent Solids	4.0	0.1%

NA = Not applicable.

SW = Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996.

ASTM = American Society for Testing and Materials

(w) = water
(s) = soil

Table 6-3

Quantitation Limits for Cold Vapor AA

Method	Parameter	Analytes	Quantitation Limits	
			Water (mg/L)	Soil (mg/kg)[a]
SW7470A (w)/ SW7471A (s)	CVAA Metal	Mercury	0.001	0.014

[a]Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/ sediment, calculated on dry weight basis may be higher.

SW = Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996.

CVAA = Cold Vapor Atomic Absorption

(w) = water

(s) = soil

Table 6-4

Quantitation Limits for SW6010B ICPES Metals

Method	Analytes	Quantitation Limits	
		Water (ug/L)	Soil (mg/kg)[a]
SW6010B	Aluminum	25.0	2.5
	Antimony	11.0	1.0
	Arsenic	9.0	1.7
	Barium	5.0	1.0
	Beryllium	5.0	0.400
	Cadmium	5.0	1.0
	Calcium	24.0	2.4
	Chromium	5.0	1.0
	Cobalt	5.0	1.0
	Copper	9.0	1.0
	Iron	83.0	8.3
	Lead	15.0	4.10
	Magnesium	120	12.0
	Manganese	5.0	1.0
	Nickel	5.0	1.0
	Potassium	136	14.00
	Selenium	19.0	1.40
	Silver	5.0	0.50
	Sodium	120	12.0
	Thallium	8.0	1.30
	Vanadium	5.00	1.00
	Zinc	13.0	4.00

[a]Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory may be higher.

SW = Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996.

ICPES = Inductively Coupled Plasma Emission Spectroscopy

Table 6-5

Quantitation Limits for Petroleum Hydrocarbons Plus Gasoline Modified SW8015B Purgeables

Method	Parameter	Analytes [a]	Quantitation Limits	
			Water (µg/L)	Soil (µg/kg) [b]
Modified SW8015B	Petroleum (Fuel) Hydrocarbons Purgeables	Benzene	0.30	30
		Toluene	0.30	30
		Ethylbenzene	0.30	30
		Xylenes (Total)	0.50	50
		Gasoline	50	5000

[a]If the characteristic pattern does not appear but other non-target analytes eluting in the gasoline (approximately C6 to C10) carbon range are present, the non-target analytes are collectively quantitated against the gasoline standard and reported as "Unidentified Organics".

[b]Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory may be higher.

SW = Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996.

Table 6-6

Quantitation Limits for Petroleum Hydrocarbons, Extractable Modified SW8015B

Method	Parameter	Analytes a	Quantitation Limits	
			Water (µg/L)	Soil (µg/kg) [b]
Modified SW8015B	Petroleum (Fuel) Hydrocarbons Extractables	Diesel Fuel	50	5.0
		Jet Fuel (JP-4)	100	10
		Kerosene	100	10

[a]If the characteristic pattern does not appear but other non-target analytes eluting in the diesel (approximately C7 - C27) range are present, the non-target analytes are collectively quantitated against the diesel standard and reported as "Unidentified Organics".

[b]Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory may be higher.

SW = Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996.

Table 6-7

Quantitation Limits for SW8081A Organochlorine Pesticides and SW8082 Polychlorinated Biphenyls (PCBs)

Method	Parameter	Analytes	Quantitation Limits	
			Water (µg/L)	Soil (µg/kg) [a]
SW8081A	Organochlorine Pesticides	Aldrin	0.085	2.8
		alpha-BHC	0.016	0.5
		beta-BHC	0.030	1.0
		delta-BHC	0.047	1.6
		Chlordane	0.16	0.5
		alpha-Chlordane	0.020	2.0
		4,4'-DDD	0.027	0.9
		4,4'-DDE	0.024	0.8
		4,4'-DDT	0.084	2.8
		Dieldrin	0.025	0.8
		Endosulfan I	0.024	0.8
		Endosulfan II	0.029	1.0
		Endosulfan Sulfate	0.300	10
		Endrin	0.055	1.8
		Endrin Aldehyde	0.038	1.3
		Endrin Ketone	0.062	2.1
		Heptachlor	0.097	3.2
		Heptachlor Epoxide	0.042	1.4
		Methoxychlor	0.031	1.0
		Toxaphene	1.54	51
SW8082	PCBs	PCB 1016	0.25	46
		PCB 1221	0.31	38
		PCB 1232	0.27	63
		PCB 1242	0.23	29
		PCB 1248	0.32	15
		PCB 1254	0.26	9.0
		PCB 1260	0.24	10

[a]Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis may be higher.

PCBs = Polychlorinated Biphenyls

SW = Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996.

Table 6-8

Quantitation Limits for SW8260B Volatile Organic Compounds

Method	Parameter	Analytes	Quantitation Limits	
			5 mL Water (µg/L)	Soil[a] (µg/kg)
SW8260B	Volatile Organic Compounds	Acetone	100	100
		Benzene	5.0	5.0
		Bromodichloromethane	5.0	5.0
		Bromoform	5.0	5.0
		Bromomethane	10	10
		2-Butanone (MEK)	100	100
		Carbon disulfide	5.0	5.0
		Carbon tetrachloride	5.0	5.0
		Chlorobenzene	5.0	5.0
		Chloroethane	10	10
		Chloroform	5.0	5.0
		Chloromethane	10	10
		Dibromochloromethane	5.0	5.0
		1,1-Dichloroethane	5.0	5.0
		1,2-Dichloroethane	5.0	5.0
		1,1-Dichloroethene	5.0	5.0
		cis-1,2-Dichloroethene	5.0	5.0
		trans-1,2-Dichloroethene	5.0	5.0
		1,2-Dichloropropane	5.0	5.0
		trans-1,3-Dichloropropene	5.0	5.0
		cis-1,3-Dichloropropene	5.0	5.0
		Ethylbenzene	5.0	5.0
		2-Hexanone	50.0	50.0
		Methylene chloride	5.0	5.0
		Methyl isobutyl ketone	50	5.0
		Styrene	5.0	5.0
		Tetrachloroethene	5.0	5.0
		1,1,2,2-Tetrachloroethane	5.0	5.0
		Toluene	5.0	5.0
		1,1,1-Trichloroethane	5.0	5.0
		1,1,2-Trichloroethane	5.0	5.0
		Trichloroethene	5.0	5.0
		Vinyl chloride	10	10
		m/p-Xylene	5.0	5.0
		o-Xylene	5.0	5.0

[a]Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on a dry weight basis may be higher.

SW = Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996.

Method	Parameter	Analytes	Quantitation Limits	
			Water (µg/L)	Soil (mg/kg) [a]
		N-Nitrosodipropylamine	10	0.33
		Phenanthrene	10	0.33
		Pyrene	10	0.33
		1,2,4-Trichlorobenzene	10	0.33
Acid Extractables				
SW8270C		4-Chloro-3-methylphenol	20	0.66
		2-Chlorophenol	10	0.33
		2,4-Dichlorophenol	10	0.33
		2,6-Dichlorophenol	10	0.33
		2,4-Dimethylphenol	10	0.33
		4,6-Dinitro-2-methylphenol	50	1.65
		2,4-Dinitrophenol	50	1.65
		2-Methylphenol	10	0.33
		4-Methylphenol [c]	10	0.33
		2-Nitrophenol	10	0.33
		4-Nitrophenol	50	1.65
		Pentachlorophenol	50	1.65
		Phenol	10	0.33
		2,4,5-Trichlorophenol	10	0.33
		2,4,6-Trichlorophenol	10	0.33

[a]Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment calculated on dry weight basis may be higher.

[b]Analyzed as a tentatively-identified compound (TIC).

[c]3- and 4-Methylphenol coelute. Laboratory uses 4-methylphenol in the calibration curve.

SW = Test Methods for Evaluating Solid Waste, Third Edition (Update III), December 1996

Table 6-10

Quantitation Limits for SW8330 Explosives (Nitroaromatics/Nitroamines)

Compounds[a]	Water (µg/L) Low-Level	Soil (mg/kg)[a]
HMX	0.39	0.25
RDX	0.156	0.100
1,3,5–TNB	0.156	0.100
1,3–DNB	0.156	0.100
Tetryl	0.312	0.200
NB	0.156	0.100
2,4,6–TNT	0.156	0.100
4–Am–DNT	0.312	0.200
2–Am–DNT	0.312	0.200
2,6–DNT	0.312	0.200
2,4–DNT	0.156	0.100
2–NT	0.312	0.200
4–NT	0.78	0.500
3–NT	0.312	0.200

a. Compound	Abbreviation	CAS No
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4
1,3-Dinitrobenzene	1,3-DNB	99-65-0
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8
Nitrobenzene	NB	98-95-3
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7
4-Amino-2,6-dinitrotoluene	4-Am-DNT	1946-51-0
2-Amino-4, 6-dinitrotoluene	2-Am-DNT	355-72-78-2
2,4-Dinitrotoluene	2,4-DNT	121-14-2
2,6-Dinitrotoluene	2,6-DNT	606-20-2
2-Nitrotoluene	2-NT	88-72-2
3-Nitrotoluene	3-NT	99-08-1
4-Nitrotoluene	4-NT	99-99-0

1. Analysis performed by E&E Laboratories

6.2.1 Terminology

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The quantitation limit is defined as the reporting limits presented in Tables 6-2 through 6-10. Blank concentrations should be below the quantitation limit; if not, or corrective action may be taken. Corrective action is not necessary if the concentration in the field samples is greater than 10 times the blank concentration.

The laboratory will perform MDL studies on an annual or quarterly basis (depending on the method) to demonstrate that it can meet or exceed the method recommended MDLs or quantitation limits. The U.S. EPA procedure used for establishing MDLs is described in Appendix B to Part 136 "Definition and Procedure for the Determination of the Method Detection Limit" - Revision 1.11, 40 CFR 136, 1986. This procedure consists of analyzing (using all sample processing steps specified in the method) seven aliquots of a standard spiked at three to five times the expected MDL. The MDL is defined as three times the standard deviation of the mean value for the seven analyses. In addition, the laboratory may establish reporting limits which are verified by the MDL studies and included on the laboratory's analytical reports.

6.3 Method Description and Calibration

This section describes the extraction and analytical methods to be used for samples collected during the LOOW Interim Removal Actions. Calibration information is summarized for each analytical method.

6.3.1 Extraction

Extraction methods for solid and liquid matrices are briefly described in this section.

SW3005A—Acid Digestion of Aqueous Samples

This method is an acid digestion procedure used to prepare water samples for metals analysis. Digested samples can be analyzed for total recoverable metals by inductively coupled plasma (ICP) emission spectroscopy.

For total recoverable metals, the entire sample is acidified at collection time with nitric acid (HNO_3). During analysis, the sample is heated with acid and reduced to a specific volume. The

sample must not be boiled because losses may occur through volatilization or spattering. The digestate is then filtered and the volume is adjusted to the desired concentration for analysis.

SW3010—Acid Digestion for Metals

SW3010 is used to prepare liquid samples for total metals (except for antimony and silver) determination by FLAA and ICP. The samples are vigorously digested with nitric acid and diluted with hydrochloric acid.

SW3020—Acid Digestion for Metals

SW3020 is used to prepare unfiltered liquid samples for total metals determination by GFAA spectroscopy. The samples are vigorously digested with nitric acid followed by dilution with ASTM Type II water.

SW3050—Acid Digestion for Solids, Sediments, and Sludges for Metals Determinations

SW3050 is applicable to the preparation of sediment, sludge, and soil samples for metals analysis by FLAA, GFAA, or ICP.

An approximately 1 gram (g) (wet weight) sample is treated and digested in nitric acid and hydrogen peroxide. The digestate is refluxed with nitric or hydrochloric acid, depending on the type of analysis to be performed. When using HCl as the final refluxing acid, do not boil because losses may occur through volatilization and spattering. A separate sample is dried for a total solids and/or percent moisture determination.

Some sludge samples can contain diverse matrix types, which may present specific analytical problems. Spiked samples and any relevant standard reference material should be processed to help determine whether SW3050 is applicable to a given matrix.

SW3500 Series Methods—Organic Extraction and Sample Preparation

The SW3500 series methods are used to extract nonvolatile organic compounds and SVOCs from various sample matrices. Prior to analysis, a sample of a known volume or weight is solvent extracted; then the extract is dried and concentrated in a Kuderna-Danish apparatus or equivalent (e.g., Turbovap).

SW3510C—Separatory Funnel Extraction

SW3510C is used to extract nonvolatile organic compounds and SVOCs from aqueous samples with standard separatory funnel techniques. The sample and extracting solvent must be immiscible so that target compounds can be recovered. Subsequent cleanup and detection methods are described in the organic analytical method used to analyze the extract.

Samples are adjusted to a specified extraction pH and extracted with the appropriate solvent for the analytical method. Methylene chloride should be employed when a solvent is not specified. Samples are extracted three times, and the combined extracts are dried with anhydrous sodium sulfate and concentrated.

SW3520C—Continuous Extraction

SW3520C is used to extract nonpurgeable organic compounds from aqueous samples using a continuous extraction apparatus. By minimizing emulsion formation, the method improves target compound recovery. The sample and extraction solvent must be immiscible and the solvent must be heavier than water. Subsequent cleanup methods and detection are described in the analytical methods.

After being placed into a continuous extraction apparatus adjusted to the specified extraction pH, each sample is extracted with the appropriate solvent. Methylene chloride should be employed when a solvent is not specified. The extraction pH and solvent to be used are listed in the quantification method. Samples are extracted for 18 hours; then the extract is collected, dried with anhydrous sodium sulfate, and concentrated. For SW8270c, the sample pH is adjusted after the first extraction, and continuous extraction occurs for 18 hours to recover another class of compounds.

SW3540C—Soxhlet Extraction

SW3540C is used to extract nonvolatile organic compounds and SVOCs from solids such as soils and sludges. The Soxhlet extraction process ensures intimate contact of the sample matrix with the extraction solvent. Extraction is accomplished by mixing the solid sample with anhydrous sodium sulfate, placing it in an extraction thimble or between two plugs of glass wool, and extracting it for 16 to 24 hours with an appropriate solvent in the Soxhlet extractor. Methylene chloride should be employed when a solvent is not specified. After being dried and concentrated, the extract is treated using a clean-up method or is analyzed directly by the appropriate measurement technique.

SW3550—Sonication Extraction

SW3550 is a procedure for extracting nonvolatile organic compounds and SVOCs from solids such as soils and sludges. The sonication process ensures intimate contact of the sample matrix with the extraction solvent.

A weighed sample of the solid waste or soil is mixed with anhydrous sodium sulfate, then dispersed into the solvent with sonication. The extract is gravity or pressure filtered and concentrated. The resulting solution may then be cleaned up or analyzed directly using the appropriate technique. Methylene chloride is typically used as the solvent, although other solvents may be used for specific analytical applications.

The method is divided into two sections based on the expected concentration of organics. For low concentrations (organic components <20 mg/kg), the sample size is usually 30 g, and the extraction process is repeated three times with fresh solvent each time. For high concentrations, the sample size is 2 g and the extraction is performed just once. Treatment of the extracts beyond this step is the same regardless of whether the anticipated levels are high or low.

SW3650—Acid-Base Cleanup

The SW3650 cleanup procedure is employed to separate acidic or basic components from interferences that prevent direct chromatographic measurement, and is based on the preferential solubility between compounds of interest and interfering species. The method allows for a choice of solvents to optimize extraction of specific species.

An aliquot of the sample is mixed in a separatory funnel with solvent and distilled water, and the pH is adjusted to 12-13 with sodium hydroxide. After extraction, the aqueous phase is collected. The solvent phase is extracted twice more with distilled water and the aqueous extracts are combined.

The solvent phase will contain the neutral and basic organic compounds. The aqueous phase will contain the acidic organic compounds in the form of dissociated salts. If the acidic components are of interest, the aqueous phase may be acidified to pH 2 and extracted with solvent. The original solvent phase or the acid extract solvent phase may be concentrated for cleanup or analysis.

SW5030—Purge-and-Trap Method

SW5030 is used to remove and concentrate volatile organic compounds (VOCs) from a variety of liquid and solid matrices prior to GC analyses. The method is applicable to nearly all types of samples, including water, waste, and soils. The success of this method depends on the level of interferences in the sample; results may vary due to the large variability and complexity of solid waste sample matrices.

A direct purge-and-trap is performed for low-concentration soils. If higher concentrations are expected, a portion of the solid sample is dispersed in methanol to dissolve the volatile organic constituents, and a portion of the methanol solution is combined with water in a purging chamber. An inert gas is bubbled through the solution at ambient temperature to transfer the volatile components to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a GC column. The GC column is temperature-programmed to elute the components detected by the appropriate detector.

Method ASTM D2216, Modified—Percent Moisture

Percent moisture is determined for solid samples undergoing analysis for organic and inorganic analytes. The percent moisture must be known so that the analytical results can be reported on a dry weight basis (i.e., µg/kg or mg/kg). The sample is weighed, dried, and then reweighed. Percent moisture is calculated as:

$$\frac{\text{Initial Weight - Dried Weight}}{\text{Initial Weight}} \times 100.$$

The aliquot used to determine percent moisture should not be used for analysis by any other method.

6.3.2 Inorganic Analytical Methods

Inorganic methods for liquid and solid matrices are briefly described in this section.

~~**SW9050—Conductance**~~

~~Sample conductance is measured on site according to method SW9050. Standard field meters are used, and the electrode is rinsed with sample prior to measuring conductance; temperature is also~~

~~reported. The meters are standardized daily using KCl solutions of known conductance with an allowance of ±5% of the expected value~~.

SW9040A/9045C—pH

~~Field and l~~ Laboratory pH measurements may be taken for water samples; the pH of soil samples is measured in the laboratory. All measurements are determined electrometrically using either a glass electrode combined with a reference potential or a combination electrode. The meters are calibrated daily using at least two buffer solutions.

~~**EPA Method 170.1—Temperature**~~

~~On-site water temperature is measured using U.S. EPA Method 170.1. A standard mercury thermometer is rinsed twice with sample prior to recording the temperature. Thermometer calibration is checked against a NIST-traceable standard thermometer.~~

SW6010B—Trace Elements (Metals) by ICP for Water and Soil

Water and soil samples are analyzed for trace elements or metals using method SW6010B. Analysis for most metals requires digestion of the sample by nitric acid. This digestion is performed using method SW3005 for water or SW3050 for soil. Following digestion, the trace elements are simultaneously or sequentially determined using ICP.

SW7470A/7471A—Mercury - Manual Cold-Vapor Technique

Water and soil samples are analyzed for mercury using methods SW7470A and SW7471A, respectively. Each method is a cold-vapor flameless AA technique based on the absorption of radiation by mercury vapor. Mercury is reduced to the elemental state and aerated from solution. The mercury vapor passes through a cell positioned in the light path of an AA spectrophotometer. Mercury concentration is measured as a function of absorbance.

6.3.3 Organic Analytical Method

Brief descriptions of the organic methods for liquid and solid matrices are presented below.

~~**SW8015B—Volatile and Extractable Total Petroleum Hydrocarbons**~~

~~Volatile petroleum hydrocarbon components, gasoline, other low molecular weight petroleum products and volatile aromatics, and benzene, toluene, ethyl benzene, and xylenes (BTEX) are~~

~~analyzed with the direct purge and trap technique described in method SW5030; or are methanol-extracted, followed by a modified approach to SW8021 and SW8015B (see following method description). Extractable total petroleum hydrocarbon (TPH) components, jet fuel, diesel, oils, and heavier molecular weight petroleum products are analyzed using extraction by SW3510/3520 or SW3540/3550, followed by GC analysis with a flame ionization detector (FID).~~

~~For volatile TPH, either 5 mL of water or 5 g of soil/sludge is placed in the purge and trap sparge vessel or is extracted into methanol. For soil/sludge, 5 mL of reagent grade organic free water is also added. Analysis is conducted using a GC equipped with an inlet splitter, two fused silica megabore columns, and FIDs and photo ionization detectors (PIDs). The BTEX components are confirmed on a second GC column of dissimilar phase and retention characteristics if no petroleum pattern is present.~~

~~Extractable TPH components, jet fuel, kerosene, diesel, motor oil, and other high molecular weight extractable petroleum products are analyzed via SW3510/3520 for water based matrices or SW3540/3550 for soil/sludge matrices. Hexane or methylene chloride or a 1:1 ratio of hexane/acetone is used as the extracting solvent. One liter of water or 10 20 g of soil/sludge are extracted and concentrated to a volume of 5 mL. Analysis is performed with a GC equipped with a capillary or megabore column and a FID.~~

~~Identification and quantitation of TPH components (except BTEX) is based on pattern recognition techniques and requires a greater degree of analytical judgement than other GC methods. The TPH chromatograms consist of groups of peaks that have a general shape or pattern and that fall within a noted carbon range (number of carbon atoms in the molecule). Selected TPH components are used to calibrate the instruments, and the resulting patterns and carbon ranges are used to compare the sample results. These components are usually reported as a gas, BTEX, or TPH range, with components matching the identified calibrated patterns. Often, unknown/uncalibrated hydrocarbons are encountered and are reported as such on the laboratory report.~~

SW8081A/SW8082—Organochlorine Pesticides/Polychlorinated Biphenyls (PCBs)

Organochlorine pesticides and polychlorinated biphenyls (PCBs) in water and soil samples are analyzed using methods SW8081A and SW8082, respectively. These analytical methods involve extraction of the sample with methylene chloride, followed by exchange to hexane, and concentration of the extract. The pesticides and PCBs are separated and quantified by GC using electron capture detection. Only pesticides or PCBs may be requested for analysis if applicable for a site. In those cases, calibration and continuing calibration are only required for the analytes requested.

SW8260B—Volatile Organics

Volatile or purgeable organics in water and soil samples may be analyzed using method SW8260B. This method consists of a purge-and-trap gas chromatography/mass spectrometry (GC/MS) technique. The same procedure as described in SW5030 is used to remove the VOCs from the sample matrix onto an adsorbent trap. The trap is backflushed and heated to desorb the purgeable organics onto a GC, where the organics are separated and subsequently detected with a mass spectrometer.

These methods use the internal standard technique for quantitation, where the concentration of each analyte is calculated relative to the nearest eluting internal standard. In the calibrations, a response factor is calculated relative to the designated internal standard. Therefore, instead of absolute response factors, all calculations and some data acceptance criteria are based on relative response factors (RRFs).

SW8260B may be used to analyze water samples to determine VOCs as an alternative to SW8021. SW8260B is a capillary column analysis that permits the use of a greater volume of the water sample than SW8240 to achieve maximum reporting limits approximately equivalent to SW8021. Other than sample volume, the analyte list and system performance check compound (SPCC) calibration criteria, and the analytical and QC procedures for SW8260B are equivalent to those for SW8240.

Chromatographic peaks that do not correspond to target analytes may be determined as tentatively identified compounds (TICs) based on comparison with a National Institute of Standards and Technology (NIST) library of mass spectra. When applicable, a fit factor is included with each TIC to assess compound identification accuracy. The TIC concentration is estimated by assuming that its RRF is equal to one.

SW8270C—Semivolatile Organics Analysis

Semivolatile organics, also known as base/neutral and acid extractables (BNA), are analyzed using SW8270C in water and soil samples. This technique is used to determine the concentration of a number of SVOCs. Organic compounds are extracted from the sample with methylene chloride at pH greater than 12 to obtain base/neutral extractables. Acid extractable compounds are obtained by a second extraction with methylene chloride after the pH has been adjusted to 2 or less. Both base/neutral and acid extracts are then concentrated by removing methylene chloride through evaporation. Compounds of interest are separated and quantified using a GC/MS.

SW8330—Explosives (Nitroaromatics and Nitroamines)

Method SW8330 will be used to determine the concentrations of trace levels of explosive residues in soil and liquid and sludge waste samples. The list of target analytes determined using this method include compounds used in the manufacture of explosives, the explosive compounds themselves, and degradation products. Aqueous samples of low concentration are extracted by a salting-oil procedure using acetonitrile and sodium chloride. Soil and sludge samples are extracted using acetonitrile in an ultrasonic bath. Aliquots of the extracts/samples are separated on a C-18 reverse phase column, using high-performance liquid chromatography and determined with a UV detector at 254 nm and confirmed on a CN reverse phase column.

~~**SW4050—TNT Explosives in Soil by Immunoassay**~~

~~Commercially available test kits (e.g. TNT Explosives Field Test Kit, D Tech, or equivalent) will be used to determine whether the soil samples collected contain explosive residues at or above detonable levels. The soil samples will be are extracted and then mixed with antibodies and color developing solutions. The resultant color change is then compared to color cards or measured with a spectrophotometer~~.

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

The data reduction, validation, and reporting procedures described in this section will ensure that complete documentation is maintained, that transcription and data reduction errors are minimized, the quality of the data is reviewed and documented, and the reported results are properly qualified.

7.1 Data Management

The primary data management activities for the LOOW Interim Removal Actions project will include:

Data transfer from field and laboratory activities to a project filing system;

Data management to ensure that data are stored and output in a manner that continues the chain of custody;

Requirements review to ensure that plans for data collection were fulfilled;

Analytical data validation which will report data to be used for remedial activities; and

Reporting functions may include outputting data for report tables, statistical analysis, interpretation of data, and electronic transfer.

A computerized project database may be used for data management on the LOOW project. The proposed database will be implemented in a relational data management software and will be based upon project databases. The database is used to store, transfer, and report analytical data. A series of programs (e.g., EXPORT®) allows electronic reporting of data. The laboratory is responsible for generating hard copies and EXPORT® files for the analytical results. Both the hardcopy analytical reports and electronic data files are transferred to the Chemical Quality Control Coordinator and/or data management staff. The laboratory provides additional documentation regarding chain-of-custody procedures, etc., that are not transmitted via electronic files.

7.2 Data Reduction

The laboratory analyst is responsible for the reduction of raw data generated at the laboratory bench. The data interpretation that is required to calculate sample concentrations follows the methodology described in the specific analytical standard operating procedure (SOP). After all analyses have been completed and reported, the laboratory manager or designee reviews the raw

data and verifies that the analyses were properly performed and reported. The laboratory manager may then transfer the raw data to the document control area, where the raw data are filed if needed for a subsequent quality control (QC) review. Raw data, together with all supporting documentation, are stored in confidential files by document control.

After all analyses for a report are complete, the data are entered into the laboratory reporting system and a preliminary report is generated for review by the laboratory managers. This review is followed by a quality check carried out by a peer reviewer.

7.3 Laboratory Reporting

The laboratory will report the data in a format that will allow raw data validation to take place if necessary. This means that the sample results should be able to be recreated from the data presented in the package. The raw data required will include laboratory instrument printout including chromatograms and mass spectra, calibration records, sample preparation records, spiking information, and dilution records. In addition, the laboratory will present reports that will contain enough information for flagging the data according to data qualifier flags, including date prepared, date analyzed, sample results, dilution factors, spike levels and percent recoveries, calibration summaries, blank results, and laboratory duplicate results. All surrogate recoveries must be reported including recoveries for QC samples and field samples.

7.4 Data Quality Assessment.

The data validation task for this project will consist of reviewing three areas of data quality. The QC checks used to assess measurement precision are field duplicates, laboratory control sample duplicates, and matrix spike duplicate samples. The QC checks used for the assessment of measurement accuracy are laboratory control samples, matrix spikes and surrogate spikes. The third group of QC data reviewed are the results for field and laboratory (i.e., method) blanks. All of the laboratory reports are reviewed for the categories listed below

Organics Data Packages:

Technical Holding Times;
Instrument Performance Check (GC/MS, GC/ECD, etc.);
Initial and Continuing Calibration;
Blanks;
Surrogates;
Laboratory Control Sample Duplicates;
Matrix Spikes/Matrix Spike Duplicates;

Internal Standards;
Tentatively Identified Compounds (if requested).

Inorganics Data Packages:

Technical Holding Times;
Initial and Continuing Calibration Standards;
Blanks;
Laboratory Control Sample Duplicates;
Duplicate Samples;
Matrix Spike Sample Duplicates;
Analytical Spike Sample (as necessary);
ICP Serial Dilution;

7.5 Data Validation Reporting

The Project QA Coordinator, or other QA staff, will review and summarize all QC sample results to evaluate the sampling and analytical performance. Reagent and field blank results will be evaluated to identify any systematic contamination; spike and duplicate results will be compared to the QA objectives presented in Section 8.0, and the results used to calculate precision and accuracy for the data set. This process will identify analytical methods and compounds for which the QA objectives are not satisfied and corresponding sample data will be qualified with a "flag" indicating the problem. Samples collected on the same day, or analyzed in the same run or batch, or individual samples may be flagged, depending on the type of problem that has been identified. Reanalysis or resampling may be recommended as a corrective action at this time if data are determined to be unacceptable for the intended application. Data assessment procedures and the corresponding corrective actions are described in Sections 9.0 and 10.0.

QC results will be reported by sample matrix and analytical method in tabular form. The measurement data will be discussed and qualified as appropriate based on the QC results. For example, matrix spike interference will influence specific samples or matrices, while laboratory blank contamination will influence all samples extracted or analyzed on a specific day or during a specific analytical run.

In cases where there are a large number of QC analyses of one type, a second level, or summary, table may be constructed. The summary tables will typically report mean or pooled statistics to describe the overall performance of the method. For example, the summary table of duplicate sample results might report the average RPD for all duplicates measured for the compound, and indicate the number of individual RPDs that did not meet the acceptance criteria. This type of

table can serve as an indication of the overall QC results. However, these applications will often have to be developed or modified from existing programs for individual investigations. A summary assessment of the data presented in these tables will be prepared for each phase of sampling, as appropriate.

Custom table formats will be used as an aid to interpretation of the investigative data. The particular format will depend on how the QC results are expected to influence the investigative data and will be developed by data management staff through discussion with the users. For example, QC results may be grouped with analytical batches, field collection batches, or summarized for the entire project.

The data validation report will include a narrative explanation of what samples the report applies to, a reference to the criteria or procedures used to qualify the data, a description of which results were qualified and why, and the hand-annotated laboratory report with the applicable qualifiers. This report will accompany the QC data summary.

8.0 INTERNAL QUALITY CONTROL CHECKS

This section of the QAPP identifies the specific internal QC methods to be used by the analytical laboratories selected for this project.

The overall QA objective is to implement QC procedures during laboratory analysis and reporting that will generate data of the quality consistent with their intended use. Internal QC checks are used to determine whether analytical operations are in control, and to determine the effect sample matrix may have on the data that are generated. These two aspects are described as batch QC and matrix-specific QC procedures, respectively. These procedures are described in this section.

The type and frequency of specific QC samples processed by the contract laboratory must adhere to the analytical method specifications and must be documented in the laboratory's SOPs. The minimum laboratory QC requirements are specified within the methods referenced for each analytical parameter. Data that vary from these target ranges will trigger the implementation of appropriate corrective measures, potential application of data qualifiers, and/or an assessment of the impact these corrective measures have on the usability of the data in the decision-making process. Corrective action requirements are further addressed in Section 10.0 of this QAPP.

At a minimum, full documentation of all actions taken will be recorded within a case narrative, which will be transmitted to CELRB with the laboratory data package. If necessary, ~~Radian~~ WST and E&E will provide immediate verbal notification to the CELRB Contracting Officer's Representative (COR) or District chemist for input on corrective action requirements, deviations to protocol taken on future samples, final decisions on data usability, etc.

8.1 Batch QC

8.1.1 Method Blanks

Method blanks are analyzed to assess the level of background interference or contamination that exists in the analytical system and that might lead to the reporting of elevated concentration levels or false positive data. The method blank is defined as a blank matrix to which all reagents are added in the same volumes or proportions as those used in sample preparation and which is carried through the complete sample preparation and analytical procedure. At least one method blank will be analyzed with every batch of samples processed.

Criteria for determining blank acceptability are based on consideration of the analytical techniques used, analytes reported, and quantitation limits required. In general, no contaminants should be detected above the target quantitation limits in the blanks.

8.1.2 Laboratory Control Samples

Evaluation of laboratory performance will be based on the use of standard control matrices that are prepared independently from the standard solutions used in establishing the calibration curve, to calculate precision and accuracy data. These data, along with method blank data, will be used to assess daily laboratory performance.

8.1.3 Other Laboratory QC Samples

Additional appropriate QC requirements are detailed within the specific analytical methods and each laboratory's QAP, and will be analyzed and reported if required.

8.2 Matrix Specific QC

Matrix-specific QC will be based on the use of an actual environmental sample for precision and accuracy determinations and includes the analysis of matrix spikes and matrix spike duplicates. The required frequencies of these analyses are a minimum of 1 matrix spike and matrix spike duplicate per 20 primary samples or 1 pair per analytical batch, which ever is more frequent. Results of these samples, supplemented with laboratory and field blank results, will be used to assess the effect of sample matrix and field conditions on analytical data.

9.0 PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The evaluation/assessment of measurement data is required to ensure that the QA objectives for the program are met and that quantitative measures of data quality are provided. It must be assumed that the planning, standard procedures, and monitoring activities conducted during the sampling and analysis process have served to control the process as much as possible to produce data of sufficient quality for project needs. After the data have been reported, it is necessary to identify any part of the process that could not be controlled, and to what extent that may affect the quality of the reported data.

The routine quality control procedures conducted in the laboratory are established in the published methods, and the analytical SOPs. The laboratory is responsible for following those procedures and operating the analytical systems within statistical control limits. These procedures include proper instrument maintenance, calibration and continuing calibration checks, and internal quality control sample analyses at the required frequencies (i.e., reagent blanks, surrogate spikes, matrix spike/matrix spike duplicate [MS/MSD], analytical spikes, laboratory duplicates). One of the additional ongoing data assessment processes is maintaining control charts for representative QC sample analyses to monitor system performance. This provides verification that the system is in statistical control, and indicates when performance problems occur, so the problems can be corrected as soon as possible. When reporting the sample data, the laboratory is required to provide the results of associated QC sample analyses so the project staff can evaluate the performance of the analytical process.

Problems with analytical data can occur in spite of all precautions taken in planning and execution of the sampling and analysis task. In these cases, the data assessment conducted by the project QA staff after the data have been reported must identify the problem, determine which data are affected, state how these data may be limited for use in the intended applications, and make recommendations for corrective actions as necessary.

The discussion of data assessment presented in this section pertains to the project-related assessment of data that is performed after data have been reported and laboratory analyses have been completed.

Data assessment procedures that will be performed for this project include:

- Initial review of analytical and field data for complete and accurate documentation, holding time compliance, and required frequency of QC sample collection and analysis;

- Evaluation of blank results to identify systematic contamination;

- Statistical calculations for accuracy and precision using the appropriate quality control sample results;

- Estimates of completeness, in terms of the percent of valid unqualified data; and

- Assigning data qualifier flags to the data as necessary to reflect limitations identified by the process.

- Qualified data will be discussed in the task reports, and data flags can be transmitted to users via data tables from the database and in analytical data reports.

9.1 Precision

Control limits for control sample analyses, acceptability limits for replicate analyses, and response factor agreement criteria specified for calibration and internal QC checks are based upon precision, in terms of the coefficient of variation (CV) or the relative percent difference (RPD). The standard deviation (S) of a sample set is calculated as:

$$S = \sqrt{\frac{\sum \left(x - \bar{x}\right)^2}{(n-1)}}$$

where:

x = Individual measurement;

$\bar{x}$ = Mean value for the individual measurements; and

n = Number of measurements.

The CV as a percentage is then calculated as:

The RPD calculation allows for the comparison of two analysis values in terms of precision with no estimate of accuracy. Relative percent difference is calculated as:

$$RPD = \frac{|M - m|}{\left(\frac{M + m}{2}\right)} \times 100$$

$$CV = \left(\frac{S}{\bar{x}}\right) \times 100$$

where: M = First measurement value; and
m = Second measurement value.

For duplicate measurements, CV is related to RPD by the following:

$$CV = \frac{RPD}{\sqrt{2}}$$

Precision is a measure of variability between duplicate or replicate analyses, and is calculated for field and laboratory replicates. By definition, field or total precision incorporates laboratory precision. Precision is calculated as the RPD between duplicate samples or analyses, or matrix spike/matrix spike duplicates as appropriate. The calculated RPDs are compared to the objectives stated in Section 8.0. Results that do not satisfy the objectives are assigned a data qualifier flag indicating uncertainty associated with imprecision.

An average RPD may be calculated and reported as a measure of overall analytical precision for compounds with multiple measurements. The specific samples collected or analyzed in duplicate are flagged if they do not satisfy the QA objectives. In addition, associated samples may be flagged to indicate variability due to poor precision. For poor field duplicate precision, samples collected by the same sampling team, from the same equipment, or on the same day may be affected; close evaluation of those results should indicate the most likely source of variability, and the corresponding samples will be qualified as warranted. For poor laboratory precision, samples processed and analyzed in the same batch will be more closely evaluated, and any anomalous results will be qualified.

The QA Coordinator is responsible for ensuring that data qualifier flags are assigned to the data as required by the established QC criteria, and that they are reported and understood by project staff using the data for specific applications. The QA Coordinator is also responsible for initiating corrective actions for analytical problems identified during the QC data assessment process. These corrective actions range from verifying that the method was in statistical control during the analytical runs, to reanalysis of the sample, or resampling.

9.2 Accuracy

The accuracy of data is typically summarized in terms of relative error (RE). This calculation reflects the degree to which the measured value agrees with the actual value, in terms of percent of the actual value. Relative error is calculated as:

$$\%\,RE = \frac{\text{Measured Value - Actual Value}}{\text{Actual Value}} \times 100$$

This way of expressing accuracy allows for a comparison of accuracy at different levels (e.g., different concentrations) and for different parameters of the same type (e.g., different compounds analyzed by the same method). Control sample analyses are typically evaluated using this calculation.

Another calculation frequently used to assess the accuracy of a procedure is the percent recovery. Percent recovery is a calculation used to determine the performance of many of the quality control checks, where:

$$\%\,\text{Recovery} = \frac{\text{Measured Value}}{\text{Actual Value}} \times 100$$

Another similar calculation used to determine the performance of a method for recovery of a spike concentration added to a sample is the percent spike recovery calculation. The percent spike recovery is determined as:

As previously defined, accuracy is associated with correctness, and is a comparison between a measured value and a known, or "true" value. Accuracy is calculated from method spike (spikes

$$\%\text{SpikeRecovery} = \frac{[(\text{Measured Sample Value Plus Spike}) - (\text{Measured Sample Value})]}{(\text{Value of Spike Added})} \times 100$$

of the pure matrix), matrix spike, or LCS results.

Spike results are reported by the laboratory as percent recovery and are compared to the accuracy objectives stated in Section 8.0. Results that do not satisfy the objectives are assigned a data qualifier flag to indicate uncertainty associated with inaccuracy.

Method spikes are spikes of a reference material into a water matrix. If recovery is outside the established limits, samples from the same extraction batch may be qualified. Matrix spike results are generally more sample specific. If matrix spike recovery is outside the established limits, results for samples collected from similar conditions and/or handled in the same batch will be examined. If any results appear atypical and can be related, those results may also be qualified.

The flagged data will be discussed in the QA/QC report for the sampling task, and specific limitations such as poor or enhanced recovery for specific compounds will be stated. Further investigation or corrective action may be taken to find methods to reduce the interferences.

Surrogate spike results are also reported and used to assess recovery of target analytes on a sample-by-sample basis and provide a measure of system performance. Surrogate spike recoveries are compared to recovery limits. Any results outside the limits are flagged on laboratory reports and in the database. Any corrective action taken in the laboratory is documented in laboratory performance records and/or discussed in the data report.

Confidence intervals can be calculated for an analytical method if performance audit samples are submitted or a series of method spikes are analyzed. The results are used to define confidence intervals for the recovery of each compound analyzed.

9.3 Control Limits

Control limits for central tendency and variability are generated by the laboratory to statistically monitor system performance. These limits are within method specified tolerances. Since control limits may change as the analytical system is improved and matrices change, these limits are not provided in this plan.

9.4 Completeness

Completeness is calculated after the QC data have been evaluated, and the results applied to the measurement data. In addition to results identified as being outside of the QC limits established for the method, broken or spilled samples, or samples that could not be analyzed for any other reason are included in the assessment of completeness. The percentage of valid results is reported as completeness.

The completeness will be calculated as follows:

$$Completeness\ (\%) = \frac{T - (I + NC)}{T} \times 100$$

where:

T = Total number of expected measurements for a method and matrix;

I = Number of invalidated results for a method and matrix; and

NC = Number of results not collected (e.g., bottles broken etc.) for a method and a matrix.

10.0 CORRECTIVE ACTIONS

This section of the QAPP addresses corrective actions that must be implemented if the laboratory QA specifications are not met. Corrective action procedures will be implemented if problems are observed with incoming samples, sample holding times, instrument calibration procedures, specified practical quantitation limits, or internal QC sample results. Corrective actions may include resampling, reanalyzing samples, or auditing laboratory procedures. Procedures for identifying and documenting corrective actions and for reporting and follow-up of corrective actions will be implemented by the CQC representative and the Project Manager.

When errors, deficiencies, or out-of-control situations exist, the contract laboratory's QA plan provides systematic procedures, called corrective actions, which will be implemented to resolve problems and restore proper functioning to the analytical system. Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation procedure for possible errors, checks the instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter will be referred to the laboratory supervisor, manager, and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure will be filed with the project records, and the information summarized within the case narrative. In the event the laboratory is unable or unwilling to implement corrective action in a reasonable and timely manner, the Project Manager, in coordination with the COR, will select another lab to perform analytical services. At a minimum, the following corrective actions and/or procedures will be employed.

10.1 Incoming Samples

Problems noted during sample receipt will be documented on an appropriate form (Cooler Receipt Form) by the sample custodian. If necessary, CELRB will be contacted immediately for problem resolution. All corrective actions taken will be thoroughly documented. Potential corrective actions include reporting data with qualifiers or resampling and reanalysis. Example forms for documentation of sample collection and transmittal are presented in Appendix ~~B~~ A of the CSAP.

10.2 Sample Holding Times

If samples cannot be or were not extracted/digested and/or analyzed within the appropriate method required holding times, CELRB will be notified immediately for problem resolution. All corrective actions will be thoroughly documented. Potential corrective actions include reporting data with qualifiers or resampling and reanalysis.

10.3 Instrument Calibration

Sample analysis will not be allowed until all initial calibrations meet the appropriate requirements. All calibrations must meet method requirements or recalibration must be performed. All continuing calibrations that do not meet method requirements will result in a review of the calibration, rerun of the appropriate calibration standard(s), and if necessary, reanalysis of all samples affected back to the previous acceptable calibration check.

10.4 Practical Quantitation Limits

Appropriate sample cleanup procedures will be employed to attempt to achieve the practical quantitation limits as stated in Section 6.0 of this QAPP. If difficulties arise in achieving these limits due to a particular sample matrix, the contract laboratory will notify the CQCSM who will in turn notify the CELRB COR and District chemist of this problem for resolution. Any dilutions made will be documented in a case narrative along with the revised practical quantitation limits for those analytes directly affected.

10.5 Method QC

All method QC, including blanks, matrix duplicates, matrix spikes, matrix spike duplicates, laboratory control samples, and other method-specified QC samples will meet the requirements as specified within the analytical method and within the project CSAP. Failure of method-required QC will result in the review of all affected data. If no errors are noted, the affected sample(s) will be reanalyzed and/or re-extracted/redigested as appropriate, then reanalyzed within method-required holding times to verify the presence or absence of matrix effects. In order to confirm matrix effects, QC results must observe the same direction and magnitude (ten times) bias. If a matrix effect is confirmed and other sources of error have not been determined, the corresponding data will be flagged accordingly using acceptable flagging symbols and criteria. If a matrix effect is not confirmed, then the entire batch of samples may have to be reanalyzed and/or re-extracted/redigested, then reanalyzed. CELRB will be notified as soon as possible to discuss possible corrective actions should unusually difficult sample matrices be encountered.

10.6 Calculation Errors

Reports will be reissued if calculation and/or reporting errors are noted with any given data package. The case narrative will clearly state the reason(s) for reissuance of a report.

11.0 PREVENTATIVE MAINTENANCE

This section of the QAPP discusses the laboratory preventative maintenance plan that will be implemented to minimize downtime and interruption of analytical work. Preventative maintenance will be routinely performed on each analytical instrument according to each laboratory's QAPP. Designated laboratory personnel are trained in routine maintenance procedures for all major instrumentation. When repairs are necessary, they will be performed by either trained staff or trained service engineers employed by the instrument manufacturer. Maintenance contracts will be maintained on all major analytical instruments. All maintenance or repairs conducted will be detailed within logbooks, unique to each instrument. Backup instrumentation will be designated in case of an extended breakdown for a piece of analytical instrumentation. It is the responsibility of the contract laboratory to have a backup plan in force such that all sample holding times can be met. This plan may include subcontracting work to other CELRB validated laboratories. Before subcontracting is initiated, CELRB personnel will be informed and approval given, in writing, from the CELRB COR and the USACE HTRW Center of Expertise (HTRW-CX).

12.0 PERFORMANCE AND SYSTEM AUDITS

This section of the QAPP describes the performance and system audits that will be performed on site and at the contract laboratory. Additional information can be found in each laboratory's QAP. Audits are QA procedures designed to meet the DQOs discussed in Section 3.0. The two basic types of QA audits are discussed below.

12.1 Systems Audits

The laboratory QA Officer performs routine audits to examine laboratory procedures and documentation. This in-house audit process provides a program that evaluates whether QA and QC procedures are being adhered to and that adequate controls are in place to provide accuracy and precision of analyses. The audit will include a detailed review of each component (log-in, computations, report generation, etc.) of the system to determine that each element is functioning within the guidelines of the QA plan and appropriate methodologies. During the audit, the QA Officer will examine records to evaluate that the proper frequency of spikes, blanks, duplicates, etc., are performed. Control charts will also be examined.

Onsite systems audits have also been performed by CELRB personnel as part of the validation process at a frequency decided during the laboratory validation process as specified within USACE ER 1110-1-263.

12.2 Performance Audits

Performance audits are quantitative evaluations of the components of a project. These evaluations consist of audit samples to be checked by the USACE HTRW-CX as a part of the laboratory validation process, QA duplicates taken as a part of the sampling process and analyzed by a QA laboratory (if requested by CELRB), and laboratory QA procedures as specified by the analytical method.

The frequency of performance and system audits may be increased, at the option of the CELRB COR. A corrective actions report will be required that addresses any deficiencies noted during audits conducted by the USACE HTRW-CX during the project or the validation process. The report will be retained within the laboratory project files.

13.0 QC REPORTS TO MANAGEMENT

This section of the QAPP discusses the QC reports which will be submitted by the laboratory to Radian for inclusion in the project files. The QC reports include an assessment of precision, accuracy, and completeness; any sample dilutions required; and any significant QA problems encountered. These reports will be included with the laboratory deliverable in the form of completed cooler receipt forms and all analysis case narratives. Analytical results from the laboratory are due to Radian within the specified turnaround times indicated on the chain-of-custody form and based on the time of arrival of the samples at the laboratory. If problems with sample receipt or analysis require immediate notification of CELRB personnel, the CELRB COR or District Chemist will be contacted by telephone for immediate resolution. All appropriate documentation will be maintained in the project files.

Results of routine laboratory system and performance audits are included in the laboratory Quality Assurance Plan (QAP). This document is updated at least annually within the laboratory.

14.0 REFERENCES

Department of the Army, U.S. Army Corps of Engineers, 1996. "Chemical Data Quality Management For Hazardous Waste Remedial Activities," ER 1110-1-263.

U.S. Army Corps of Engineers, "Minimum Chemistry Data Reporting Requirements for DERP and Superfund HTW Projects," CEMRD-ED-GC Memorandum, August 1989.

U.S. Army Corps of Engineers, Technical Project Planning (TPP) Process, Engineer Manual EM 200-1-2, 31 August 1998.

U.S. Army Corps of Engineers, Requirements for the Preparation of Sampling and Analysis Plans, Engineer Manual EM 200-1-3, 1 September 1994.

U.S. Army Corps of Engineers, Chemical Quality Assurance for HTRW Projects, Engineer Manual EM 200-1-6, 10 October 1997

U.S. Environmental Protection Agency, 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," EPA-540/R-94-013.

U.S. Environmental Protection Agency, 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," EPA-540/R-94-013

U.S. Environmental Protection Agency, 1993. "Data Quality Objectives Process for Superfund Interim Final Guidance," USEPA 540-R-93-071.

U.S. Environmental Protection Agency, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846," Third Edition, November 1986; Revision 1, July 1992; Revision 2, November 1992; Update II, September 1994; Update III, December 1996.

U.S. Environmental Protection Agency, 1983. "Methods for Chemical Analysis of Water and Wastes," Office of Research and Development, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, EPA-600/4-79-0202