SAMPLING AND ANALYSIS PLAN - FINAL

TNT WALKOVER AND SITE INVESTIGATION

Former Lake Ontario Ordnance Works
Lewiston, New York

Contract #DACW49-00-D-0002
Delivery Order #0002

Prepared by:
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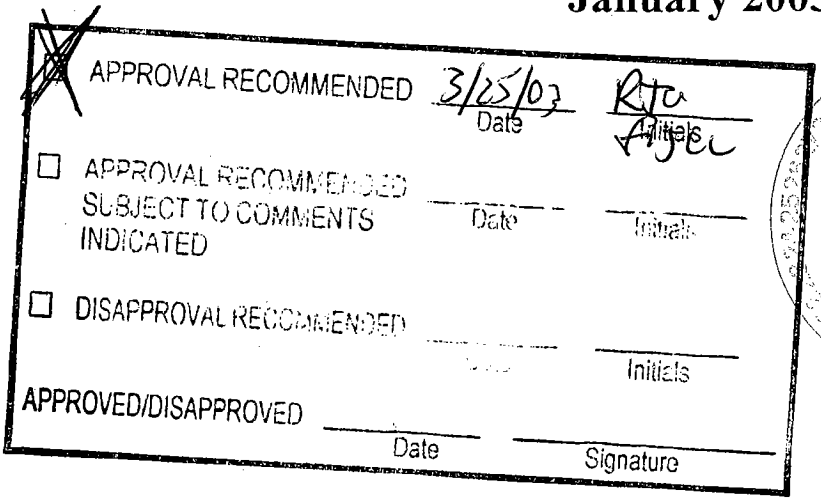
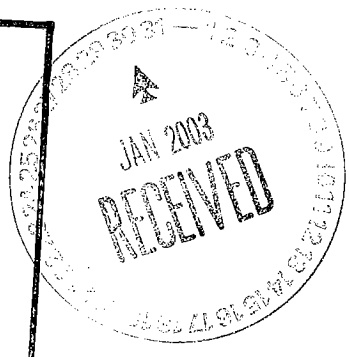
January 2003





TNT Walkover and Site Investigation
Former Lake Ontario Ordnance Works; Lewiston, New York

SAMPLING AND ANALYSIS PLAN

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TNT WALKOVER AND SITE INVESTIGATION

FORMER LAKE ONTARIO ORDNANCE WORKS
LEWISTON, NEW YORK

CONTRACT # DACW49-00-D-0002
DELIVERY ORDER #0002

FIELD SAMPLING PLAN - FINAL

Prepared By:

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January 2003

TNT WALKOVER AND SITE INVESTIGATION
FORMER LAKE ONTARIO ORDNANCE WORKS
LEWISTON, NEW YORK

FIELD SAMPLING PLAN

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List of Abbreviations and Acronyms

bgs	Below Ground Surface
CDFR	Chemical Data Final Report
CIH	Certified Industrial Hygienist
CMSA	Contaminated Materials Storage Area
COC	Chain-of-Custody
CQC	Contractor Quality Control
CQCM	Chemical Quality Control Manager
CQCSM	Contractor Quality Control Systems Manager
DCQCR	Daily Chemical Quality Control Report
DOD	Department of Defense
DOE	Department of Energy
DQO	Data Quality Objective
EM	Engineer Manual
FCR	Field Change Request
FedEx	Federal Express
FSP	Field Sampling Plan
IDW	Investigation Derived Waste
ISSI	ISSI Unexploded Ordnance, Inc.
LOOW	Lake Ontario Ordnance Works
NCR	Non-Conformance Report
NYSDEC	New York State Department of Environmental Conservation
PCB	Polychlorinated Biphenyl
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
Sevenson	Sevenson Environmental Services, Inc.
SOP	Standard Operating Procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
STL	Severn Trent Laboratories
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TNT	2,4,6-Trinitrotoluene
USACE	US Army Corps of Engineers
USDOT	US Department of Transportation
USEPA	US Environmental Protection Agency
VOC	Volatile Organic Compound
WST	Waste Stream Technology Inc.

1.0 PROJECT DESCRIPTION

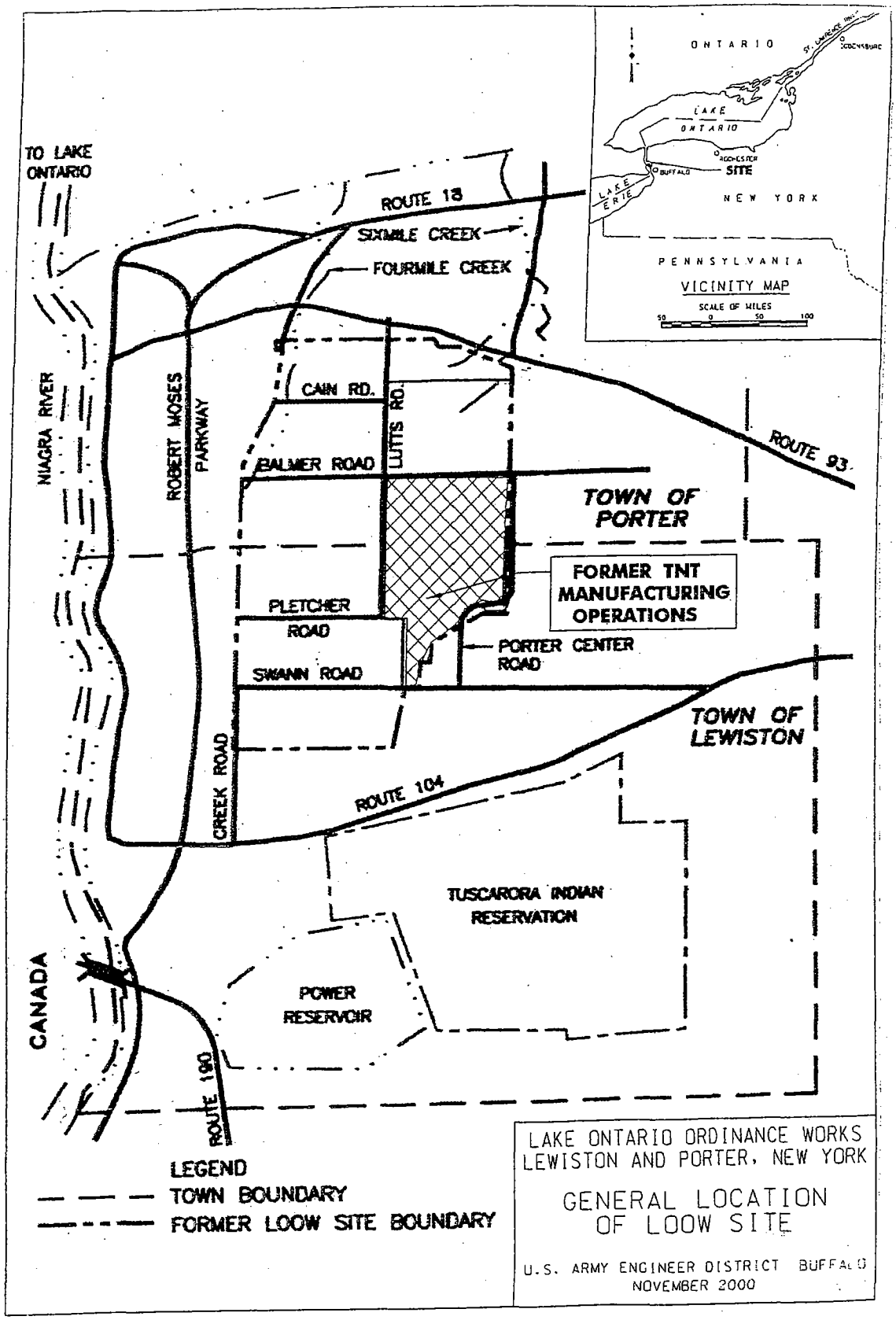
1.1 Introduction

This Field Sampling Plan (FSP) is part of the Sampling and Analysis Plan (SAP), which has been prepared by Sevenson Environmental Services, Inc. (Sevenson) to fulfill the requirements of Contract DACW49-00-D-0002 (Delivery Order 0002) for the U.S. Army Corps of Engineers (USACE) at the Former Lake Ontario Ordnance Work Site (the Site), located in Lewiston/Porter, New York. The work conducted under the current contract involves the investigation of subsurface soils in the vicinity of the wastewater treatment plant, the investigation of residual sediments in vaults and pipes associated with the wastewater treatment plant, the walkover and removal of explosives (in particular 2,4,6-trinitrotoluene (TNT)) in three remaining TNT pipelines and the Contaminated Materials Storage Area (CMSA), and amending and disposal of the contaminated materials removed during the walkover. The purpose of the SAP is to ensure that all data obtained from sampling during the implementation of the investigation and remedial action at the Site are of known and acceptable quality, legally defensible, and meet the requirements of the contract specifications and USACE Engineering Manual EM 200-1-3 (Requirements for the Preparation of Sampling and Analysis Plans, February 2001). The FSP describes the field sampling activities that must be performed and defines the procedures and methods that must be used to collect field measurements and samples. The FSP focuses on the performance of all data quality management activities and specifies the procedures for sample collection, packaging, shipping, and analysis. Additionally, the FSP describes field-sampling deliverables. The overall objective of the FSP is to develop and ensure the implementation of procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide legally defensible data of known quality. The FSP provides a framework to ensure that all sampling and analytical data are of known and acceptable quality required for meeting the needs of the end use of data.

1.2 Site Location and Description

The former Lake Ontario Ordnance Works (LOOW) is located in the Town of Lewiston and the Town of Porter in Niagara County, New York (Figure 1-1). The Site is located approximately 10 miles north of the City of Niagara Falls, New York.

Figure 1-1: General Location of Lake Ontario Ordnance Works Site



The original Site encompassed approximately 7,500 acres with US Department of Defense (DOD) activities occurring on 2,500 acres. During the early 1940s, the LOOW site was used as a manufacturing plant producing TNT for use in World War II. Once completed, the complex contained a power plant, hospital, fire department, a water supply system adequate for a population of 100,000, and water supply and wastewater treatment system of underground water, sewage, acid, and TNT pipelines.

The manufacturing portion of the plant was located in the central southwestern section of the Site. Wastewater from the TNT manufacturing operation, as well as stormwater and sanitary sewage, was transferred through and underground sewer network to a wastewater treatment plant located in the western portion of the TNT plant. The TNT pipeline ran as one pair of east-west trending lines across the TNT production area before being routed south to the wastewater treatment plant at the west end of the production line (Figure 1-2).

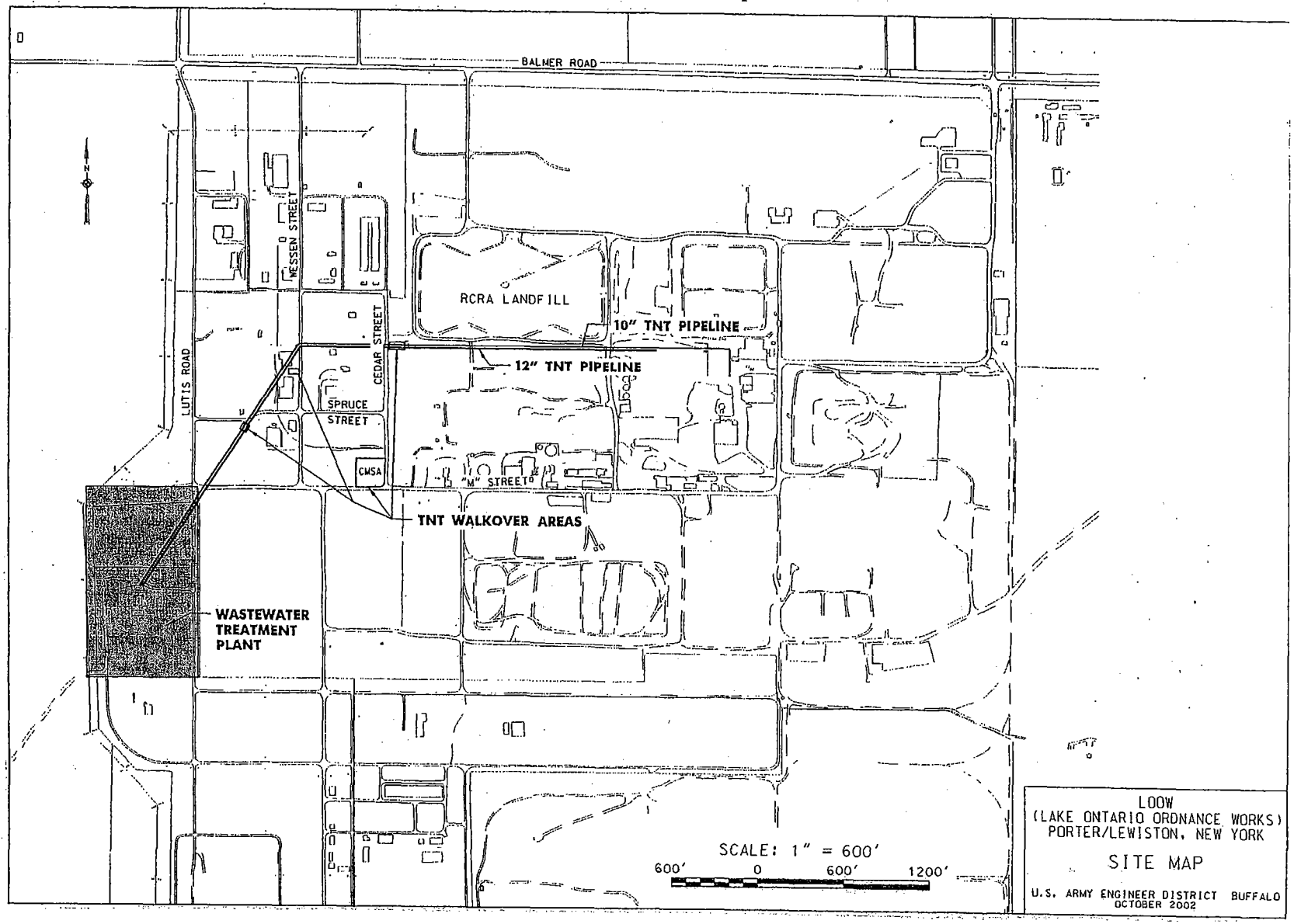
An overestimation by the Army of the need for TNT during World War II resulted in the closure of the TNT plant in July 1943, after only 9 months of operation. Following the decommissioning of the TNT plant, the majority of the facility was sold to private citizens with the government retaining the former active 2,500-acre portion of the Site.

Portions of the LOOW Site have since been used by several branches of the DOD and the US Department of Energy (DOE) for various manufacturing and storage activities, including the pilot production of high energy fuels. In 1955, the Navy and Air Force acquired 360 and 200 acres, respectively, of the former TNT plant. The acquisition of the properties was for the joint development of a boron- and lithium-based high-energy rocket fuel production plant. Part of the construction of the production plant involved tying in the sanitary, stormwater, and chemical waste sewer systems into the former TNT wastewater treatment plant located approximately 1,000 feet to the southwest.

1.3 Summary of Existing Site Data

The primary contaminant of concern at the Site is TNT. Existing Site data is included in the Remedial Investigation Report and other documents maintained as part of the project library.

Figure 1-2: Site Map



1.4 Site Specific Sampling and Analysis Problems

Due to the potential presence of detonable quantities of TNT and explosive compounds (including TNT intermediates such as 2,4-dinitrotoluene and 2,6-dinitrotoluene) along the TNT pipeline, an explosives expert will accompany Sevenson personnel during Site activities at potential/known explosives hazard locations.

With the exception of samples submitted to the off-Site laboratory for waste characterization purposes, all samples collected will be analyzed on-Site using the TNT EnSys® Soil Test System produced by Strategic Diagnostics, Inc. Sevenson's explosives subcontractor, ISSI Unexploded Ordnance, Inc. of Huntsville, Alabama, will perform the field analysis using the EnSys® system. The on-Site analysis involves a rapid extraction of the soil with an organic solvent, usually acetone or methanol because of the high solubility of TNT in these polar solvents, followed by a colorimetric analysis of the extract using a HACH DR/2000 spectrophotometer. Details of the EnSys® system and the spectrophotometer are included in Appendix C. Due to the nature of the EnSys® system, analysis will be performed in a controlled environment at temperatures between 40°C and 100°C. In addition, if soils appear to have greater than 10% moisture, they will be allowed to dry prior to analysis.

The EnSys® system will be used to verify whether the concentrations of TNT in the soil samples collected during the Site investigation are less than 10%. If the TNT concentrations are greater than 10%, soils will be amended with sand prior to stockpiling and off-Site disposal. Prior to off-Site disposal, the stockpiled materials will be sampled and submitted to the laboratory for analysis of waste characterization parameters and nitroaromatic and nitroamine explosives.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Site Organization

The successful completion of any project requires an effective organization skilled in management techniques and controls. Sevenson distinguishes itself by its ability to organize, schedule, staff, and manage projects. Sevenson's corporate policy is to perform a quality job and earn a client's satisfaction, respect and repeat business. Sevenson's entire staff, including the President, involves themselves in project operations with project needs taking first priority. This approach is key to Sevenson's unmatched record for completing projects on time, within budget and to the customer's satisfaction.

Prior to mobilization to a job site, Sevenson establishes the project schedule, cost control system, prepares project submittals, and develops the required work plans and related documentation necessary to begin work. These are typically discussed with the owner of the project and their engineer.

These documents are reviewed weekly during job-site meetings and plan and/or work adjusted as conditions warrant.

2.2 Resource Management

Sevenson organizes projects with only the most qualified and experienced personnel from a company resource "pool". A project management team is assembled from the pool and is comprised of individuals who have the necessary experience to execute the work safely and efficiently and have experience working together, as a team, on past projects. Once project responsibilities are assigned, the onsite project manager establishes the lines of communications and reporting protocol. Keys to a successful project include teamwork, the development of close communication channels on every level, and clearly assigning responsibilities to project team members. The onsite project manager works closely with the corporate project manager to foster teamwork and cooperation.

Sevenson's employee turnover rate is nearly zero. Sevenson has earned the loyalty of its personnel by providing a secure and positive workplace environment. As a result of their commitment to the company, Sevenson employees are provided training and the real opportunity for personal and professional growth

within the organization. Their personal growth translates into gaining remedial construction insight and experience. Experience and well-trained employees translate into a better project.

When Sevenson engages subcontractors, subcontractor scheduling is incorporated into the Sevenson project planning process; and typically subcontractors work within the firm's project planning process.

2.3 Project Organization

The management structure that will be used to implement the project is shown in the organizational chart attached as Figure 2-1. All individuals may be contacted as specified in Table 2-1.

Sevenson, on behalf of USACE, has overall responsibility for the Site investigation. With the exception of the collection of waste characterization samples for laboratory analysis by Sevenson's field chemist, an explosives subcontractor, ISSI Unexploded Ordnance, Inc., (ISSI) will collect samples and perform the related field analysis using the TNT EnSys® Soil Test System. Project direction and field quality assurance (QA) oversight will be provided by USACE.

Sevenson has assigned staff to the following key Chemical Quality Management positions:

- Laurence A. Elia – Office in Charge
- Al LaGreca – Corporate Project Manager
- Paul Hitcho - Corporate Health and Safety Director
- Ken Paisely – Regulatory Specialist/Chemical Quality Control Manager (CQCM)
- Jerry Castiglione - On-Site Project Manager
- Rick Korpolinski – Project General Superintendent
- Dana Draper – Site Safety and Health Officer (SSHO)/Contractor Quality Control Systems Manager (CQCSM)
- Jennifer Singer – Project Chemist
- Jeff Shirley – Field Chemist/Environmental Sampler

FIGURE 2-1:
PROJECT ORGANIZATION CHART

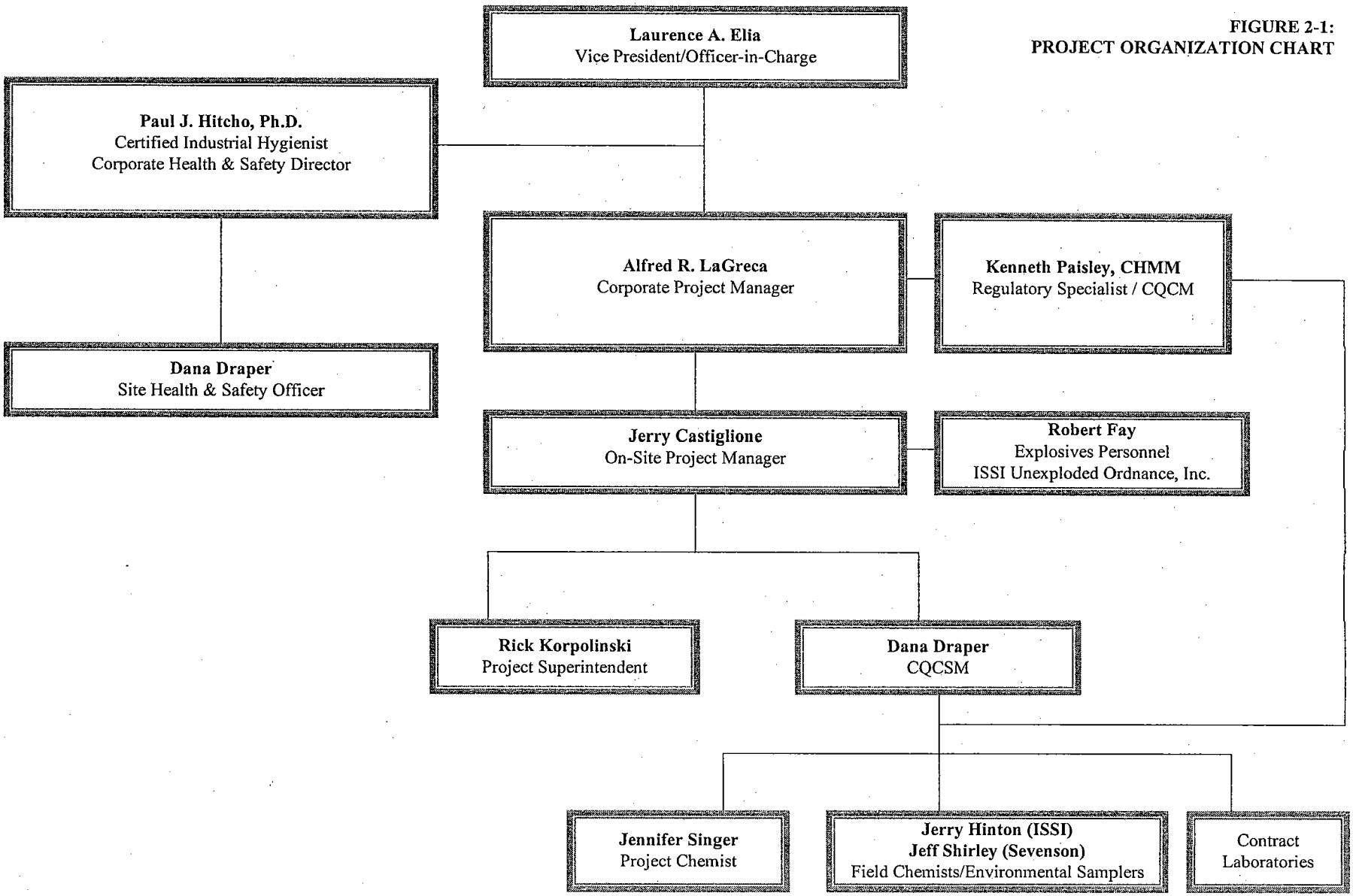


TABLE 2-1
POINTS OF CONTACT

Name	Address	Phone Number
Al LaGreca (Corporate Project Manager)	Sevenson Environmental Services, Inc. 2749 Lockport Road Niagara Falls, NY 14305	Phone - 716-284-0431 Fax - 716-284-1796
Paul Hitcho (Sevenson Health and Safety Director)	Sevenson Environmental Services, Inc. 2749 Lockport Road Niagara Falls, NY 14305	Phone - 716-284-0431 Fax - 716-284-1796
Kenneth Paisley (Regulatory Specialist/ CQCM)	Sevenson Environmental Services, Inc. 2749 Lockport Road Niagara Falls, NY 14305	Phone - 716-284-0431 Fax - 716-285-4201
Jerry Castiglione (Project Manager)	Sevenson Environmental Services, Inc. 2749 Lockport Road Niagara Falls, NY 14305	Phone - 716-284-0431 Fax - 716-284-1796
Dana Draper (Site Health and Safety Officer/CQCSM)	Sevenson Environmental Services, Inc. 2749 Lockport Road Niagara Falls, NY 14305	Phone - 716-284-0431 Fax - 716-284-1796
Jennifer Singer (Project Chemist)	Sevenson Environmental Services, Inc. 2749 Lockport Road Niagara Falls, NY 14305	Phone - 716-284-0431 Fax - 716-285-4201
Jeff Shirley (Field Chemist/Environmental Sampler)	Sevenson Environmental Services, Inc. 2749 Lockport Road Niagara Falls, NY 14305	Phone - 716-284-0431 Fax - 716-285-4201
Robert Fay (Project Manager)	ISSI Unexploded Ordnance, Inc. P.O. Box 11 Huntsville, Al 35804	Phone – 256-247-7050 Fax – 256-247-0593
Jerry Hinton (Environmental Sampler)	ISSI Unexploded Ordnance, Inc. P.O. Box 11 Huntsville, Al 35804	Phone – 256-247-7050 Fax – 256-247-0593
Sid Tyrell/Dan Vollmer (Waste Stream Technology)	Waste Stream Technology, Inc. 302 Grote Street Buffalo, NY 14207	Phone - 716-876-5290 Fax - 716-876-2412
Severn Trent Laboratories	Severn Trent Laboratories, Inc. 2417 Bond Street University Park, IL 60466-3182	Phone – 708-534-5200

2.3.1 Proposed Staffing Plan

The project management and field supervision team assigned to the LOOW Site possess a broad range of remedial action and construction skills. All have numerous years experience in the proper handling of contaminated material at hazardous waste sites. All are intimately familiar with components of a project team to work safely and efficiently on a day-to-day basis.

Sevenson's Project Manager and General Superintendent will be the persons with whom the USACE or its designated representative will deal on a daily basis at the job site.

When problems arise that cannot easily be handled in the field, Sevenson field personnel may rely completely on home office support. The first person to be notified in such case will be the Corporate Project manager, namely, Mr. Al LaGreca. Mr. LaGreca will remain personally involved until the problem is resolved.

The on-Site Project Manager and/or Project Superintendent will report to Mr. LaGreca at least once a day on the progress of the job. Mr. LaGreca will in fact be present on the jobsite as required to ensure that the project is progressing on schedule. Mr. LaGreca will be present on site for initial weekly project meetings.

Sevenson's health and safety staff consists of a certified site health and safety officer. Dr. Paul Hitcho, a Ph.D., and a Board-Certified Industrial Hygienist, manages the program in-house. Dr. Hitcho is responsible for the preparation, implementation, and enforcement of the site-specific health and safety plans, as well as the air monitoring programs. The Site Health and Safety Officer, Mr. Dana Draper, will report to Dr. Hitcho on a regular basis. All job records generated are analyzed completely by Dr. Hitcho.

2.3.2 Home Office Personnel

Laurence A. Elia – Vice President. Mr. Elia will be ultimately responsible for the project's success. He will make available all Sevenson resources required to ensure that the project is executed successfully. He will be informed of the project's progress and whether or not the contract is meeting its goals. Mr. Elia will resolve problems that cannot be resolved by the Project Manager. He will periodically visit the Site and become acquainted with field personnel and procedures.

Paul Hitcho, PhD, CIH – Corporate Health and Safety Director. Dr. Hitcho is a Certified Industrial Hygienist (CIH) with over 20 years experience in managing Health and Safety issues for government and private remedial projects. Dr. Hitcho will be responsible for review and approval of the site-specific Safety and Health Plan (SSHP). He will also provide Site Safety and Health Officer (SSHO) supervision, present initial site-specific training to all Site personnel, perform the respirator qualitative fit tests, and develop the air-monitoring program. He will conduct quarterly safety audits/inspections.

Al LaGreca – Corporate Project Manager. Mr. LaGreca will also be ultimately responsible for the project's success. He will make available all Sevenson resources required to complete the project successfully. He will be kept informed of the project's progress and whether or not the contract is meeting its goals. Mr. LaGreca will resolve problems that cannot be resolved by the Project Manager or the Site Superintendent. He will periodically visit the site and become acquainted with TRC field personnel and other representatives. It is anticipated Mr. LaGreca will be on-site once a month.

Kenneth Paisley, CHMM – Regulatory Specialist/Chemical Quality Control Manager. Mr. Paisley has 14 years experience in the chemistry and environmental field. Mr. Paisley is committed to overseeing all field sampling and data acquisition plans, as well as interfacing with off-site laboratory concerns. Mr. Paisley will review laboratory reports with the selected laboratory in order to ensure compliance with project specifications and all required protocols. He will coordinate off-site waste removal, including transport, disposal, manifesting, waste profiles, regulatory compliance, and disposal requirements.

Jennifer Singer – Project Chemist. The Project Chemist will support the Contractor Quality Control Systems Manager. Ms. Singer will perform a cursory review of all analytical data reports received from the laboratory (i.e., confirm that sample results are included for all parameters, confirm that all method required laboratory QA/QC results are included) prior to the submission of the data to the Contracting Officer or a Designated Representative.

2.3.3 Field Personnel

Jerry Castiglione – On-Site Project Manager. The responsibilities of the Project Manager will include:

- Subcontractor coordination and oversight.

- Acting as Site liaison between Sevenson and USACE.

- Charge of all field operations.

- Hiring and termination/reassignment of personnel as necessary to support successful task order implementation.

- Management and coordination of all aspects of the project as defined in the Contract Specifications with an emphasis on adhering to the objectives of the Site investigation.

- Assuring corrective actions are taken for deficiencies cited during audits of sampling/analytical activities.

- Project coordination to implement and comply with the SAP in coordination with the USACE, Contractor Quality Control Systems Manager, Field Chemist, and Environmental Samplers, including the coordination of field and laboratory schedules pertaining to relevant operation/sampling activities and allocation of resources and staffing to implement the quality assurance/quality control (QA/QC) program.

- Implementation of the Site Safety and Health Plan (SSHP), including temporarily suspending field activities if the health and safety of personnel are endangered and/or temporarily suspending an individual for field activities for infractions of the SSHP, pending further consideration by the Health and Safety Manager.

- Review of all documents prepared by project personnel, including all relevant field records and logs.

Dana Draper – Site Health and Safety Officer/Contractor Quality Control Systems Manager. As SSHO, Mr. Draper will report directly to the Corporate Health and Safety Director and be responsible for the implementation of Sevenson's approved SSHP, including conducting required safety inspections, safety briefings, and reports of safety-related activities. As CQCSM, Mr. Draper will report directly to the Project Manager on matters concerning quality control. He will have both the authority and the duty to stop whatever operation appears to be out of compliance with the contract documents. The CQCSM is responsible for field

chemistry and environmental sampling staff, and responsibility for all records related to personnel, supplies, equipment use, equipment calibration, and waste transportation and disposal.

Jeff Shirley – Field Chemist/Environmental Sampler. Mr. Shirley will be responsible for collection of waste characterization samples for submittal to the off-Site laboratory. His primary role will be to collect, document, package, and ship the required samples.

Jerry Hinton – Field Chemist/Environmental Sampler. Mr. Hinton will be responsible for collection and field analysis of explosives related materials. He will be trained in the sampling and analysis techniques required to correctly and safely operate the TNT EnSys® Soil Test System.

3.0 SCOPE AND OBJECTIVES

3.1 Overall Project Objectives and Activities

The overall project objectives are to:

1. Define the level and extent of subsurface soil contamination in the vicinity of the wastewater treatment plant through the use of an on-Site screening system.

2. Use an on-Site screening system to establish the levels of contamination present in residual sediments present in a subsurface wooden pipe and vaults associated with the wastewater treatment plant.

3. Perform walkovers in three remaining TNT pipeline areas and the CMSA, remove any residual TNT materials present, and perform an on-Site screening of any TNT materials removed during the walkover to determine if concentrations are greater than 10% to establish whether amending with sand is required prior to off-Site disposal.

4. Sample and analyze the generated solid wastes and isolated TNT materials to characterize for waste disposal purposes according to 40 CFR 261 and the requirements of the off-Site disposal facility.

5. Sample and analyze any liquid wastes generated during the sampling activities (e.g., decontamination wastewater) to characterize the liquid for waste disposal purposes according to the requirements of the off-Site disposal facility and 40 CFR 261.

3.2 Sampling Objectives

Details of the sample collection procedures are included in Section 4.0 of this FSP.

3.2.1 Subsurface Soil Characterization Samples

Subsurface soils will be collected to a total depth of approximately fourteen to sixteen feet below ground surface (bgs) at six locations in order to establish the nature and extent of contamination in the vicinity of the

wastewater treatment plant. Subsurface soil characterization samples will be analyzed on-Site using the TNT EnSys® Soil Test System.

3.2.2 Residual Sediment Samples

At the direction of USACE, samples will be obtained of residual sediments present in Site structures associated with the wastewater treatment plant. Representative grab samples will be collected from a subsurface wooden pipe as close as possible to the mixing tank and from vaults associated with the former acid neutralization building and former pumping station. Residual sediment samples will be analyzed on-Site using the TNT EnSys® Soil Test System.

3.2.3 On-Site Screening of Isolated TNT Materials

A walkover of three remaining TNT pipelines and the CMSA area will be performed and any residual TNT materials will be isolated and removed. An on-Site screening of these materials will be performed using a spectrophotometric technique to determine whether the soil contains greater than 10% TNT and thus requires amending with sand prior to disposal at the off-Site disposal facility.

3.2.4 Solid Waste Disposal Characterization Samples

Solid waste disposal characterization samples include soil cuttings, disposable equipment and debris, and isolated TNT materials. All solid materials will be analyzed per this SAP to meet disposal facility requirements. Sevenson anticipates the collection of one solid waste disposal characterization sample. If the volume generated for disposal increases above what is currently anticipated, additional waste characterization samples may be required by the off-Site disposal facility. Analytical requirements of the off-Site disposal facility are included in Table 3-1.

3.2.5 Liquid Materials

Liquid samples anticipated for analysis during this project include decontamination wastewaters. All liquid materials generated during remediation activities will be analyzed per this SAP to meet disposal facility requirements. Sevenson anticipates collecting one characterization sample for liquid materials. If the volume

generated for disposal increases above what is currently expected, additional waste characterization samples may be required by the off-Site disposal facility. Analytical requirements of the off-Site disposal facility are included in Table 3-1.

TABLE 3-1
ANALYTICAL REQUIREMENETS – SOLID AND LIQUID WASTE DISPOSAL CHARACTERIZATION

Parameter	Analytical Method
Corrosivity	SW-846 Method 9045C/9040C
Ignitability	SW-846 Method 1010
Reactivity – Hydrogen Cyanide	SW-846 Section 704.3.2, Method 9014
Reactivity – Hydrogen Sulfide	SW-846 Section 7.4.4.2, Method 9034
Toxicity Characteristic Leachate Procedure (TCLP) Volatile Organic Compounds (VOCs)	SW-846 Method 1311/5030C/8260B
TCLP Semi-Volatile Organic Compounds (SVOCs)	SW-846 Method 1311/3510C/8270C
TCLP Pesticides	SW-846 Method 1311/3510C/8081A
TCLP Herbicides	SW-846 Method 1311.3510C/8151A
TCLP Metals	SW-846 Method 1311/3015/6010B/7470A
Nitroaromatic and Nitroamine Explosives	SW-846 Method 8330

4.0 FIELD ACTIVITIES

Field sampling activities in support of the Site investigation are presented in this section. The types of samples to be collected include: subsurface soil characterization samples from the vicinity of the wastewater treatment plant, sediment samples from remaining structures present at the wastewater treatment plant including a subsurface wooden pipe and vaults at the acid building and pumping station, and waste characterization samples. In addition, TNT containing soils isolated and removed from the TNT pipelines and CMSA will be screened on-Site to determine the relative percentage of TNT present and to establish whether amending with sand is required prior to off-Site disposal. Specified sample collection and identification procedures, QA/QC requirements, and standard procedures necessary for obtaining data of acceptable quality are also presented in this and subsequent sections of the FSP. Qualified personnel experienced in the type of sampling being performed will conduct all sampling. Sampling personnel will adhere to health and safety requirements provided in the SSHP. The following sections detail the methods of collection for each of the sampling matrixes listed above.

4.1 Subsurface Soil Characterization Samples

Soil samples will be collected at the Site in order to provide the data necessary to define the levels and extent of subsurface soil contamination in the vicinity of the wastewater treatment plant. Samples will be collected and analyzed in the field using the TNT EnSys® Soil Test System (Table 4-1). The concentration and distribution of target compounds will be determined through the analysis of soil samples collected every two feet to a total depth of 14-16 feet from six subsurface locations. The total depth of the soil borings will depend upon the depth of the buried pipe present in the sampling area. The soil borings will be performed utilizing direct push technology (i.e., Geoprobe®). The Geoprobe® system is comprised of a pneumatically driven, truck-mounted unit. The standard operating procedure (SOP) for the Geoprobe® sampler is included in Appendix C. The direct push sampling method involves sampling devices that are directly inserted into the soil to be sampled without drilling or borehole excavation. Direct push sampling consists of advancing a sampling device into the subsurface by applying static pressure, impacts, or vibrations or any combinations thereof to the aboveground portion of the sampler extensions until the sampler has been advanced its full length into the desired soil strata. A Geoprobe® soil sampling system consists of a sample collection tool; hollow extension rods for advancement, retrieval, and transmission of energy to the sampler; and an energy source to force penetration by the sampler.

Table 4-1: Sampling and Analysis Matrix

Sample	*Location*	*Rationale*	*Frequency*	*Parameter(s)*	*Sample Type*	*Type of Bottles*[1]	*Number of Bottles*	*Methodology*	*Holding Time*[2]	*Preservative*
Subsurface Soil Characterization	Wastewater treatment plant area	On-Site screening of Geoprobe® samples collected to a total depth of 14-16 feet bgs to verify that soil contains less than 10% TNT	1 sample collected every 2-feet to 14-16 feet bgs at six predetermined locations	TNT	Grab	NA	NA	TNT EnSys® Soil Test System	NA	NA
Residual Sediments	Wooden pipe, acid neutralization building vault, pumping station vault	Characterize residual sediments in remaining structures	1 sample per location	TNT	Grab	NA	NA	TNT EnSys® Soil Test System	NA	NA
Isolated and removed TNT materials	Walkover area	On-Site screening to determine if relative percentage of TNT prior to off-Site disposal <10%	1 sample per 5-gallon bucket collected in the field	TNT	Grab	NA	NA	TNT EnSys® Soil Test System	NA	NA
Solid Waste Materials	Stockpile	Meet federal, state, and local regulations in accordance with the requirements of the disposal facility	(1) 5-point composite sample per soil stockpile	Ignitability	Composite	1L AG	2	SW-846 1010	7 Days	Cool 4°C
				Corrosivity				SW-846 9045C	Immediately	
				Reactive Cyanide				SW-846 Section 7.4.3.2/ Method 9014	14 Days	
				Reactive Sulfide				SW-846 Section 7.4.4.2/ Method 9034	7 Day	
				TCLP Metals				SW-846 1311/3015/6010B/ 7470A	180 Days to TCLP Extraction (Hg 28 days) and 180 Days to Analysis (Hg 28 days)	
				TCLP SVOCs				SW-846 1311/3510C/8270C	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP Pesticides				SW-846 1311/3510C/8081A	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP Herbicides				SW-846 1311/3510C/8151A	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP VOCs	Grab	4 oz CWM	2	SW-846 1311/5030B/8260B	14 Days to TCLP Extraction 14 Days to Analysis	Cool 4°C
				Nitroaromatic and nitramine explosives	Grab	4 oz. CWM	2	SW-846 8330	7 days to extraction 40 days to analysis	Cool 4°C

Sample	*Location*	*Rationale*	*Frequency*	*Parameter(s)*	*Sample Type*	*Type of Bottles*[1]	*Number of Bottles*	*Methodology*	*Holding Time*[2]	*Preservative*
Wastewater (i.e., decon water)	55-gallon Drum	Characterize waste in accordance with the requirements of the disposal facility and 40 CFR 261	1 grab sample per 20 drums generated	Ignitability	Composite	1L AG	4	SW-846 1010	7 Days	Cool 4°C
				Corrosivity				SW-846 9040C	Immediately	
				Reactive Cyanide				SW-846 Section 7.4.3.2/ Method 9014	14 Days	
				Reactive Sulfide				SW-846 Section 7.4.4.2/ Method 9034	7 Day	
				TCLP Metals				SW-846 1311/3015/6010B/ 7470A	180 Days to TCLP Extraction (Hg 28 days) and 180 Days to Analysis (Hg 28 days)	
				TCLP SVOCs				SW-846 1311/3510C/8270C	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP Pesticides				SW-846 1311/3510C/8081A	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP Herbicides				SW-846 1311/3510C/8151A	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP VOCs	Grab	40 mL G vial w/Teflon septa	4	SW-846 1311/5030C/8260B	14 Days to TCLP Extraction 14 Days to Analysis	Cool 4°C
				Nitroaromatic and nitramine explosives	Grab	4 oz. CWM	2	SW-846 8330	7 days to extraction 40 days to analysis	Cool 4°C

Notes:
1) Bottle types – AG: Amber Glass; HDPE: High Density Polyethylene Plastic; CWM: Clear wide mouth glass jar with Teflon lid
2) From Verified Time of Sample Collection

The sampling technique employed will involve continuous sampling at four-foot intervals to a total depth of 14-16 feet below grade. At each of the six soil boring locations, samples will be collected by continuous advancement of stainless steel hollow tubes. The hollow tubes are 48-inch long, 4-inch diameter stainless steel sampling tubes, which are fitting with disposable acetate liners. The hollow tube is pneumatically driven at four-foot intervals utilizing a Geoprobe® unit. When the hollow tube is brought to the surface, the acetate liner is removed.

The following sampling procedure is consistent with USACE Environmental Sampling Instructions (USACE EM-200-1-3, Appendix C-6).

- Place plastic sheeting on the ground near the sampling location.
- Gloves will be donned immediately prior to sampling and a clean pair of new disposable gloves will be worn each time a different location is sampled.
- Assemble decontaminated Geoprobe® sampling device that will be pushed into the ground to collect samples.
- Advance the sampling device into subsurface soils by applying static pressure, impacts, or vibrations or any combination thereof to the aboveground portion of the sampler extensions until the sampler has been advanced its full length into the desired soil strata.
- Recover the sampler from the borehole and remove the soil sample from the sampler. The stainless-steel sample tube is fitted with a disposable, internal acetate liner and then equipped with a cutting shoe that is pushed into the ground. The tube is retrieved from the ground, the cutting shoe is removed, and the internal acetate liner the removed from the stainless-steel tube.
- Cut the acetate liner lengthwise and remove soil from two-foot intervals for on-Site field screening.
- Repeat the soil collection procedures until a total depth of 14-16 feet has been reached.
- Decontaminate all sampling equipment that contacts the soil during collection activities following each probe or sample (Section 4.7).

Soil samples will be collected continuously utilizing a four-foot Geoprobe® sample tube. The sampler will be advanced four-feet into the subsurface, recovered, field observations noted, and the soil from each two-ffoty interval segregated for on-Site analysis. Another sample tube is then inserted into the open borehole and advanced an additional four-feet, and so on, until the desired terminus is attained. The surface of closed exploration holes will be returned to the sample elevation as the surrounding surface. Unaltered bentonite chips will be tamped into the hole in accordance with New York State Department of Environmental Conservation (NYSDEC) rules and regulations. The correct chip size will be provided for the space being filled.

4.2 Residual Sediment Samples

4.2.1 Subsurface Wooden Pipe Samples

Residual sediment samples will be collected from a subsurface wooden pipe present in the former wastewater treatment plant area. The pipe is located approximately ten feet bgs and will require mechanical excavation of the soil above the pipe prior to sampling. Once the depth of the pipe is achieved, the pipe will be opened using hand tools and representative sediment samples will be obtained using a hand dipper, sample trowel, or drum thief, as warranted by the field conditions. Samples will be collected and analyzed on-Site using the EnSys® system as summarized in Table 4-1. Briefly, the on-Site analysis involves a rapid extraction of the soil with an organic solvent, usually acetone or methanol because of the high solubility of TNT in these polar solvents, followed by a colorimetric analysis of the extract. Details of the use of the field test system and the HACH DR/2000 spectrophotometer are included in Appendix C. Following sample collection, all non-dedicated sampling equipment will be decontaminated as described in Section 4.7.

4.2.2 Vault Sampling

Residual sediment samples will be collected from the open-top vaults present in the former acid neutralization building and former pumping station located in the wastewater treatment plant area. The vaults are open depressions in the remaining concrete floors of these previously demolished buildings. Samples will be collected using a hand dipper, sample trowel, or drum thief, as warranted by the field conditions. Only samples of sediment below any freestanding liquids will be obtained. Samples will be collected and analyzed on-Site using the EnSys® system as summarized in Table 4-1. Briefly, the on-Site analysis involves a rapid extraction of the soil with an organic solvent, usually acetone or methanol because of the high solubility of

TNT in these polar solvents, followed by a colorimetric analysis of the extract. Details of the use of the field test system and the HACH DR/2000 spectrophotometer are included in Appendix C. Following sample collection, all non-dedicated sampling equipment will be decontaminated as described in Section 4.7.

4.3 Waste Characterization Samples

4.3.1 Waste Disposal Characterization Sample Collection – Solids

All soil cuttings, disposable equipment and debris, and isolated TNT materials will be sampled prior to disposal to meet Federal, state, and local regulations in accordance with the requirements of the disposal facility.

All waste characterization samples will be collected as a five-point composite from the soil stockpile area. The compositing procedure is designed to provide a representative sample of the waste material by combining five discrete samples taken from within the stockpile. Discrete samples should be spread evenly within the stockpile so that they are spatially representative of the waste both horizontally and vertically (i.e., one each at a shallow, medium, and deep depth along the length of the pile). Prior to sampling, a visual inspection of the soil will be performed to locate areas suitable for sampling. Once the sampling locations have been determined, the following procedure will be used for each sampling depth:

- Gloves will be donned immediately prior to sampling and a clean pair of new disposable gloves will be worn each time a different location is sampled.

- Using a clean hand auger or disposable sample trowel, collect sufficient sample into a dedicated, disposal aluminum container from the predetermined sample location.

- If this sampling location was selected for TCLP VOC analyses, the last part of the sample collected should be placed directly into the appropriate sample container (Table 4-1) and sealed tightly. The jar should contain as little headspace as possible.

- The five sample aliquots in the aluminum container should be homogenized with a dedicated, disposable stainless steel trowel or by physically mixing the soil by gloved hand. At no time will a bare hand come into contact with the sample.

- Place the homogenized soil into the appropriate sample containers as specified in Table 4-1. Decontaminate any non-dedicated sampling equipment.

- Any leftover sample material from the aluminum container, and the container itself, will be placed back in the stockpile.

4.3.2 Waste Disposal Characterization Sample Collection – Wastewater

Wastewaters generated during Site activities will include decontamination water. Liquid wastes will be containerized in 5-gallon buckets in the field and transferred to 55-gallon drums. Aqueous samples will be collected to determine the waste management approach. The goal of sampling the wastewaters will be to meet Federal, state, and local regulations in accordance with the requirements of the disposal facility. Required analyses, sample container requirements, and sample analysis methods are presented in Table 4-1.

The following sampling procedure is consistent with USACE Environmental Sampling Instructions (USACE EM-200-1-3, Appendix D-1).

- Insert open tube (i.e., Thief) sampler almost to the bottom of the container. Approximately 1 foot of tubing should extend above the drum.

- Be sure that the liquid in the container maintains a constant level in the tube during the descent of the tube.

- Cap the top of the sampling tube with a tapered stopper or gloved thumb, ensuring that the liquid does not come into contact with the stopper or thumb.

- Carefully remove the capped tube from the container and insert the uncapped end into the sample container, being careful not to spill any liquid outside the container. Removal of the tube from the container may require a step or platform aid.

- Release the stopper or thumb and allow the liquid to drain into the sample container until the appropriate sample containers are filled (Table 4-1). Repeat as necessary.

- Remove the tube from the sample container and dispose of in accordance with Section 4.7.1 of the FSP.

- Secure the caps of the sample containers tightly.

- Label the sample bottles using the sample identification system provided in Section 5.2 of the FSP. A sequential sample number will follow the Site designator code to identify the samples for collection and delivery to the laboratory. Decontaminate any non-dedicated sampling equipment.

- Complete all chain-of-custody documents and field sheets and record in the field logbooks as described in Section 5 of the FSP.

4.4 On-Site Screening of Isolated TNT Materials

A walkover of three remaining TNT pipelines and the CMSA area will be performed and any residual TNT materials will be isolated and removed. Prior to off-Site disposal of the TNT materials, an on-Site field test will be performed to determine the relative percentage of TNT present in the soils. Specifically, soils with greater than 10% TNT will require amending with sand prior to off-Site disposal.

Sevenson's explosives subcontractor will utilize a TNT EnSys® Soil Test System produced by Strategic Diagnostics, Inc. Briefly, the on-Site analysis involves a rapid extraction of the soil with an organic solvent, usually acetone or methanol because of the high solubility of TNT in these polar solvents, followed by a colorimetric analysis of the extract. Details of the use of the field test system and the HACH DR/2000 spectrophotometer are included in Appendix C.

4.5 Investigative-Derived Wastes

The types of Investigation Derived Waster (IDW) anticipated to be generated during field activities are (1) soil cuttings collected during soil sampling, (2) disposable contact equipment and debris (e.g., personal protective equipment (PPE), plastic sheeting), (3) decontamination fluids, and (4) uncontaminated solids and miscellaneous trash. All wastes generated during the field activities will be handled in bulk or drummed at the Site for disposal by the contractor. Effort will be made throughout the field program to minimize the

volume of wastes derived from sampling and decontamination procedures. PPE from workers within contaminated areas will be handled as contaminated waste.

IDW will be shipped to a commercial disposal facility, as necessary. IDW will be managed, stored, and disposed in accordance with NYSDEC, USEPA and US Department of Transportation (USDOT) regulation and requirements of the receiving facility.

4.5.1 Soil Wastes and Cuttings

All soil wastes and cuttings generated during sampling events will be segregated by sampling location and drummed at the point of generation. A label will be placed on the drum describing the contents of the drum, source of the contents, name and phone number for point of contact, waste type, and date of closure of the drum. The drummed wastes will then be transported to a secure staging area for project wastes. It is presumed that these drummed wastes will be incorporated into bulk shipments and processed with other like-wastes leaving the Site. The soil wastes and cuttings will be consolidated with other disposable contact equipment and debris (Section 4.5.2) for testing and off-Site disposal at a permitted landfill under an approved waste-disposal profile that includes a percentage of Site debris in the wastestream.

4.5.2 Disposable Equipment and Debris

Disposable equipment and debris which has come into direct contact with potentially contaminated materials during sample collection or equipment decontamination, such as health and safety equipment, plastic sheeting, and other equipment or debris not reused during project operations will be collected in plastic bags during sampling, placed into appropriately labeled containers, and managed with the soil wastes and cuttings as described in Section 4.5.1. The containers will be stored in a suitable location as determined by Site personnel.

4.5.3 Decontamination Wastewater

Field sampling equipment will be decontaminated following procedures specified in Section 4.7 of this FSP. Decontamination fluids and any other aqueous wastes generated from sampling will be collected in the field in five gallon buckets, or other appropriate container, and returned to a designated storage area for transfer to

a 55-gallon drum or other containment vessel, as appropriate. The wastewaters will be tested as required for disposal at a permitted wastewater treatment plant.

4.5.4 General Office Trash/Debris

Any Site debris that is not generated during the collection of environmental samples will be considered municipal trash. This may include any paper or non-paper office wastes, non-contact sampling wastes (e.g., plastic wrapping, cardboard boxes), or other daily trash. All municipal trash will be deposited in a collection container provided by and serviced for periodic removal by a commercial trash hauling and disposal company. No additional management, tracking, or testing of this waste will be conducted.

4.6 Quality Assurance and Quality Control Samples

Quality assurance and quality control samples are collected and analyzed as a check of field measurements and in order to verify the contract laboratory's performance on chemical samples. With the exception of temperature blanks included with each sample cooler submitted to the laboratory, QA/QC samples will not be collected and submitted to the laboratory during this phase of work since the only samples collected for laboratory analysis are for waste disposal profile purposes. Duplicate samples will be collected and analyzed at a frequency of at least 5% of field samples collected for on-Site analysis using the EnSys® system.

4.6.1 Replicate Samples

A field quality control duplicate sample is a second sample collected at the same location as the original sample used as an indicator of overall measurement (sampling and analytical) precision. Duplicate samples are collected using identical sampling techniques and treated in an identical manner during analysis. QC samples will be collected as one sample, homogenized, and spilt into two samples. Field QC samples will be collected at a rate of at least 5% of the total number of field samples that are collected for field analysis.

4.6.2 Temperature Blanks

Temperature blanks will accompany all sample coolers shipped from the Site to the off-Site laboratory. A temperature blank consists of potable water sealed in a small plastic bottle (e.g. a 40-mL polyethylene bottle).

Use of these blanks enables the receiving laboratory to assess the temperature of the incoming sample shipment without disturbing any of the field samples.

4.7 Sampling Equipment Decontamination

The following describes standard operating procedures for the decontamination of non-disposable sampling equipment and tools that may come into direct contact with a field sample intended for analytical analysis. This procedure only addresses the decontamination of equipment as it pertains to the chemical integrity of samples for analysis and is not intended for use in health and safety decontamination of personnel, materials, and equipment that may become contaminated during field operations.

4.7.1 Applicability

Decontamination of all analytical devices, sampling tools, and storage equipment that may come into direct contact with a field sample is necessary in order to achieve analytical results that are representative of true field conditions. To the extent practical, no sampling equipment will be decontaminated in the field and disposable sampling equipment will be utilized. Sufficient sampling equipment will be pre-cleaned, wrapped in aluminum foil, and brought to the field. Sample containers will be pre-cleaned in accordance with USEPA protocols and will be supplied by the laboratory.

The decontamination procedures below may be modified, upon proper managerial approval, as long as the chemical integrity of the field sample is maintained and the sample source is not permanently compromised. Anticipated contaminants and concentrations, matrices (water, air, soil, etc.), surface area of possible cross contamination, method of sampling, and many other factors are considered when establishing a sampling equipment decontamination procedure. Any modifications of the procedures below will be carefully thought out, approved by Sevenson's CQCM and the USACE Contracting Officer or a Designated Representative, and documented accordingly. Samples will be collected from locations with the lowest known concentrations of contaminants first, progressing toward the areas of highest known contaminations. This procedure will minimize the potential for cross contamination of samples.

4.7.2 Procedures

All equipment will be considered contaminated unless determined otherwise. In order to provide consistency to the decontamination procedure, a designated sampling team crewmember will be responsible for equipment decontamination. Similarly, it is desirable to decontaminate all the equipment necessary for a field task prior to mobilization. In this way, field decontamination will be limited. As an aid to field personnel and as part of the Site QC inspections, Sevenson Checklist Number 009, "Task Specific QC Checklist – Decontamination", is included in Appendix A.

4.7.2.1 Decontamination Equipment List

The following supplies are needed for equipment decontamination:

- Clean disposable nitrile gloves
- Wastewater container (drum, basin, or buckets)
- Clean water spraying devices (plastic squirt or spray bottles)
- Clean brushes
- Plastic garbage bags
- Non-phosphate detergent (e.g., Alconox®)
- Deionized/distilled water (i.e., DI water)
- Clean plastic buckets and other containers, as needed (e.g., small plastic swimming pool)
- Plastic sheeting to cover ground at work station
- Aluminum foil
- Package labels, ink pens, and black markers
- Potable water, warm if available
- 1% nitric acid if equipment will be used for sampling for inorganic analysis
- Reagent grade methanol

4.7.2.2 General Equipment Decontamination Procedure

The following steps will be considered as Sevenson's general equipment decontamination procedure:

1. Cover hands with disposable gloves
2. Wash and scrub the equipment in a solution of non-phosphate detergent (e.g., Alconox) and potable water
3. Rinse three times with potable water
4. Rinse with 1% nitric acid solution
5. Rinse with potable water
6. Rinse with reagent grade methanol
7. Rinse with potable water
8. Rinse with deionized reagent grade water and allow to air dry thoroughly
9. If equipment will not be used immediately, wrap in aluminum foil (shiny side out)

All waste liquids generated by the decontamination procedure will be containerized and tested for waste characterization. Any solid wastes generated, such as personal protective equipment, will be containerized and transported to an intermodal box for disposal.

All handling of decontaminated equipment will be performed using clean disposable gloves. Care will be exercised in the storage of decontaminated equipment, so as to not re-contaminate what has been cleaned. Sampling personnel will also avoid solvents, greases, oils, gasoline, water, dusts, and other potential sources that might contaminate the equipment before its use. Sampling personnel handling such materials shall wear protective gloves when doing so.

4.7.2.3 Geoprobe® Rig Decontamination

All sampling equipment that comes into direct contact with the soil will be decontaminated with an Alconox detergent wash followed by a deionized water rinse between sample depths and steam/power washed between soil boring locations. Cleaning will be accomplished by flushing and wiping components to remove all visible sediments and other foreign matter. Special attention will be given to the threaded sections of the drill rods and sample tubes.

Prior to mobilization, the Geoprobe® rig and all associated equipment will be thoroughly cleaned to remove oil, grease, mud, and other foreign matter. In addition, before initiating drilling at each location, the samplers, drill steel, and associated equipment that will be in contact with the soil will be thoroughly cleaned to prevent potential cross-contamination from the previous drilling location.

5.0 SAMPLE CHAIN-OF-CUSTODY/DOCUMENTATION

5.1 Field Log Book

Field logbooks are water resistant, bound notebooks that provide the means of recording data collecting activities. Sufficient information will be recorded in the logbooks to permit reconstruction of all site-sampling activities conducted. Information recorded on other project documents will not be repeated in the logbooks except in summary form where determined necessary. All field logbooks will be kept in the possession of field personnel responsible for completing the logbooks, or in a secure place when not being used during fieldwork. Upon completion of the field activities, all logbooks will be submitted to the USACE to become part of the final project file.

Entries into the logbook will be made in ink and will contain a variety of information, including:

- Name and location of Site of investigation or interest.
- Date and time of arrival and departure.
- Names of all sampling team members present and the signature of the person making the entry.
- Names of visitors to the Site, their affiliation, and the purpose of their visit.
- Available information on the Site and composition and concentrations of contaminants, if known.
- Field instrument equipment used and purpose of use, calibration methods used, field results, and quality control information.
- Location of sampling points.
- Identification number, volume, sampling method, and containers (size/type) for each sample collected.
- Date and time of sample and data collection and any factors that may affect their quality.
- All sample identification numbers and a description of samples, especially any related QC samples.
- Weather conditions on the day of sampling and any additional pertinent field observations.
- Description of the number of shipping coolers packaged and the shipping method employed.
- Name and address of all receiving laboratories.

5.2 Sample Numbering System

A sample identification numbering system will be used to identify each sample collected and submitted to analysis to assist in tracking samples and retrieving analytical results. The sample identification numbers for each sampling effort will be used on sample labels, chain-of-custody forms, field logbooks, and all other applicable documentation. A listing of all sample identification numbers will be recorded in the field logbook.

The sample identification number format will be:

AB-CDE-F

Where: A = Location identifier (L = Lake Ontario Ordnance Works)
B = Delivery order number
C = General area of the Site (e.g., SB = soil boring; WP = wooden pipe; AB = acid building; PS = pumping station)
D = Matrix type (e.g., SO = soil; SD = sediment; DS = drum/container solid or sludge; DL = drum/container liquid)
E = Sample location number
F = Sequential sample number (e.g., 01, 02, 03, etc.)

5.3 Sample Documentation

5.3.1 Sample Labels and/or Tags

Immediately after a sample has been collected, a self-adhesive identification label will be completed in indelible ink and neatly affixed to the outside of the sample container. After completing the sample label, it will be covered with clear tape for protection. Appendix A of this SAP provides an example of a sample label. The following information will be legibly entered on all sample labels:

- Contractor name.
- Sample type (grab or composite).
- Analysis/method to be performed.

- Type of chemical preservative present in the container.
- Site name.
- Date and time of sample collection.
- Sample identification number.
- Sampler's name or initials.

Sample logbooks and COC records will contain the same information as the labels affixed to the sample containers. These records will record all information related to the sampling effort and the process employed.

5.3.2 Chain of Custody Records

The primary objective of the chain-of-custody (COC) procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from collection to completion of all required analyses. Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they are deemed to be in the custody of such authorized personnel.

Sample COC forms will be used for each packaged lot of samples. Appendix A of the SAP provides an example of a blank COC form that will be used at the Site. Each cooler sent to the laboratory will contain Chain-of-Custody form(s) listing the samples contained therein. The purpose of these forms is to document the transfer of a group of samples traveling together from the field to the laboratory. The original of the COC always travels with the samples and the sampler keeps a copy with the Site sampling records. The chain-of-custody record must be fully completed by the field technician or other member of the Contractor's Quality Control Organization Staff who has been designated as responsible for sample shipment to the laboratory for analysis. When transferring the samples, the individuals relinquishing and receiving them must sign, date, and note the time on the chain of custody record.

The following documentation procedures will be followed for completion and utilization of the chain-of-custody record sheets:

- The field technician will fill in all requested information on the COC from the sample label. This includes the unique sample number, time and date acquired, sampler's name, analysis to be performed, matrix type, and any special instructions. In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns (e.g., extraction time or sample retention period limitations, etc.), the person completing the chain-of-custody record should note these constraints in the "Remarks" section of the custody record and the laboratory will be contacted in advance of the shipment of such samples. All samples shall be shipped from the site within 24 hours of collection.

- The sampler or a member of the Contractor's Quality Control Organization Staff will sign, date, and note the time in the "Relinquished by" box and will keep a copy of the chain-of-custody at the Site with the project records. The original chain-of-custody record will accompany the shipment of samples to the laboratory.

- In the instance where the sampler relinquishes custody to a common carrier such as Federal Express (FedEx), the sampler will write "FedEx" in the "Received by" box. A copy of the accompanying shipment air bill will be retained as part of the permanent documentation and can be attached to the Site copy of the chain-of-custody.

- After delivery by FedEx, the person receiving custody will sign and date in the "Received by" box. The person receiving custody will check the sample label against the custody record. He will also check sample condition and note anything unusual under "Remarks" on the chain-of-custody form. The receipt temperature of the temperature blank is immediately recorded and pertinent information as to shipment, pickup, and courier is entered in the "Remarks" section. Upon receipt of the sample containers, the person receiving custody will also complete the Army Corp of Engineers Sample Receipt Form and Laboratory Sample Shipment Checklist. Copies of these forms (specific to Waste Stream Technology, Inc. (WST), one of the contract laboratories for the project) are included in Appendix A. Any problems and/or discrepancies noted during sample check-in will result in the laboratory project manager contacting the CQCSM. Any discrepancies noted during sample receipt (e.g., cooler received outside of the temperature requirements, samples improperly preserved, sample containers broken, etc.) that may affect sample integrity will result in the laboratory contacting CQCSM and documenting the issue and resolution of the Sample Shipment Checklist. The USACE

will also be copied on all sample receipt problems for consultation regarding resolution (e.g., recollect samples, apply data qualifiers, analyze samples "as is", etc.), if necessary.

- The sample custodian then enters the sample identification number and other information into the laboratory sample tracking system. The custodian will then place each sample in the proper secure storage area. When a technician from sample preparation and/or analysis requests samples, the custodian will relinquish the samples to the technician using laboratory-stipulated logging out procedures. Upon return of the samples, laboratory-stipulated logging in procedures will be followed and the custodian will return the samples to the proper secure storage area.

- If for any reason the samples are left unattended or any personnel in the custody chain refuses to sign the chain-of-custody, this will be documented and explained on the COC.

5.3.3 Custody Seals

Shipping containers must be sealed with custody seals for shipment to the laboratory. An example of a sample cooler custody seal can be found in Appendix A of this SAP. When samples are shipped, two or more custody seals are to be placed on each shipping container, with at least one at the front and one on the side, located in a manner that would indicate if the container were opened in transit. Wide, clear packaging tape should be placed over the custody seals to ensure that the seals are not accidentally broken during shipment. Upon receipt of the sample coolers, the sample custodian must check and confirm that all custody seals on the coolers are intact.

5.4 Corrections to Documentation

All original data recorded in field notebooks and on sample identification labels, chain-of-custody records, and sample receipt forms are written in waterproof ink. These documents are not to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a document, the individual entering the information/data will make the corrections. A single solid line (in indelible ink, preferably) will be made through the errant entry. Under no circumstances

shall a correcting fluid (i.e. White-Out®) be used or any erasures made. The erroneous information should not be obliterated. Each correction shall be dated and initialed by the individual making the correction.

Should any improper correction of returned paperwork (e.g. laboratory-signed COCs, analytical reports) be suspected, it should be brought to the attention of the Site Project Manager immediately for further action, as necessary.

5.5 Field Variance System

Procedures cannot fully encompass all conditions encountered during field activities. Variances from the operating procedures, Field Sampling Plan, and/or Safety and Health Plan may occur. All variances that occur during field activities will be documented on a field change request (FCR) form and will be noted in the appropriate field logbooks. A sample of a typical FCR is included in Appendix A. If a variance is anticipated (e.g., because of a change in field instrumentation), the applicable procedure will be modified and the change noted in the field logbook.

6.0 SAMPLE PACKAGING AND SHIPPING

6.1 Sample Packaging

This section describes the procedures for properly packaging and shipping the environmental samples collected from the Site. These procedures will be performed after samples have been collected and placed in the proper containers and correctly preserved. As an aid to field personnel and as part of the Site QC inspections, Sevenson Checklist Number 007, "Task Specific QC Checklist – Packing, Storing, and Shipment of Samples" and Sevenson Checklist Number 010, "Task Specific QC Checklist – Sample Cooler Shipment" are included in Appendix A.

Environmental samples should be prepared for shipment as follows:

1. Follow all appropriate instructions for collecting the sample in accordance with the project FSP outlined in Section 4.0 and immediately chill upon collection with ice. Sample labels are placed on samples immediately after sample collection as described in Section 5.3.1.

2. Secure the lid of the sample jar tightly. A thin strip of duct tape may be place around the edge of the lid of liquid sample jars (except for VOC samples) to further prevent leakage.

3. Securely wrap the sample jar with bubble-wrap. Tape the bubble-wrap to the sample jar to ensure the sample jar does not slide out.

4. Each wrapped sample bottle/jar is placed in a separate Ziplock plastic bag, which is then sealed.

5. A picnic cooler will be used as the shipping container. Only hard plastic, impact resistant coolers in good condition should be used. If the sample cooler has a drain plug, tape it shut on the inside and outside of the cooler. Place a large, new, clean garbage bag inside the cooler as a secondary liner.

6. Place the sample jars in an upright position inside the lined cooler in such a way that they do not touch and will not touch during shipment. Place bubble-wrap, or other suitable material that will retain its integrity if it gets wet, between each sample bag to take up any void space and to prevent the containers from touching. Place a temperature blank in close proximity to the samples.

7. Samples should be shipped to the laboratory on ice and chilled to 4°C. Place ice inside a Ziplock bag. Place the bag of ice inside a second Ziplock bag. The field team will determine the number of bags of ice needed. Place the double-bagged ice around, among, and on top of the sample bottles to assure samples will arrive at the laboratory at 4°C. Secure the liner bag with a twist-tie or knot.

8. The paperwork (e.g., original chain-of-custody) going to the laboratory is placed inside a Ziplock bag and taped to the inside lid of the cooler. The chain-of-custody form should indicate the overnight carrier and the associated air bill number. A copy of the chain-of-custody is retained with the project files.

9. The cooler is closed and taped shut with fiber-reinforced tape (strapping tape) by running the tape around both ends of the cooler at least two times.

10. Orientation arrows and "Handle With Care" stickers are placed on at least two sides of the cooler.

11. A minimum of two signed custody seals will be applied across the lid opening, one on the front and one on the side, to maintain the integrity of the sample custody process.

12. The cooler is handed over to the overnight carrier. A standard air bill is necessary for environmental samples. The address label should contain both the shipped from and ship to address. The air bill is placed on the top of the cooler. A copy of the air bill is retained with the project document files.

13. A copy of the COC and the air bill should be faxed to the laboratory to assist in tracking of potentially misrouted coolers and for planning of analysis.

6.2 Sample Shipping

All shipments will be in compliance with applicable USDOT regulations for environmental samples. The On-Site Project Manager and Laboratory Coordinator will discourage the shipping of samples on Fridays unless it is absolutely necessary, and the laboratory has assured that personnel will be present on Saturdays to receive and implement any necessary processing within the analytical holding times.

6.2.1 Shipping Companies

All project samples will be shipped to the laboratory via FedEx courier services to ensure timely receipt of the samples by the laboratory.

6.2.2 Shipping Destinations

Project samples will be shipped to WST for chemical analysis (except samples for explosives). Site environmental samples and field QC samples will be delivered within 24 hours of their collection (except those collected on Friday which will be held under appropriate conditions for shipment on Monday, unless prior arrangements have been made with the laboratory for Saturday sample receipt) via FedEx to the laboratory at the following address:

Waste Stream Technology, Inc.
302 Grote Street
Buffalo, NY 14207
(716) 876-5290

Samples for explosives will be sent to Severn Trent Laboratories (STL) at the following address:

Severn Trent Laboratories
2417 Bond Street
University Park, Il 60466-3182
(708) 534-5200

The chain of custody form and sample shipment documentation will be faxed to the respective laboratory when samples are shipped for package tracking and sample analysis planning purposes.

All laboratories will be responsible for maintaining proper sample receipt protocols or identifying any sample receipt abnormalities as per their appropriate laboratory SOP, as described in the Quality Assurance Project Plan (QAPP).

7.0 CONTRACTOR QUALITY CONTROL

Contactor quality control (CQC) is the means by which the contractor ensures that the field activities comply with the requirements of the contract. Sevenson will ensure that the CQC Systems Manager maintains quality throughout all fieldwork by means of a three-phase process performed onsite for each definable work element. The three phases of control include the preparatory phase, the initial phase, and the follow-up phase. Examples of the inspection checklists for the three-phase procedures have been provided in Appendix A of this SAP. These activities are further defined below.

7.1 Preparatory Phase

The preparatory phase of the CQC program will be performed prior to the initiation of remedial activities or phases of remedial activities, after all required plans/documents/materials are accepted/ approved and will consist of a meeting conducted by the Sevenson CQC Systems Manager. This meeting will have meeting minutes recorded and will occur prior to the initiation of sampling activities or phases of remedial activities. The meeting may include:

- Review of the planned activities to assure field personnel and subcontractors are aware of overall data quality objectives, the specific type of data being collected, and specific sampling and data analysis requirements.
- Review of all required forms.
- Review of equipment decontamination procedures.
- Review of proper IDW management and storage.
- Review of proper sample collection, packaging, and documentation.
- Review of field equipment and support material checklists.
- Confirm any required preliminary tasks are complete.
- Review safety issues and analyze for any potential hazards.
- Review of other issues as deemed necessary by the Sevenson CQC Representative.

The USACE will be notified at least 48 hours in advance of the preparatory control phase. The results of the preparatory phase actions will be documented by minutes prepared by the CQC Systems Manager and attached to the Daily Quality Control Report.

7.2 Initial Phase

The Sevenson CQC Systems Manager shall oversee and confirm compliance with the SAP at the initiation of each definable work feature. The CQC Systems Manager will observe and document compliance and/or deviations from the approved FSP and QAPP. Minutes of this phase will be prepared and attached to the daily QC report. Activities will include:

- Oversight of sampling and field activities to assure compliance with contract terms.
- Oversight of sample acquisition, labeling, and shipping.
- Oversight of sampling equipment decontamination.
- Inspection of all required documentation, including field notebooks and chain of custody forms to assure completeness, consistency, and accuracy.
- Completion of QC Inspection Report and Task-Specific QC Checklists (copies included in Appendix A of this SAP).
- Verification that activities are conducted according to the Site-Specific Safety and Health Plan to assure worker and community safety.

The USACE will be notified at least 48 hours in advance of the beginning the initial phase. The initial phase will be repeated for each new work crew to work on-Site, or at any time acceptable quality standards are not being met.

7.3 Follow-Up Phase

The Sevenson CQC Systems Manager will provide daily inspections to ensure compliance with the SAP until completion of each definable work element. This daily inspection will document deficiencies noted during the initial phase, communicate any such deficiencies to both field personnel and the project manager, provide appropriate methods to correct the deficiencies, and follow up with the affected personnel to assure corrective measures are implemented. This phase will include the completion of the daily chemical quality control report (DCQCR), a copy of which is included in Appendix A and further discussed in Section 8.1 of the FSP.

8.0 SITE REPORTING AND DAILY CHEMICAL QUALITY CONTROL REPORTS

8.1 Daily Chemical Quality Control Reports (DCQCR)

For days that chemical sampling is performed, Sevenson's CQC Systems Manager or appropriate designee will prepare and sign a Daily Chemical Quality Control Report (DCQCR). A copy of the DCQCR form is provided in Appendix A. The reports will be sequentially numbered and submitted on a regular basis to the Contracting Officer or a Designated Representative attached to the Daily Quality Control Report. The following will be attached to the DCQCR for final hard-copy submittal to the USACE: sample summary tables, copies of COC, sample shipment bills of lading, field generated analytical results, and any other relevant project forms (e.g., corrective action forms, field change request forms).

The CQCSM will report any deviations that may affect DQOs immediately to the USACE. Any instructions given by the USACE will be recorded in the DCQCR along with the appropriate corrective actions, as applicable.

The DCQCR will contain the following elements:

- Job identification and site numbers.
- Weather conditions, including temperature, wind speed and direction, barometric reading, and significant wind changes.
- Subcontractors present onsite (if any).
- Health and Safety requirements for daily work tasks.
- Health and Safety violations (if any) and corrective actions taken.
- Summary of planned daily activities.
- Description of chemical data acquisition tasks performed including specific information identifying project samples collected and equipment calibrations performed.
- Sample shipments including shipment and delivery problems that may affect project data quality objectives (DQO) requirements.
- Chemical parameter measurement problems that may affect project DQO requirements, including instrument malfunction and performance requirement failure.

- Any sampling performed as contingency sampling.
- Corrective actions and/or deviations from the approved SAP, including approvals.
- A summary of the feedback procedure for any corrective action taken.
- Signatures of responsible authority and initials of all persons conducting change/corrective actions.

8.2 Laboratory Analytical Data Reports

Each environmental sample collected during sampling events for off-Site chemical analysis will be sent to the appropriate analytical laboratory. Upon completion of analysis, the laboratory will prepare an analytical data report for each sample. Specifics of analytical report preparation and requirements can be found in Section 10.4.1 of the QAPP. The chemistry data package will contain information to demonstrate that the project DQOs have been fulfilled.

9.0 CORRECTIVE ACTIONS

Corrective actions will be implemented when a discrepancy is discovered by field or laboratory personnel or during field or desk audits. The Sevenson CQCM will coordinate and facilitate corrective actions. If the problem is determined to be minor, the corrective action will be recorded in the field notes, with verbal notifications to other field teams or subcontractors about the deficiency and the corrective action. If the deficiency is severe and may affect the QA objectives of the project, a formal written review and corrective action will be initiated, called a Non-Conformance Report (NCR). The NCR will identify the deficiency, identify how the deficiency might affect the work product QA, propose corrective action, and document that the corrective action has been taken. The Sevenson CQCM will supervise this process. In addition, the CQCM will maintain a log of all NCRs for the project and ensure that the NCRs and corrective actions are maintained with final project files. Details of non-conformances and corrective actions are provided below.

9.1 Non-Conformance

A nonconformance is an unauthorized deviation from documented sampling or analysis procedures, practices or standards, or a defect in an item that is sufficient to render the quality of a sample or datum unacceptable or indeterminate. Field non-conformances may include, but are not limited to, the following:

- Incorrect sampling procedures
- Failure of field instrumentation
- Improper instrument calibration
- Incorrect sample preservation
- Incorrect sample packaging
- Inappropriate sample shipment resulting in exceeded holding times
- Incorrectly identified samples

If a non-conformance is suspected, the CQCM Representative for the project will be notified as soon after the situation is identified as possible. For field non-conformances, the project manager, field chemist, or field sampler will make the notification; for laboratory non-conformances, the laboratory QC Manager will make the notification.

After evaluation of the potential non-conformance situation, the CQCM will notify the USACE Contracting Officer or a Designated Representative and request a modification to the approved program. Any request for modification will be initiated on a FCR form. An example of a FCR is included in Appendix A of this SAP. Each FCR will be sequentially numbered and entered into the Project documentation files. The CQCM will be responsible for controlling, tracking, and, if necessary, overseeing the implementation of any approved changes.

If the proposed modification is unacceptable to the USACE, any action taken during the period of departure from established protocols will be evaluated for impact to the project and to determine subsequent actions that may be required.

9.2 Corrective Action

Corrective actions are required for two classes of problems: analytical and equipment problems and noncompliance (i.e., those which do not follow the written procedures stated in the Site plans). A sample corrective action form is included in Appendix A of this SAP. Corrective actions for field and analytical activities may include:

- Repeating the measurement to check for error
- Recalibration of instruments using freshly prepared calibration standards
- Check for adequate power supply or operation
- Replacement of sampling or analytical equipment
- Reanalysis of samples
- Re-sampling
- Additional training of field personnel in correct implementation of sample preparation, collection, or analytical methods
- Reassignment of personnel, if necessary, to improve the overlap between operator skills and sampling requirements
- Communication with the CQCM to determine the appropriate action (e.g., insufficient sample remaining for reanalysis)

Noncompliance or departure from the approved SAP will be reported immediately to the Sevenson Project Manager, the CQCM, and the Contracting Officer or a Designated Representative. The offsite laboratory will report any departures from specified analytical methodologies to the CQCSM.

Prior to implementation, Sevenson's CQCM will approve all corrective actions planned to address the deviations from the SAP. The CQCM will ideally submit a report within 48 hours of the non-conformance event to the Contracting Officer or a Designated Representative. The CQCM is responsible for ensuring that all corrective actions for non-conformances are initiated by:

- Evaluating all reported non-conformances
- Modifying or stopping additional work on non-conformance items
- Determining action to be taken
- Maintaining a log of non-conformances
- Reviewing non-conformance reports and corrective actions taken
- Ensuring that any non-conformance is included in the DCQCR and that all reports are made part of the final Site document files

10.0 PROJECT SCHEDULE

A final project schedule, including sampling activities, will be submitted with the Site Work Plan.

11.0 SAMPLING APPARATUS

11.1 Field Equipment

The following section details the equipment needed to collect samples from the various media presented in this FSP for laboratory analysis. The specific procedures for sampling, storing, and shipping the samples are found in Sections 4, 5, and 6, respectively, of this FSP. General sampling equipment common to all sampling categories is also presented. It should be noted that all equipment listed might not be necessary for each sampling event. Conditions at the time of sampling may dictate the use of alternate devices.

11.2 Sampling Equipment for Soil

- Geoprobe® drilling system
- Acetate liners
- Stainless steel knife
- Plastic sheeting for ground protection

11.3 Sampling Equipment for Residual Sediments

- Plastic sheeting for ground protection
- Plastic bucket
- Hand dipper, sample trowel, or drum thief

11.4 Sampling Equipment for Solid Waste

- Plastic sheeting for ground protection
- Disposable scoop or trowel (stainless steel)
- Disposable aluminum containers
- Sample containers provided by the laboratory

11.5 Sampling Equipment for Wastewaters

- Plastic sheeting for ground protection
- Plastic bucket
- Thief sampler
- Mesh under gloves
- Sample containers provided by the laboratory

11.6 General Sampling Equipment

The following equipment may be used for some, if not all, sampling activities:

- Tool box (miscellaneous tools)
- Disposable latex and/or nitrile gloves (powderless)
- Water (potable and distilled)
- Sample labels
- Chain-of-Custody Forms
- Duct tape
- Plastic bags (trash and various sized Ziplock storage bags)
- Paper towels
- Utility knife
- Ice or ice packs
- Coolers
- Bubble wrap
- Spray bottles
- Log books, hardbound with numbered pages
- Field forms
- Indelible ink pens

12.0 REFERENCES

1. Data Quality Evaluation Guidance, USACE (CENWK-EC-EF), July 1999.

2. "Identification and Listing of Hazardous Waste", 40 CFR Part 261, 1999.

3. On-Site Analysis of High Concentrations of Explosives in Soil, Thomas F. Jenkins, Patricia W. Schumacher, Jane G. Mason, and Philip G. Thorne, US Army Corps of Engineers Special Report 96-10, May 1996.

4. Requirements for the Preparation of Sampling and Analysis Plans, USACE-Environmental Quality (EM 200-1-3), February 2001.

QAPP

TNT WALKOVER AND SITE INVESTIGATION

FORMER LAKE ONTARIO ORDNANCE WORKS
LEWISTON, NEW YORK

CONTRACT # DACW-49-00-D-0002
DELIVERY ORDER #0002

QUALITY ASSURANCE PROJECT PLAN - FINAL

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January 2003

TNT WALKOVER AND SITE INVESTIGATION
FORMER LAKE ONTARIO ORDNANCE WORKS
LEWISTON, NEW YORK

QUALITY ASSURANCE PROJECT PLAN

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List of Abbreviations and Acronyms

CDFR	Chemical Data Final Report
CMSA	Contaminated Materials Storage Area
COC	Chain of Custody
CQCM	Chemical Quality Control Manager
CQCSM	Contractor Quality Control Systems Manager
DNF	Deficiency Notification Form
DQO	Data Quality Objective
FSP	Field Sampling Plan
ICP	Inductively Coupled Plasma
IDL	Instrument Detection Limit
ISSI	ISSI Unexploded Ordnance, Inc.
LCS	Laboratory Control Sample
LCS	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
MD	Matrix Duplicate
MDA	Minimum Detectable Activity
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAD	Normalized Absolute Difference
NCR	Non-Conformance Report
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAM	Radioactive Material
RF	Response Factor
RPD	Relevant Percent Difference
RSO	Radiation Safety Officer
SAP	Sampling and Analysis Plan
Sevenson	Sevenson Environmental Services, Inc.
SOP	Standard Operating Procedure
STL	Severn Trent Laboratories
TNT	2,4,6-Trinitrotoluene
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
WST	Waste Stream Technology, Inc.

1.0 PROJECT DESCRIPTION

This portion of the Sampling and Analysis Plan (SAP) presents the Quality Assurance Project Plan (QAPP) for the activities to be performed during work at the Former Lake Ontario Ordnance Works located in Lewiston/Porter, New York. The United States Army Corps of Engineers (USACE) and the United States Environmental Protection Agency (USEPA) require that all environmental monitoring and measurement efforts mandated or supported by these organizations participate in a centrally managed quality assurance (QA) program. Any party generating data for this project has the responsibility to implement minimum procedures to ensure that the precision, accuracy, completeness, and representativeness of the data are known and documented. To ensure that these responsibilities are met uniformly, each party must adhere to the QAPP.

This QAPP presents the organization, objectives, functional activities, and specific QA and quality control (QC) activities associated with the Sampling and Analysis Plan for the Site. It describes the specific protocols that will be followed for sampling, sample handling and storage, chain of custody, and laboratory analysis. This plan also presents details regarding data quality objectives (DQOs) for the project and laboratory analytical procedures for all media sampled. The QAPP provides necessary technical detail and direction such that laboratory and field personnel understand all project sample analyses, quality control and data reporting requirements. It also contains sufficient detail and direction such that analytical laboratory personnel understand analytical methods, required method detection limits, method QC requirements, data validation, project data quality objectives, and reporting requirements. The Field Sampling Plan (FSP), which is also part of this SAP, sets forth the sampling procedures, preservation for the samples collected in the field, field documentation, and sample packaging and shipping. The FSP and QAPP are integrated and cross-referenced where applicable to avoid redundancy.

All QA/QC procedures will be in accordance with applicable professional technical standards, USEPA requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP is prepared in accordance with USEPA and USACE guidance documents: *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 2001), *Chemical Quality Assurance for HTRW Projects* (USACE 1997), and *Guidance Objectives for the Data Quality Objectives Process* (USEPA 1994).

1.1 Site History and Contaminants

A description of the site history and contaminants identified at the site is provided in Sections 1.2 and 1.3 of the Field Sampling Plan and is not repeated here for the sake of brevity.

1.2 Site Specific Sampling and Analysis Problems

Due to the potential presence of detonable quantities of TNT and explosive compounds (including TNT intermediates such as 2,4-dinitrotoluene and 2,6-dinitrotoluene) along the TNT pipeline, an explosives expert will accompany Sevenson personnel during Site activities at potential/known explosives hazard locations.

With the exception of samples submitted to the off-Site laboratory for waste characterization purposes, all samples collected will be analyzed on-Site using the TNT EnSys® Soil Test System produced by Strategic Diagnostics, Inc. Sevenson's explosives subcontractor, ISSI Unexploded Ordnance, Inc. of Huntsville, Alabama, will perform the field analysis using the EnSys® system. The on-Site analysis involves a rapid extraction of the soil with an organic solvent, usually acetone or methanol because of the high solubility of TNT in these polar solvents, followed by a colorimetric analysis of the extract using a HACH DR/2000 spectrophotometer. Details of the EnSys® system and the spectrophotometer are included in Appendix C. Due to the nature of the EnSys® system, analysis will be performed in a controlled environment at temperatures between 40°C and 100°C. In addition, if soils appear to have greater than 10% moisture, they will be allowed to dry prior to analysis.

The EnSys® system will be used to verify whether the concentrations of TNT in the soil samples collected during the Site investigation are less than 10%. If the TNT concentrations are greater than 10%, soils will be amended with sand prior to stockpiling and off-Site disposal. Prior to off-Site disposal, the stockpiled materials will be sampled and submitted to the laboratory for analysis of waste characterization parameters and nitroaromatic and nitroamine explosives.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Sevenson Environmental Services, Inc. (Sevenson) is the designated United State Army Corps of Engineers (USACE) contractor responsible for conducting the activities required by the current task order. The functional responsibilities of key personnel are described in the following parts of this section. The assignment of personnel to each project position will be based on a combination of (1) experience in the type of work to be performed, (2) experience working with USACE personnel and procedures, (3) a demonstrated commitment to high quality and timely job performance, and (4) staff availability.

2.1 Corporate Project Manager

The Sevenson Corporate Project Manager, Mr. Al LaGreca, has direct responsibility for implementing the SAP, including all phases of work plan development, field activities, data management, and report preparation. This individual will also provide the overall management of the project, and serve as technical lead and point of contact with the USACE Project Manager. The activities will include coordinating all personnel working on the project, interfacing with USACE personnel, and tracking project budgets and schedules. The Sevenson Corporate Project Manager will also develop, monitor, and fill project staffing needs, delegate specific responsibilities to project team members, and coordinate with administrative staff to maintain a coordinated and timely flow of all project activities.

2.2 Chemical Quality Control Manager

The Chemical Quality Control Manager (CQCM), Mr. Kenneth Paisley, is responsible for project Quality Assurance/ Quality Control (QA/QC) in accordance with the requirements of the QAPP, other work plan documentation, and appropriate management guidance. This individual, in coordination with the on-Site QC Manager, will be responsible for participating in the project field activity readiness review; approving variances during field activities before work continues; approving, evaluating, and documenting the disposition of Nonconformance Reports; overseeing and approving ant required project training; and designing audit/surveillance plans followed by supervision of these activities. The Chemical Quality Control Manager reports directly to the Corporate Project Manager and On-Site Project Manager.

2.3 Contractor Quality Control Systems Manager

The Contractor Quality Control Systems Manager (CQCSM), Mr. Dana Draper, is responsible for the implementation and documentation of all project QA/QC protocols during field activities. In this capacity he will direct and implement various components of the Contractor Chemical Quality Control program as identified in EM200-1-3. This will include but not be limited to: documentation of QAPP instructions to field personnel; oversight of field sampling and analytical activities; documentation of field QC activities; and completion of Daily Chemical Quality Control Reports. The CQCSM reports directly to CQCM, but will inform the Corporate and on-Site Project Managers of all information and decisions reported.

2.4 Health and Safety Director

The Health and Safety Director, Mr. Paul Hitcho, is responsible for ensuring that health and safety procedures designed to protect personnel are maintained throughout the field activities. This will be accomplished by strict adherence to the project Site Safety and Health Plan, which has been prepared as a separate document for this project. This individual, in conjunction with the Site Safety and Health Officer, will have the authority to halt fieldwork if health or safety issues arise that are not immediately resolvable in accordance with the Site Safety and Health Plan. The Health and Safety Director and Site Safety and Health Officer report directly to the Corporate and on-Site Project Managers.

2.5 Project Chemist

The Project Chemist, Ms. Jennifer Singer, is responsible for resolving questions the laboratory may have regarding QAPP requirements and deliverables. She will perform a cursory review of all analytical data reports received from the laboratory (i.e., confirm that sample results are included for all parameters, confirm that all method required laboratory QA/QC results are included). The Project Chemist reports directly to the on-Site QC Manager and the Chemical Quality Control Officer.

2.6 On-Site Project Manager

The on-Site Project Manager, Mr. Jerry Castiglione, is responsible for implementing all field activities in accordance with the FSP and the QAPP. This individual is responsible for: ensuring proper technical

performance of field operations and sampling activities; adherence to required sample custody and other related QA/QC field procedures; coordination of field personnel activities; management of investigation-derived wastes; checks of all field documentation; and preparation of Field Change Orders if required. The on-Site Project Manager reports directly to the Corporate Project Manager except in regard to QA/QC matters that are reported directly to the CQCM.

2.7 Field Chemists/Field Samplers

Mr. Jeff Shirley of Sevenson will be responsible for the collection of waste characterization samples for submittal to the off-Site laboratory. Mr. Jerry Hinton of ISSI Unexploded Ordnance, Inc. (ISSI) will be responsible for the collection and field analysis of explosives related materials. He will be trained in the sampling and analysis techniques required to correctly and safely operate the TNT EnSys® Soil Test System. The Field Chemists report directly to the on-Site QC Manager and the Chemical Quality Control Officer.

2.8 Subcontracted Laboratory Support

Analytical laboratory support specific to Site sampling activities will be obtained from Waste Stream Technology, Inc. (WST) of Buffalo, New York and Severn Trent Laboratories (STL) of University Park, Illinois. STL will perform all analyses of samples for explosives (i.e., SW-846 Method 8330 nitroaromatic and nitramine explosives). The laboratories will maintain a current validation from the USACE; proof of current USACE validation will be required from the laboratories and will be verified by USACE prior to initiating sampling activities. WST's Quality Assurance (QA) and Quality Control (QC) Plan (August 2002) is included in Appendix B. STL's QA/QC Plan is not included in this SAP but will be made available upon request.

An organizational chart outlining WST's key laboratory personnel and organization is included in their QA/QC Plan (Appendix B). Prior to the commencement of field activities for the project, a complete copy of the SAP, including this QAPP, will be sent to the laboratories. The responsibilities of key laboratory personnel are described in the following paragraphs.

2.8.1 Laboratory Quality Assurance/Quality Control Manager

The Laboratory QA/QC Manager is responsible for the laboratory QA/QC in accordance with the requirements of this QAPP in conjunction with the established laboratory QA/QC program. In coordination with the Project Laboratory Coordinator, the QA/QC Manager will be responsible for:

- Documenting that samples received by the laboratory are analyzed in accordance with required methodologies;
- Assuring that instrument calibration is performed properly and documented;
- Verifying that field and internal laboratory QC samples are analyzed and documented;
- Reporting both field and QC samples in the format required by the laboratory scope of work and the QAPP;
- Processing laboratory nonconformance reports (NCRs) and laboratory/analytical deficiency notification forms (DNF) in a timely manner; and
- Implementing Corrective Action Report recommendations and requirements.

2.8.2 Laboratory Project Manager

The responsibilities of the laboratory Project Manager include the following:

- Initiation and maintenance of contact with the project on individual job tasks;
- Preparation of all laboratory-associated work plans, schedules, and manpower allocations;
- Initiation of laboratory associated procurement for the project;

- Provision of day-to-day direction of the laboratory project team including analytical department managers, supervisors, QA personnel, and data management personnel;
- Coordination of all laboratory related financial and contractual aspects of the project;
- Provision of formatting and technical review for all laboratory reports;
- Provision of final review and approval on all laboratory analytical reports to the project; and
- Response to all post project inquiries.

2.8.3 Laboratory Manager

The responsibilities of the Laboratory Manager include the following:

- Coordination with all analytical production activities conducted within the analytical departments;
- Working with the Laboratory Project Manager to ensure all project objectives are met;
- Provision of guidance to analytical department managers; and
- Facilitation of transfer of data produced by the analytical departments to the report preparation and review staff for final delivery to the client.

2.8.4 Laboratory Section Heads, Department Managers, and Technical Leads

The responsibility of each laboratory section or department include the following:

- Coordination of all analytical functions related to specific analytical areas;
- Provision of technical information to and oversight of all analysis being performed;

- Review and approve all analytical results produced by their specific analytical area of expertise; and

- Maintenance of all analytical records and information pertaining to the analysis being performed.

Analytical professionals exhibiting the qualifications defined in Appendix I of USACE EM 200-1-3 (February 2001), shall staff the laboratory.

2.9 Contact Information

Points of contact for personnel for Sevenson, WST, and STL are provided in Table 2-1 of the FSP. If it should become necessary at any time throughout the duration of this project to make any changes/additions to staff personnel, Sevenson will notify the USACE Contracting Officer or a Designated Representative prior to such changes and/or additions. In addition, the WST and STL contact persons will be notified if any of these personnel changes directly affect whom to contact for sample receipt problems, data reporting problems, guidance, and decision authority.

2.10 Personnel Qualification Requirements

Personnel performing the tasks and having the responsibilities identified under Section 2.0 shall have and maintain the qualifications as specified in the specification document and USACE contract documents. The Sevenson Project Manager will maintain a record of requirements, training, and qualifications for each individual.

3.0 DATA QUALITY OBJECTIVES (DQO)

During the course of these activities, the project must develop and implement procedures for field sampling, chain of custody (COC), laboratory analysis, and reporting, which will provide information for site remediation, evaluation, and assessment. Data must be technically sound and legally defensible. Procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventative maintenance of laboratory equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the objectives for data accuracy, precision, completeness, representativeness, and comparability. The SAP identifies specific task objectives as they relate to Site action levels and remediation.

Data quality objectives (DQO) are qualitative and quantitative statements that specify the quality of data required to support decisions made during remedial response activities, and are based on the end use of the data being collected.

3.1 Project Objectives

The overall project objectives are to:

1. Define the level and extent of subsurface soil contamination in the vicinity of the wastewater treatment plant through the use of an on-Site screening system.

2. Use an on-Site screening system to establish the levels of contamination present in residual sediments present in a subsurface wooden pipe and vaults associated with the wastewater treatment plant.

3. Perform walkovers in three remaining TNT pipeline areas and the Contaminated Materials Storage Area (CMSA), remove any residual TNT materials present, and perform an on-Site screening of any TNT materials removed during the walkover to establish whether amending with sand is required prior to off-Site disposal.

4. Sample and analyze the generated solid wastes and isolated TNT materials to characterize for waste disposal purposes according to 40 CFR 261 and the requirements of the off-Site disposal facility.

5. Sample and analyze any liquid wastes generated during the sampling activities (e.g., decontamination wastewater) to characterize the liquid for waste disposal purposes according to the requirements of the off-Site disposal facility.

3.2 Data Quality Levels

Samples of Site media will be obtained and contaminant constituent parameters will be measured to generate data that supports Site data use requirements. Definitive data quality is anticipated for this project. A summary of data quality levels by sample type is included in Table 3-1.

A field screening level of data quality indicates that the analytical test will be performed in the field through the use of field instruments/test kits (e.g., TNT EnSys® Soil Test System) and will provide real-time data. All instruments shall be maintained and/or calibrated daily, according to the manufacturer's specifications and documented in the field logbook. Results of all field measurements will be recorded in the field logbook and on the TNT Soil Test Kit Worksheet (Appendix A). For this project, screening level data will be generated to characterize subsurface soil samples, characterize residual sediments, and to determine the relative percentage of TNT present in the soil collected during a walkover in order to verify whether dilution with sand is required prior to off-Site disposal.

A definitive level of data quality indicates that the analytical test will be performed off-Site by instrumentation capable of giving a quantifiable data result. For this level of data for the Project, all samples will be shipped for analysis at an approved laboratory. Data generated at this level is subject to quality assurance and control procedures that include the collection and analysis of QA/QC samples, which are discussed in Section 3.5. Definitive quality data shall be acquired, documented, verified, and reported to ensure that the specified precision, accuracy, representativeness, comparability, completeness, and sensitivity requirements are met.

Table 3-1
DATA QUALITY LEVELS FOR CHEMICAL PARAMETERS
Former Lake Ontario Ordnance Works

CHEMICAL PARAMETER	ANALYTICAL METHOD[1]	DQO LEVEL
TNT	TNT EnSys® Soil Test System	Screening
TCLP VOCs (soil and aqueous)	SW-846 Method 1311/5030C/8260B	Definitive
TCLP SVOCs (soil and aqueous)	SW-846 Method 1311/3510C/8270C	Definitive
TCLP Pesticides (soil and aqueous)	SW-846 Method 1311/3510C/8081A	Definitive
TCLP Herbicides (soil and aqueous)	SW-846 Method 1311/3510C/8151A	Definitive
TCLP Metals (soil and aqueous)	SW-846 Method 1311/3015/6010B/7470A	Definitive
Ignitability	SW-846 Method 1010	Definitive
Corrosivity (pH)	SW-846 Method 9045C/9040C	Definitive
Reactive Cyanide	SW-846 Section 7.4.3.2, Method 9014	Definitive
Reactive Sulfide	SW-846 Section 7.4.4.2, Method 9034	Definitive
Nitroaromatic and Nitramine Explosives (soil and aqueous)	SW-846 Method 8330	Definitive

[1] Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Final Update III, December 1996.

3.3 Quality Assurance Program

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

The stated objectives of the laboratory QA program are to:

- Properly collect, preserve, and store all samples;
- Maintain adequate custody records from sample collection through reporting and archiving of results;
- Use properly trained analysts to analyze all samples by approved methods within holding times;
- Produce defensible data with associated documentation to show that each system was calibrated and operating within precision and accuracy control limits;
- Accurately calculate, check, report, and archive all data using the Laboratory Information Management System (LIMS); and
- Document all of the above activities so that all data can be independently validated.

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

3.4 QA Objectives for Chemical Data Measurement

DQOs have been developed with reference to the PARCC goals (i.e. precision, accuracy, representativeness, comparability, and completeness), method sensitivity, documentation, data reporting, and data validation. These parameters are defined below.

- **Precision.** Precision is a measure of the degree of the agreement among individual measurements of the same property under similar conditions. Precision measures the random error component of the data collection process. Precision may be affected by the natural variation of the matrix or contamination within the matrix, as well as by errors made in the field and/or laboratory handling procedures. The degree of agreement, expressed as relative percent difference, is calculated using the formula included in Section 8.3.

  Matrix spike (MS) and matrix spike duplicate (MSD) pairs and laboratory duplicate samples are used to assess analytical precision. Field precision is assessed by measurement of field duplicate samples. The objective for laboratory precision is to recover relative percent difference (RPD) values within the established laboratory control limits for each method. The objective for field precision is to recover RPD values between field duplicate samples within the acceptance criteria presented in CENWK-EC-EF (July 1999) for each method. If the RPD acceptance criteria for field duplicate samples are not achieved, field-sampling procedures, including homogenization, will be reviewed with sampling personnel. In addition, the laboratory will be made aware of the discrepancy such that they may review internal sample preparation and analysis procedures. The laboratory and field precision goals are included in Table 3-2.

- **Accuracy**. Accuracy is the degree of agreement of a measurement with an accepted reference or true value. Accuracy measures the bias or systematic error of the entire data collection process. Sources of these errors include the sampling process, field and laboratory contamination, sample preparation and handling, sample matrix interferences, sample preparation methods, and calibration and analytical procedures. Accuracy is expressed as a percent recovery and is calculated using the formula found in Section 8.2 of this QAPP.

TABLE 3-2
PRECISION AND ACCURACY OBJECTIVES
Former Lake Ontario Ordnance Works

Parameters	Precision (Relative Percent Difference)	Accuracy % of Spike Recovery		Field Duplicate RPD Acceptance Criteria
Nitroaromatics and Nitramines		**LCS**	**MS/MSD**	
Amino-dinitrotoluenes	*	*	*	50
2,6-Dinitrotoluene	*	*	*	50
HMX	*	*	*	50
Nitrobenzene	*	*	*	50
1,3,5-Trinitrobenzene	*	*	*	50
2,4,6-Trinitrotoluene	*	*	*	50
TCLP ANALYSES				
TCLP Metals		**LCS**	**MS/MSD**	
Arsenic	25	85-115	75-125	40
Barium	25	85-115	75-125	40
Cadmium	25	85-115	75-125	40
Chromium	25	85-115	75-125	40
Lead	25	85-115	75-125	40
Mercury	25	80-120	75-125	40
Selenium	25	85-115	75-125	40
Silver	25	85-115	75-125	40
TCLP VOCs		**LCS**	**MS/MSD**	
Vinyl Chloride	25	74-134	68-140	40
1,1-Dichloroethene	25	74-121	76-116	40
2-Butanone	25	60-158	49-175	40
Chloroform	25	75-131	76-125	40
Carbon Tetrachloride	25	79-130	69-134	40
Benzene	25	86-116	83-118	40
1,2-Dichloroethane	25	84-123	76-126	40
Trichloroethene	25	87-113	87-110	40
Tetrachloroethene	25	82-115	75-120	40
Chlorobenzene	25	86-116	86-115	40
1,4-Dichlorobenzene	25	84-118	82-115	40
TCLP SVOCs		**LCS**	**MS/MSD**	
Pyridine	NA	10-67	5-74	35
1,4-Dichlorobenzene	35	53-100	44-113	35
2-Methylphenol	35	44-88	13-126	35
3&4-Methylphenol	35	44-88	13-126	35

TABLE 3-2
PRECISION AND ACCURACY OBJECTIVES
Former Lake Ontario Ordnance Works

Parameters	Precision (Relative Percent Difference)	Accuracy % of Spike Recovery		Field Duplicate RPD Acceptance Criteria
Hexachloroethane	35	49-104	37-119	35
Nitrobenzene	35	56-106	47-118	35
Hexachlorobutadiene	35	44-119	57-112	35
2,4,6-Trichlorophenol	35	65-109	56-115	35
2,4,5-Trichlorophenol	35	63-115	50-127	35
2,4-Dinitrotoluene	35	66-121	58-123	35
Hexachlorobenzene	35	68-111	54-120	35
Pentachlorophenol	35	66-126	32-153	35
TCLP Pesticides		**LCS**	**MS/MSD**	
gamma-BHC (Lindane)	30	74-114	59-126	35
Heptachlor	30	73-122	57-142	35
Heptachlor Epoxide	30	73-105	36-137	35
Endrin	30	76-139	58-155	35
Methoxychlor	30	67-145	53-167	35
Toxaphene	30	60-150	50-160	35
Chlordane	30	60-150	50-160	35
TCLP Herbicides		**LCS**	**MS/MSD**	
2,4-D	35	68-167	41-171	35
2,4,5-TP	35	81-143	78-146	35
RCRA Characteristics		**LCS**	**MS/MSD**	
Ignitability	NA	NA	NA	NA
Corrosivity	NA	NA	NA	NA
Reactive Sulfide	35	4-23	2-69	NA
Reactive Cyanide	35	68-131	62-139	NA

Notes:

* Indicates laboratory-specific limits to be obtained from STL

Analytical accuracy is measured by the analysis of calibration checks, system blanks, quality control samples, surrogate spikes, matrix spikes, and other method-specific checks. Field accuracy is assessed by evaluating the results of field and trip blanks and is maintained by frequent and thorough review of field procedures. The objective for precision is to meet the established laboratory control limits for the methods. The accuracy goals are included in Table 3-2.

- **Representativeness.** Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population of samples, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling strategies and techniques. The sampling program was designed so that the samples collected are as representative as possible of the medium being sampled and that a sufficient number of samples are collected. The determination of representativeness of the data will be performed by:

    - Comparing actual sampling procedures to those described in Section 4.0 of the FSP.
    - Identifying and eliminating non-representative data.
    - Comparing analytical results of field duplicate samples.
    - Evaluating holding times and condition of samples on arrival at the laboratory.
    - Examining blanks for cross contamination.
    - In the laboratory, making certain that all sub-samples taken from a given sample are representative of the entire sample.

The representativeness objective of this SAP is to eliminate all non-representative data. If, during the data evaluation, results indicate that a sample is not representative, Sevenson will notify the USACE and provide recommendations for an alternate location or sampling method.

- **Comparability.** Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through employing narrowly defined sampling methodologies, site audits/surveillances, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Thus, this objective will be met by following techniques and methods set forth in the SAP.

- **Completeness.** Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected under normal conditions. Completeness is determined as a percentage using the formula given in Section 8.4 of this QAPP. To be considered complete and valid, the reported data set must meet all acceptance criteria including precision and accuracy in accordance with the specified analytical method being used.

  The following completeness criteria shall be met:

  1. COMPLETENESS FOR SAMPLE COLLECTION. Completeness for sample collection is defined as the percentage of specified samples listed in the FSP that were actually collected. The completeness for sample collection will be 95%.

  2. COMPLETENESS FOR ACCEPTABLE DATA. Completeness for acceptable data is defined as the percentage of acceptable data out of the total amount of data generated. This completeness will be 95% for each analytical method. Acceptable data includes data that has passed all QC criteria and data which may have not passed all criteria but which had appropriate corrective actions taken.
  3. COMPLETENESS FOR QUALITY DATA. Completeness for quality data is defined as the percentage of quality data out of the total amount of data generated. The completeness shall be 90%. Quality data is that data that has passes all applicable quality control criteria specified in the QAPP.

- **Sensitivity.** Sensitivity is a measure of a method's detection limit and ability to distinguish between two values. The method detection limit (MDL) is the smallest reportable concentration in a sample

within a specified level of confidence, while method quantitation limits (MQL) represent the sum of all of the uncertainties in the analytical procedure plus a risk factor. Hence, the method quantitation limit is based on the method detection limit. Additionally, the lowest calibration standard is typically set at the MQL. The laboratory MQLs for the samples generated through the FSP and the analytical methods that will be used to achieve the appropriate sensitivities are given in Tables 3-3 and 3-4 on an analyte-by-analyte basis.

- **Documentation.** Documentation is a method of tracking site samples and chemical data. All samples and site conditions affecting chemical data shall be documented in sample collection logs, chain-of-custody forms, and sample receipt checklists. Documentation shall also include, but not be limited to, the completion of all forms or checklists (i.e. records of conversations, cooler receipt forms, corrective action forms, etc.). Any changes to the sampling, shipping or receiving information, analytical raw data, or chemical results shall be lined out, initialed, and dated by the person responsible for making the change. Also, all deviations from the accepted sampling procedures and analytical methods will be documented and communicated to the Contracting Office or a Designated Representative; if any corrective actions are necessary, they will be approved and documented as well. Finally, all reports and data packages shall be reviewed and approved by the Chemical Quality Control Manager before submittal to the USACE.

- **Data Reporting.** Data reporting will follow the requirements as prescribed in Chapter 2 of EM 200-1-6 (USACE 1997). Chemical data packages will contain, but not be limited to, the following: all applicable sample tracking information; a laboratory case narrative; all analytical results with detection limits, dilution factors, percent moisture for solid samples, and any laboratory qualifications or flags; results of any sample dilutions performed to bring the sample data within the appropriate calibration range; all internal and field-initiated quality control parameters including all associated laboratory blanks, surrogate and matrix spike/matrix spike duplicate percent recoveries with control limits, laboratory duplicates or matrix spike duplicate pair relative percent differences (RPDs) with control limits, laboratory control samples with control limits, and field blanks. In addition, all preparation and analytical methods shall be provided with the analytical results in the data package.

TABLE 3-3 REPORTING LIMITS – SOIL SAMPLES Former Lake Ontario Ordnance Works	
Constituent	**Soil Reporting Limit**
Nitroaromatics and Nitramines (mg/Kg)	
Amino-dinitrotoluenes	1.0
2,6-Dinitrotoluene	0.26
HMX	1.0
Nitrobenzene	1.0
1,3,5-Trinitrobenzene	0.25
2,4,6-Trinitrotoluene	0.25

TABLE 3-4
REPORTING LIMITS – WASTE CHARACTERIZATION SAMPLES
Former Lake Ontario Ordnance Works

Constituent	Soil Reporting Limit
TCLP Metals (mg/L)	
Arsenic	0.045
Barium	0.025
Cadmium	0.025
Chromium	0.025
Lead	0.075
Mercury	0.001
Selenium	0.095
Silver	0.025
TCLP VOCs (µg/L)	
Vinyl Chloride	10.0
1,1-Dichloroethene	10.0
2-Butanone	100.0
Chloroform	10.0
Carbon Tetrachloride	10.0
Benzene	10.0
1,2-Dichloroethane	10.0
Trichloroethene	10.0
Tetrachloroethene	10.0
Chlorobenzene	10.0
1,4-Dichlorobenzene	10.0
TCLP SVOCs (µg/L)	
Pyridine	2.0
1,4-Dichlorobenzene	2.0
2-Methylphenol	2.0
3&4-Methylphenol	4.0
Hexachloroethane	2.0
Nitrobenzene	2.0
Hexachlorobutadiene	2.0
2,4,6-Trichlorophenol	2.0
2,4,5-Trichlorophenol	2.0
2,4-Dinitrotoluene	2.0
Hexachlorobenzene	2.0
Pentachlorophenol	4.0
TCLP Pesticides (µg/L)	
gamma-BHC (Lindane)	0.010
Heptachlor	0.010
Heptachlor Epoxide	0.010

TABLE 3-4
REPORTING LIMITS – WASTE CHARACTERIZATION SAMPLES
Former Lake Ontario Ordnance Works

Constituent	Soil Reporting Limit
Endrin	0.010
Methoxychlor	0.010
Toxaphene	0.250
Chlordane	0.200
TCLP Herbicides (µg/L)	
2,4-D	0.40
2,4,5-TP	0.40
RCRA Characteristics	
Ignitability (°F)	NA
Corrosivity	NA
Reactive Sulfide (mg/Kg)	40
Reactive Sulfide (mg/Kg)	40

Once completed, WST will submit each finished data package to Sevenson's project chemist for cursory review (i.e., ensuring that analytical results and method required laboratory QA/QC sample results are included). The approved data package will then be submitted to the Contracting Officer or a Designated Representative.

All completed data packages shall be clearly delineated by the project number either on the package itself or in an accompanying cover letter. All analytical reports shall be submitted to Sevenson within 21 days of the validated time of sample receipt by the laboratory, unless otherwise specified.

- **Data Validation.** Commensurate with the data reporting requirements, the data reporting packages will be reviewed and confirmed by the off-site laboratories as per the requirements of the particular analytical methodology.

3.5 Quality Control Checks

Implementation of quality control procedures during sample collection, analysis, and reporting ensures that the data obtained are consistent with its intended use. Both field QC and laboratory QC checks are performed throughout the work effort to generate data confidence. With the exception of temperature blanks, field QC samples will not be collected at the Site since the only samples submitted for laboratory analysis are for waste disposal profile purposes. Sample preservation and analytical holding time requirements play a key role in producing quality data. As these are method-specific, a basic guideline has been prepared for this project on an analysis-by-analysis basis, as represented in Table 3-5. If further detail is required, the respective method(s) should be consulted.

3.5.1 Field Quality Control

The applicability and appropriateness of the field sampling protocol can be verified by the inclusion of a program of scheduled field control samples, such as field replicates, field blanks, and background samples. All field control samples should be handled exactly as the Site samples. The identity of the field control samples will be held blind to the laboratory until the data are reported.

Table 3-5: Sampling and Analysis Matrix

Sample	*Location*	*Rationale*	*Frequency*	*Parameter(s)*	*Sample Type*	*Type of Bottles*	*Number of Bottles*	*Methodology*	*Holding Time*	*Preservative*
Subsurface Soil Characterization	Wastewater treatment plant area	On-Site screening of Geoprobe® samples collected to a total depth of 14-16 feet bgs to verify that soil contains less than 10% TNT	1 sample collected every 2-feet to 14-16 feet bgs at six predetermined locations	TNT	Grab	NA	NA	TNT EnSys® Soil Test System	NA	NA
Residual Sediments	Wooden pipe, acid neutralization building vault, pumping station vault	Characterize residual sediments in remaining structures	1 sample per location	TNT	Grab	NA	NA	TNT EnSys® Soil Test System	NA	NA
Isolated and removed TNT materials	Walkover area	On-Site screening to determine if relative percentage of TNT prior to off-Site disposal <10%	1 sample per 5-gallon bucket collected in the field	TNT	Grab	NA	NA	TNT EnSys® Soil Test System	NA	NA
Solid Waste Materials	Stockpile	Meet federal, state, and local regulations in accordance with the requirements of the disposal facility	(1) 5-point composite sample per soil stockpile	Ignitability	Composite	1L AG	2	SW-846 1010	7 Days	Cool 4°C
				Corrosivity				SW-846 9045C	Immediately	
				Reactive Cyanide				SW-846 Section 7.4.3.2/ Method 9014	14 Days	
				Reactive Sulfide				SW-846 Section 7.4.4.2/ Method 9034	7 Day	
				TCLP Metals				SW-846 1311/3015/6010B/ 7470A	180 Days to TCLP Extraction (Hg 28 days) and 180 Days to Analysis (Hg 28 days)	
				TCLP SVOCs				SW-846 1311/3510C/8270C	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP Pesticides				SW-846 1311/3510C/8081A	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP Herbicides				SW-846 1311/3510C/8151A	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP VOCs	Grab	4 oz CWM	2	SW-846 1311/5030B/8260B	14 Days to TCLP Extraction 14 Days to Analysis	Cool 4°C

Sample	*Location*	*Rationale*	*Frequency*	*Parameter(s)*	*Sample Type*	*Type of Bottles*[1]	*Number of Bottles*	*Methodology*	*Holding Time*[2]	*Preservative*
				Nitroaromatic and nitramine explosives	Grab	4 oz. CWM	2	SW-846 8330	7 days to extraction 40 days to analysis	Cool 4°C
Wastewater (i.e., decon water)	55-gallon Drum	Characterize waste in accordance with the requirements of the disposal facility and 40 CFR 261	1 grab sample per 20 drums generated	Ignitability	Composite	1L AG	4	SW-846 1010	7 Days	Cool 4°C
				Corrosivity				SW-846 9040C	Immediately	
				Reactive Cyanide				SW-846 Section 7.4.3.2/ Method 9014	14 Days	
				Reactive Sulfide				SW-846 Section 7.4.4.2/ Method 9034	7 Day	
				TCLP Metals				SW-846 1311/3015/6010B/ 7470A	180 Days to TCLP Extraction (Hg 28 days) and 180 Days to Analysis (Hg 28 days)	
				TCLP SVOCs				SW-846 1311/3510C/8270C	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP Pesticides				SW-846 1311/3510C/8081A	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP Herbicides				SW-846 1311/3510C/8151A	14 Days to TCLP Extraction 7 Days to Preparative Extraction 40 Days to Analysis	
				TCLP VOCs	Grab	40 mL G vial w/Teflon septa	4	SW-846 1311/5030C/8260B	14 Days to TCLP Extraction 14 Days to Analysis	Cool 4°C
				Nitroaromatic and nitramine explosives	Grab	1 L AG	2	SW-846 8330	7.days to extraction 40 days to analysis	Cool 4°C

Notes:

1) Bottle types – AG: Amber Glass; HDPE: High Density Polyethylene Plastic; CWM: Clear wide mouth glass jar with Teflon lid

2) From Verified Time of Sample Collection

- **Temperature Blanks.** A temperature blank is a container of water packaged in the shipping cooler, along with field samples, which will represent the temperature of the incoming cooler upon receipt at the laboratory. Use of these samples within a shipping container enables the receiving laboratory to assess the temperature of shipment without disturbing any project field samples.

3.5.2 Laboratory Quality Control

Laboratory quality control will occur as described below and per the method-specific requirements.

- **Method Blanks.** In order to assess the laboratory's ability to perform each analytical method, a method blank must be analyzed with each group of site samples. A method blank is a sample of a non-contaminated substance of the matrix of interest (usually distilled/deionized water or silica sand) that is then subjected to all of the sample preparation (digestion, distillation, extraction) and analytical methodology applied to the samples. The purpose of the method blank is to check for contamination from within the laboratory that might be introduced during sample preparation and analysis that would adversely affect analytical results. Ideally, all blanks should demonstrate freedom from contamination and interferences. If, however, laboratory contamination is suspected, the magnitude of the contamination can be evaluated, but the samples results will not be adjusted to compensate for the blank concentrations. If the method blanks contain target analytes at concentrations greater than the reporting limits, the laboratory will exercise corrective actions including re-preparing and reanalyzing the affected Site samples after the source of contamination has been identified and eliminated.

  A method blank must be analyzed with each sample batch, where a sample batch is defined as a group of up to twenty (20) samples that are all processed simultaneously as a unit. After analysis, the method blanks may be compared to field and trip blanks in order to give an indication of where in the sampling/analysis process contamination may have been introduced.

- **Laboratory Control Samples.** Laboratory control samples (LCS) are intended to evaluate the accuracy of the analytical method, as performed by the contract laboratory, in the absence of matrix interference. The LCS contains known concentrations of analytes representative of the contaminants to be determined and is carried through the entire preparation and analysis process. The actual analyte

concentration and percent recovery will be reported with the laboratory QC data. One LCS will be analyzed with each analytical sample batch.

- **Laboratory Duplicates.** Laboratory duplicates are separate aliquots of a single sample that are prepared and analyzed concurrently at the laboratory. The primary purpose of the laboratory duplicate is to check the precision of the laboratory analyst, the sample preparation methodology, and the analytical methodology. In contrast to field duplicate and QA samples, laboratory duplicate samples are originated in the laboratory and measure analytical precision only, while the field duplicates measure the precision of the sampling and analysis process as a whole. As such, they give some indication of the amount of matrix interference inherent in a sample.

- **Laboratory Matrix Spike/Matrix Spike Duplicates.** The primary purpose of matrix spike/matrix spike duplicate samples is to assess the effect of sample matrix on the accuracy and precision of the analyses. A matrix spike (MS) is an aliquot of a sample spiked with known quantities of analytes and subjected to the entire analytical procedure. It is used to indicate the appropriateness of each method for the matrix by measuring recovery or accuracy (i.e., the nearness of a result to the true or accepted value). A matrix spike duplicate (MSD) is a second aliquot of the same sample with known quantities of compounds added which is carried through the identical analytical process as the associated field samples. The purpose of the MSD, when compared to the MS, is to determine method precision (i.e., measure of the reproducibility of a set of replicate results).

  The contract laboratory will be required to run MS/MSD samples when analyzing all sample parameters. MS and MSD analyses are performed per 20 samples of similar matrix. To be executed properly, MS/MSD samples are prepared by homogenizing a sample and taking three (3) representative sample aliquots from the container. One of these will be analyzed as a normal sample; the remaining aliquots serve as the MS and MSD samples and are prepared as described above. After analysis, the percent recoveries of the matrix spike and the matrix spike duplicate samples will be calculated with respect to the original concentration in the sample and the relative percent difference between the two will be determined.

- **Surrogate Spiking Activity.** A surrogate spike is prepared by adding a pure compound to each and every organic sample before extraction. These surrogate standards will be different for each type of

organic analysis, as each surrogate compound is closely related to the group of chemicals being analyzed. The primary function of the surrogate spiking activity is to determine the efficiency of recovery of analytes in the sample preparation and analysis and thus the degree to which the sample matrix plays a role in the organic analysis. This matrix interference will be measured as a percent recovery, which is then used to gauge the total accuracy of the analytical method for that sample. Table 3-6 shows a breakdown of the surrogate compounds related to each type of analysis and the associated acceptable percent recovery ranges of each.

3.6 Assessment of Data Quality and Acceptability

QC samples will be continually evaluated and assessed to determine the usefulness of the data from sampling and analysis. The laboratory will perform a review of its internal quality control checks prior to issuance of the analytical data report.

TABLE 3-6
SURROGATE PERCENT RECOVERY CRITERIA FOR ORGANIC ANALYSES
Former Lake Ontario Ordnance Works

Compounds	TCLP Percent Recovery Limits
VOCs	
Bromofluorobeneze	79-125
1,2-Dichloroethane-d4	77-118
Toluene-d8	84-112
SVOCs	
Phenol-d6	13-48
2-Fluorophenol	20-69
2,4,6-Tribromophenol	49-144
Nitrobenzene-d5	42-126
2-Fluorobiphenyl	44-133
p-Terphenyl-d14	43-149
Pesticides and PCBs	
Tetrachloro-m-xylene	72-117
Decachlorobiphenyl	71-123
Herbicides	
2,4-DCPAA	24-146

4.0 LABORATORY CUSTODY AND HOLDING TIMES

Sample custody will begin in the field with proper and correct sample labeling, chain-of-custody documentation and seals, and air bills (if shipped by common carrier). Specifics of field related custody and holding time requirements are presented in Sections 4.0, 5.0, and 6.0 of the FSP.

4.1 Sample Receipt

When non-radiological samples arrive at the laboratory, custody is transferred to the Sample Custodian who will be the last person to sign the COC. The Sample Custodian will then open the shipping container under a fume hood, wearing appropriate gloves, and perform the following:

1. Check each sample container to see if breakage, cracking, external corrosion, or leaking has occurred.

2. A gamma radiation screen shall be performed on all samples to determine if special handling is required. Measure exposure rate at 3 ft. from package surface and record.

3. Check the temperature of the temperature blank to assure that the samples were kept cool at 4°C ± 2°C.

4. Check the pH of the non-volatile water samples for parameters which require preservation to ensure that they were properly preserved.

5. Inventory the samples shipped to see if the number of samples received and the description on each sample label correspond to information on the COC.

6. Complete WST Sample Shipment Checklist and USACE Sample Receipt Form (Appendix A).

4.2 Custody in the Laboratory

After the samples are inventoried and the Sample Shipment Checklist is finalized, each sample is individually logged into the Master Log Book for General Laboratory samples listing the following information:

1. A unique sequenced WST sample number assigned only to that sample;
2. Client name or name of agency representing the client (i.e. Sevenson);
3. Site name (i.e. Lake Ontario Ordnance Works);
4. Client/Site Sample locations or description;
5. Date received and date sampled;
6. Container size and number of containers;
7. Analytical tests to be performed;
8. Any comments/notes regarding the sample condition or shipment non-conformance;
9. Sample group number; each group of samples received from a site will be assigned its own group number which is used to track the samples as a group;
10. LIMS login number for General Laboratory; and
11. Initials of the person logging in the samples, usually the Sample Custodian.

The sample ID numbers are then recorded onto the label of each container associated with each of the samples and the sample containers are then placed into a sample storage refrigerator or room temperature storage area in a specific location designated by the Sample Custodian. The sequential WST sample numbers are also recorded on the COC adjacent to the corresponding client/site sample location or description. The sample

group number is then recorded on the COC for tracking purposes. The Sample Shipment Checklists are then attached to the original copy of the COC.

The Sample Custodian will then log the samples into the LIMS Labworks database. The following information is entered for each sample in the group:

1. The unique WST sample ID number assigned to the sample.

2. Date and time the sample was collected.

3. Date and time the sample was received by the laboratory.

4. Name of the client and the site (i.e. Sevenson and Lake Ontario Ordnance Works).

5. The client/site sample description or location.

6. Date the analytical report is due.

7. Analyses required on the samples. Each analysis performed in the laboratory has a designated analysis code. The code for each analysis required on the sample will be assigned to the sample.

8. Any comments/notes regarding the sample.

9. Date on which the sample will have exceeded its holding time.

10. The sample group number.

The COC and Sample Shipment Checklists are then submitted to the Data Coordinator for reporting and filing.

The Labworks LIMS system will be used to track the samples and all the data generated from the analytical process. Each analytical section has access to the LIMS system and, on a daily basis, they generate a backlog

report that shows them which samples require what analyses, when the results are due and when the sample holding time expires. The backlog report is then used by the technicians and/or analysts, in conjunction with the Extraction Lab Supervisor, Metals Lab Supervisor and/or Assistant Lab Director to prioritize sample extraction and analysis.

When an analysis on a sample has been completed, the analyst will enter the results, either manually or by automatic computer file transfers, into the LIMS system under the appropriate analysis code for that sample. The data is then submitted to the QA/QC Department for review and report generation.

4.3 Sample Security and Internal Chain-of-Custody

In order to maintain the integrity and validity of the sample(s) within the laboratory, all samples are maintained under locked storage or in limited access areas under the jurisdiction of the Sample Custodian. Release of samples to laboratory personnel necessitates internal chain of custody procedures. Internal chain-of-custody is tracked by the Sample Custodian via a notebook. Entered into the notebook is WST Sample ID number, the date and time the sample is relinquished, the name of the person to whom the sample was given (responsible party), the date and time the sample is returned, and the Sample Custodian's initials. The responsible party is required to maintain the sample(s) in their physical possession or view at all times. The Sample Custodian, Assistant Lab Director, or QA/QC Officer may confiscate unattended samples, return them to storage, notify the appropriate supervisor, and reprimand the responsible party.

5.0 LABORATORY ANALYTICAL PROCEDURES

Laboratories reviewed and validated by USACE will analyze all samples collected during the investigation activities. Each laboratory supporting this work shall provide statements of qualifications including organizational structure, QA Manual, and standard operating procedures (SOPs).

Samples collected during the project will be analyzed by USEPA SW-846 methods and other documented USEPA or nationally recognized methods. Laboratory standard operating procedures are based on the methods as published by USEPA in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846*, Third Edition (November 1986; Revision 1, July 1992; Revision 2, November 1992; and Updates 1, 2, and 3). Analytical parameters, methods, project reporting levels, and laboratory-specific precision and accuracy are listed in Tables 3-1 through 3-3 and 3-6.

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

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

SOPs for modified methods must be adopted from and reference standard USEPA SW-846 methods or appropriate national standard and thereby specify:

- Procedures for sample preparation;
- Instrument start-up and performance check;
- Procedures to establish the actual and required detection limits for each parameter;
- Initial and continuing calibration check requirements;
- Specific methods for each sample matrix type; and
- Required analyses and QC requirements.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

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

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

In all cases where analyses are conducted according to SW-846 protocols, the calibration procedures and frequencies specified in the applicable methods will be followed. For analyses governed by SOPs, refer to the appropriate SOP for the required calibration procedures and frequencies. All analytical calibrations and method QC will be consistent with the USACE *Shell for Analytical Chemistry Requirements* (1998).

Records of calibration will be kept as follows:

- Each instrument will have a record of calibration with an assigned record number.
- A written stepwise calibration procedure will be available for each piece of test and measurement equipment.
- Any instrument that is not calibrated to the manufacturer's original specification will display a warning tag to alert the analyst that the device should not be used.

7.0 INTERNAL QUALITY CONTROL CHECKS

Field and laboratory performance QC are required to ensure that laboratory systems (e.g., instrumentation, sample preparation, analysis, data reduction, etc.) are operating within acceptable QC guidelines in order to provide data to the degree of quality consistent with their intended use. Laboratory QC samples consist of method blanks, instrument blanks, laboratory control samples, surrogate compounds, and method-related calibration samples. In addition to laboratory performance QC, matrix-specific QC is utilized to determine the effect of the sample matrix on the data generated. Typically, this includes matrix spikes, matrix spike duplicates, and sample duplicates. To ensure the production of analytical data of known and documented quality, laboratories associated with these investigations will implement all method QA and QC checks.

7.1 QA Program

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

The stated objectives of the laboratory QA program are to:

- Properly collect, preserve, and store all samples;
- Maintain adequate custody records from sample collection through reporting and archiving of results;
- Use properly trained analysts to analyze all samples by approved methods within holding times;
- Produce defensible data with associated documentation to show that each system was calibrated and operating within precision and accuracy control limits;
- Accurately calculate, check, report, and archive all data using the Laboratory Information Management System; and

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

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

7.2 QC Checks

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

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

Laboratories will provide documentation in each data package that both initial and ongoing instrument and analytical QC functions have been met. The laboratory will reanalyze any non-conforming analysis, if sufficient sample volume is available. It is expected that sufficient sample volumes will be collected to provide for reanalysis, if required.

7.3 Quality Control Batch

Samples will be extracted and analyzed in batches, not to exceed 20 samples, which are uniquely identified. Two types of batches are identified, the preparation batch and the analytical, or instrumental, batch. The preparation batch is defined as samples that are prepared together by the same person using the same equipment/glassware with the same method sequence and the same lots of reagents undergoing common manipulations for each sample within the same time period or in limited continuous sequential time periods. The analytical batch is defined as samples that are analyzed together within the same analytical run sequence, within the same time period, or in continuous time periods. Included in each batch will be a number of QC samples including a Method Blank, Laboratory Control Sample (LCS), and Matrix Spike/Matrix Spike

Duplicate (MS/MSD) or Matrix Spike/Matrix Duplicate (MS/MD). For some analyses, matrix specific QC samples require the collection of additional sample volume. If sufficient sample volume is not available for the analysis of matrix spike and matrix spike duplicate samples, the laboratory may analyze duplicate laboratory control samples in order to assess laboratory precision.

7.4 Method Blank

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 a QC sample that consists of a blank matrix (e.g., deionized laboratory water, purified solid matrix) to which all reagents specific to the method are added and which is carried through every aspect of the procedure, including preparation, cleanup, and analysis. At least one method blank will be analyzed with every batch of samples processed. Results of the method blank analysis are evaluated, in conjunction with other QC information, to determine the acceptability of the data generated for that batch of samples. Potential sources of contamination include solvents, reagents, glassware, other sample processing hardware, or the laboratory environment. Corrective actions may include reanalysis of the blank and/or repreparation and reanalysis of the blank and all associated samples. Sample results will not be corrected for blank contamination.

7.5 Instrument Blank

The instrument blank is an unprocessed aliquot of reagent used to monitor the contamination of the analytical system at the instrument. System contamination may lead to the reporting of elevated analyte concentrations or false positive data. The instrument blank does not undergo the entire analytical process and generally consists of an aliquot of the same reagent(s) used for sample dilution. Instrument blanks, also referred to as continuing calibration blanks, are routinely applied in analyses for inorganic parameters.

7.6 Laboratory Control Sample

A laboratory control sample (LCS) is a laboratory-generated sample beginning with a known and well-characterized matrix that is fortified with target analytes used to calculate precision and accuracy data. The standard solution used to prepare the LCS is separate from that used in establishing the calibration curve. The

LCS is used to monitor the laboratory's day-to-day performance as well as the ongoing performance of the analytical methods. Day-to-day performance is characterized by the measure of the accuracy of the results. Ongoing monitoring of the results provides evidence that the laboratory is performing the method within both acceptable accuracy and precision guidelines. The results of the LCS can provide evidence that the laboratory performed the method correctly or that the sample matrix affected the results.

7.7 Matrix Spike/Matrix Spike Duplicate

A matrix spike is an environmental sample to which known concentrations of target analytes have been added. MS samples are analyzed to evaluate the effect of the sample matrix on the analytical methodology. MS samples are generated by taking a separate aliquot of an actual field sample and spiking it with the selected target analyte(s) prior to sample preparation or extraction. The MS sample then undergoes the same extraction and analytical procedures as the unfortified field sample. Due to the potential variability of the matrix of each sample, these results may have immediate bearing only on the specific sample spiked and not on all samples in the QC batch. The concentration(s) of the analyte(s) in the unfortified field sample may also affect the recovery of the spiked analyte(s), especially if the analyte concentration(s) are near or above the instrument calibration range.

A matrix spike duplicate is a second aliquot of a sample that is spiked with the selected target analyte(s) and analyzed with the associated sample and MS sample. The results of the MS and MSD are used together to determine the effect of a matrix on the precision of the analytical process. Due to the potential variability of the matrix of each sample, the MS/MSD results may have immediate bearing only on the specific sample spiked but not on all samples in the QC Batch.

For metals, a matrix spike will be analyzed at a 5% frequency or once every week, whichever comes first.

When matrix spike recoveries are outside QC limits, associated matrix spike blank and surrogate recoveries will be evaluated to attempt to verify the reason for the deviation and determine if the effect on the reported sample results.

7.8 Laboratory Duplicates

For the analysis of TAL metals in soil samples, laboratory duplicates will be analyzed to assess laboratory precision. A laboratory duplicate is defined as a second aliquot of an environmental sample (taken from the same sample container when possible) that is processed identically with the first aliquot of that sample. That is, sample duplicates are processed as independent samples within the same QC batch. The results are compared to determine the effects of the matrix on the precision of the analytical process.

7.9 Internal Standards

Internal standard areas and retention times are monitored for organic analyses performed by GC/MS methods. An internal standard is a compound or element with similar chemical characteristics and behavior in the analysis process to the target analytes but is not normally found in environmental samples. The internal standard is usually added into all field samples, calibration standards, and QC samples after sample preparation and prior to analysis. The primary function of the internal standard is quantitative, however, it also provides a short-term indication of instrument performance. The response of each internal standard is plotted on a control chart. If internal standard areas in one or more samples exceed the specified tolerances, then the instrument will be recalibrated and all affected samples reanalyzed. The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods.

7.10 Analytical Spike

It is not currently anticipated that the graphite furnace atomic absorption spectrometer will be used for analysis of samples during the current scope of work; however, it may be utilized as a backup for sample analysis should problems with the inductively coupled plasma atomic absorption spectrometer be encountered. If analysis of samples is required using the graphite furnace, analytical spikes/post-digestion spikes will be analyzed. An analytical spike is created by spiking target analytes into a prepared portion of a sample (extract or digestate) just prior to analysis. It provides information on matrix effects encountered during analysis such as suppression or enhancement of instrument signal levels. If the post digestion spike recovery is not within 85% to 115% of the expected concentration, the "method of standard additions" procedure will be used to analyze the sample.

7.11 ICP Serial Dilution and Post-Digestion Spike Analysis

For inductively coupled plasma (ICP) analyses by Method 6010B, two additional tests are performed on a new sample matrix to determine if matrix interferences are effecting the metals analysis. A serial dilution test is performed by dilution (1 volume to 4 volumes of acidified reagent water) and analysis the sample digestate. The results obtained from the dilution analysis must within10% of the results obtained for the undiluted sample analysis. Differences greater than 10% indicate that the sample matrix is interfering with the ICP analysis and that analysis of the sample using the method of standard additions procedure may be required. It should be noted that the serial dilution test is only applicable to samples that have metals concentrations greater than 50 times the method quantitation limit (MQL) so that the concentration of the metals in the 5 fold dilution analysis are at least 5 time MQL.

A post-digestion spike analysis is also performed on new sample matrices. The ICP post-digestion spike analysis is performed and must meet the same criteria for graphite furnace atomic absorption spectroscopy procedures. The method of standard additions procedure will be used to analyze the sample if the recovery of the spiked metals does not meet criteria.

8.0 CALCULATION OF DATA QUALITY INDICATORS

8.1 Method Detection Limits

To determine the method detection limit (MDL), seven replicates of the appropriate volume of extraction solvent or Type II water are spiked with a known amount of the analyte(s). The amount of the analyte(s) added is the same for all seven replicates and should be at least two-to-three times greater than the instrument detection limit (IDL). The replicates are subjected to the same extraction and analytical procedures as a sample would be and the concentrations of the analyte(s) of interest would be measured. The MDL is defined as the standard deviation of the seven readings multiplied by the student t-test at a 99%, single-sided confidence interval (i.e., t99) using n-1 degrees of freedom (df). The calculation of the MDL should be done in units of weight of the analyte.

The equation that applies to the calculation of the MDL is:

$$MDL = SD\ (t99[1\text{-sided}];df=6);\ \text{or}\ MDL = SD \times 3.143$$

Where: MDL =method detection limit in units of weight for those methods dependent upon absolute quantity, and in concentration units for those dependent on concentration

SD = the standard deviation of the seven readings from the mean, in units of weight or concentration

The method detection limit will be determined for all analytes associated with each method on at least an annual basis. The MDL will also be determined whenever the sample preparation method or extraction method is modified.

8.2 Accuracy

Analytical accuracy may be assessed through the use of known and unknown QC samples and spiked samples, such as matrix spikes or standard reference materials. Accuracy is most commonly presented as percent

recovery or percent bias. Percent bias is the reciprocal of percent recovery. Accuracy determined by percent recovery is calculated as follows:

$$\%R = \frac{|SSR - SR|}{SA} \times 100$$

Where: SSR = measured value of the spiked sample
SR = measured value of the unspiked sample
SA = known amount of the spike in the sample

8.3 Precision

Precision is determined from duplicate sample analyses; thus, precision is usually expressed as relative percent difference (RPD). Every batch of samples analyzed will include matrix duplicates and/or matrix spike duplicates to evaluate precision in this manner. Precision determined by RPD will be calculated as follows:

$$RPD = \left(\frac{|X_1 - X_2|}{\frac{(X_1 + X_2)}{2}} \right) \times 100$$

Where: X_1 = Concentration of spiked compound recovered from the MS sample or, for duplicate sample analysis, the concentration of the analyte in the original sample analysis

X_2 = Concentration of spiked compound recovered from the MSD sample or, for matrix duplicate samples, the result from the duplicate sample analysis

8.4 Completeness

Completeness is an overall gauge of field sampling and analytical laboratory performance. The overall project completeness is a comparison between the total number valid sample results to the number of planned sample results. Completeness may be calculated for the project as follows:

$$\%C = \left(\frac{V}{N} \right) \times 100$$

Where: V = number of measurements judged valid

N = total number of sample results

9.0 CORRECTIVE ACTIONS

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

Noncompliance with specified criteria and analytical/equipment problems will be documented through a formal corrective action program at the time the problem is identified. Laboratory deficiency and tracking notification will be implemented should any deviations or departures from the approved SAP or standard sampling and analysis methodologies which may affect the achievement of project DQOs or the usability of the data be identified throughout the performance of field-dependent (e.g., sample shipping, chain-of-custody) or laboratory activities. Sevenson will work closely with the laboratory to maintain open communication. When any sample or analytical problems are identified, the USACE Project Chemist will be notified immediately.

Deficiency and corrective action tracking will be implemented through the use of an Analytical Deficiency Tracking Log and a Laboratory/Analytical Deficiency Notification Form (DNF). Copies of the DNF and tracking log are included in Appendix A. Any deficiency identified by laboratory personnel will be assigned a tracking log number and all pertinent information recorded describing the deficiency and its associated corrective action. The completed DNF will be immediately sent by the laboratory QA/QC manager via e-mail or facsimile to the Sevenson Project Manager, Contractor Quality Control Manager (CQCM), and/or Project Chemist. Sevenson will immediately notify the USACE Contracting Officer or a Designated Representative when an event requiring corrective action occurs and submit the required deficiency notification/ corrective action report so that approval to follow through with the required corrective action may be obtained.

Sevenson personnel will confer with the laboratory as quickly after the notification as practical to discuss the ramifications of the deficiency with regard to project DQOs and potential effects on the reportability and validity of sample data. Deficiencies which may prevent meeting contractual DQOs or which preclude the use of data in final Site reporting may require reanalysis, reevaluation, or resampling. If corrective actions are deemed insufficient, work may be stopped through a stop-work order issued by the Sevenson Project Manager and the USACE Project Manager.

Within the laboratory, a high-level of communication is maintained between the operational and managerial staff in order to promptly address any quality assurance deficiencies that arise. No staff member will initiate corrective action without prior communication of findings through the proper channels. In the event of a non-conformance or analytical method deviation that impacts samples from the Site, the laboratory will notify Sevenson's Contractor Quality Control Manager immediately.

Deficiency notification and corrective actions are necessary if the following conditions exist:

- Any QC data are outside control limits for precision and accuracy.
- Blanks contain target analytes above acceptable levels and must be investigated.
- Undesirable trends are detected in spike or surrogate recoveries or RPD between duplicates.
- There are unusual changes in detection limits.
- The QA department detects deficiencies during internal audits, external audits, or from performance evaluation sample results.
- Inquiries concerning data quality are received from USACE.

9.1 Identification and Documentation of Problem

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation procedures for possible errors, checks the instrument calibration, spike, surrogate, calibration solutions, instrument sensitivity, and so on. The laboratory supervisor, manager, and/or QA department will be advised if the problem persists or cannot be identified. Once resolved, full documentation of the deficiency/corrective action procedure will be submitted to the appropriate Sevenson personnel and filed with the project records. The deficiency and corrective action will also be summarized within the case narrative. If the problem encountered requires that a sample or group of samples be re-extracted and/or reanalyzed, the QA/QC Officer will initiate the corrective action by filling out a Sample Re-Extraction/Reanalysis Form.

Other corrective actions may be required that do not involve sample reanalysis. In these cases, the QA/QC Officer will notify the analyst or technician of a problem through a QC Memo. If the problem is significant enough to impact the quality of the data, the QA/QC Officer may stop the analysis of additional samples until the problem is resolved. The analyst or technician must record onto the memo a description of the corrective action(s) taken and the date it was performed. The memo will be returned to the QA/QC Officer for review. If the corrective action has mitigated the problem, analysis of samples can be resumed. If not, the QA/QC Officer may issue another memo detailing the additional actions that need to be taken in order to resolve the problem.

If, upon repeated attempts, the QA/QC Officer feels that the actions taken have not satisfactorily corrected the problem, he/she will inform the appropriate corporate officer of the problem. The problem will then be resolved through a joint effort between the laboratory management, the QA/QC Officer, and the corporate officer. Any problems affecting the quality of the data from the analysis of samples from the Site will be detailed in the case narrative of the final analytical result report. If it appears that the problem will affect sample holding times or delay the timely reporting of analytical results, the QA/QC Officer will notify the Sevenson Project Manager, CQCM, and/or Project Chemist.

9.2 Problems and Actions

9.2.1 Sample Receipt

Problems noted during sample receipt will be documented on the Sample Shipment Checklist. If irregularities are noted, the Sample Custodian will submit the Sample Shipment Checklist to the laboratory QA/QC Officer or the laboratory Project Manager, who in turn, will contact the Sevenson Project Manager, CQCM, and/or Project Chemist. A decision concerning the disposition of the sample shipment in question will be made. USACE will also be contacted immediately for problem resolution (e.g., recollect samples, apply data qualifiers, analyze samples "as is", etc.), if necessary. All corrective actions taken will be thoroughly documented on the Sample Shipment Checklist. This written record will contain, at a minimum, the time and date of the conversation, the name of the Site contact, the names of any offsite individuals involved in the decision, and the resolution reached with respect to the irregularity. Some examples of irregularities encountered during sample receipt, which may require consultation to determine corrective action, include:

- Custody seal on cooler is broken or appears to have been tampered with;
- Temperature inside cooler is outside the acceptable temperature range;
- Broken sample container(s) or missing container(s);
- Unlabeled, mislabeled, or illegible sample container(s);
- Improperly preserved sample(s);
- VOC vials contain bubbles or air space; and/or
- Chain-of-custody form incomplete, improperly completed, or illegible.

9.2.2 Sample Holding Times

If samples cannot or were not extracted/digested and/or analyzed within the appropriate method required holding times, the Sevenson Project Manager, CQCM, and USACE Project Manager will be notified immediately for problem resolution. All corrective actions will be thoroughly documented on the Deficiency Notification Form and the case narrative to be included in the final laboratory analytical data report.

9.2.3 Instrument Calibration

Sample analysis will not be allowed until all initial calibrations meet the appropriate requirements. All calibrations must meet method time requirements or recalibration must be performed.

When the continuing calibration is outside the acceptable range, the problem should be identified by the analyst and corrected before any sample analysis is undertaken. If the non-acceptability of the continuing calibration is not determined by the analyst, the QA/QC Officer will notify the appropriate analyst that a new calibration curve must be prepared or the continuing calibration standard should be checked. 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.

9.2.4 Calibration Standards

Calibration standards will not be used beyond their permitted shelf life.

9.2.5 Practical Quantitation Limits

Appropriate sample cleanup procedures will be employed to attempt to achieve practical quantitation limits. If difficulties arise in achieving these limits due to a particular sample matrix, the contract laboratory will notify Sevenson's Project Manager, CQCM, and/or Project Chemist of this problem via a DNF for resolution. The USACE Contracting Officer or a Designated Representative will also be notified immediately of the problem. Any dilutions made will be documented in the case narrative along with the revised practical quantitation limits for those analytes directly affected. Analytes detected above the method detection limit, but below the practical quantitation limit will be reported as an estimated value.

9.2.6 Method QC

All method QC, including blanks, matrix duplicates, matrix spikes, matrix spike duplicates, surrogate recoveries, laboratory control samples, and other method-specified QC samples will meet the requirements as specified within the analytical method. Failure of method-required QC will result in the review of all affected data. If no errors can be noted, the affected sample(s) will be reanalyzed and/or re-extracted/redigested, 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 bias. If matrix effect is confirmed, the corresponding data will be flagged. If matrix effect is not confirmed, then the entire batch of samples may have to be reanalyzed and/or re-extracted/redigested, then reanalyzed. Sevenson's Project Manager, CQCM, and/or Project Chemist and the USACE Project Manager will be notified as soon as possible via a DNF to discuss possible corrective actions should unusually difficult sample matrices be encountered.

9.2.6.1 Laboratory Method Blanks Exceed Method Detection but are Below Quantitation Limits

When laboratory blanks exhibit the presence of target analytes at a level exceeding the method detection limit, but still below the quantitation limit, the QA/QC Officer will notify the responsible analyst, who will check the reagent blanks that have been retained at the time the reagents were first used in order to determine if contamination or interferences are due to impurities in the reagents. If this is the case, the reagent batch will be discarded and new reagents from fresh containers will be used. If the reagents appear to be sufficiently pure, the cleanliness in the laboratory will be inspected and reinforced to establish if the source of the problem

may have been contamination of the apparatus. The data associated with the blank will be reviewed. If the analytes detected in the method blank are detected in the samples, the results reported for that analyte will be flagged.

9.2.6.2 Laboratory Method Blank Exceeds Quantitation Limit

When the laboratory method blank exceeds the quantitation limit, the QA/QC Officer will immediately notify the responsible analyst. Once again, the analyst will check the reagents and apparatus for potential contamination. If reagents are contaminated, the existing batch will be rejected and a fresh batch from a new container will be prepared. If the problem arose from the apparatus, whether glassware or instrumental, the problem will be corrected by the analyst and/or extraction technician. The corrective action will be documented before further analyses can be undertaken. The analyst will then notify the QA/QC Officer of the corrective action. The Sevenson Project Manager, CQCM, and/or Project Chemist will be kept abreast of the situation via DNF.

The data associated with the failed method blank will be rejected. The samples will be re-extracted and reanalyzed to produce acceptable data. However, in instances where the analyte found in the blank is not detected or detected below the quantitation limit in the samples associated with the blank, the data may be accepted. If re-extraction or reanalysis of the sample is not an option (e.g., sample holding time is exceeded or not enough sample available), the sample data will be flagged using the "B" data qualifier, which indicates that the analyte was found in the associated blank sample as well as in the Site sample.

9.2.6.3 Laboratory Control Sample Exhibits Recoveries Outside the Acceptable Limits

The laboratory will utilize the *Shell for Analytical Chemistry Requirements* (February 2001) to determine the corrective action requirements for LCS sample recoveries outside of the acceptance limits as follows:

- If the laboratory control sample recoveries do not meet the acceptance criteria and the sample results are reported as not detected (i.e., below the method quantitation limit), the laboratory will not perform further corrective actions if the number of sporadic marginal failures allowed by the Shell document are not exceeded.

- If the laboratory control sample recoveries do not meet the acceptance criteria and the sample results are reported as not detected (i.e., below the method quantitation limit), the laboratory will perform further corrective actions if the number of sporadic marginal failures allowed by the Shell document is exceeded. The Sevenson Project Manager, CQCM, and/or Project Chemist will be notified of the problem by a DNF.

- If the laboratory control sample recoveries do not meet the acceptance criteria and the sample results are detected above the method quantitation limit, the laboratory will perform corrective actions even if the number of sporadic marginal failures allowed by the Shell document is not exceeded. The Sevenson Project Manager, CQCM, and/or Project Chemist will be notified of the problem by a DNF.

Corrective actions performed by the laboratory for the scenarios outlined above include re-preparation and reanalysis of the LCS sample and the associated field samples. Before repeating the re-preparation of the samples, the calibration of the instrument will be checked by analyzing a continuing calibration check standard. If the instrument is within calibration, the samples will be re-prepared and reanalyzed. If the instrument calibration has drifted, recalibration will be performed and the samples will be reanalyzed.

9.2.6.4 Surrogate Compound Recoveries Outside the Acceptance Limits

When the recoveries of the surrogate compounds are outside the acceptance limits, but the laboratory spiked blank is within acceptable limits, the apparent poor or enhanced recovery may be due to matrix effect. The sample exhibiting the unacceptable recovery may be re-prepared or reanalyzed within appropriate holding times. If the same phenomenon is observed, it will be assumed that the failure to meet recovery criteria was in fact a matrix effect. This information will be included in the analytical results report and the original data will be reported. The unacceptable surrogate recovery will be flagged using the "#" qualifier.

If, upon reanalysis, the recovery of the surrogate falls within acceptable limits, the results of the reanalysis will be reported and the original analysis results rejected due to a potential procedural problem.

In some instances, it may be obvious from the data produced or from the observations made during the preparation process that the sample matrix is causing the unacceptable recoveries. In these cases, the sample

will not be re-prepared or reanalyzed. The observations made will be included in the case narrative of analytical result report and the unacceptable surrogate recovery will be flagged using the "#" qualifier.

If the surrogate recovery in a method blank or reference sample is outside the acceptance limits, but the analytes in the reference sample are within acceptable limits, the analyst may need to analyze the surrogate standard solution to check for degradation or contamination. If the standard solution is determined to be the problem, the analyst will immediately prepare a new standard and the affected samples will be re-extracted and reanalyzed. It is also possible that the calibration of the surrogate compound has drifted, in which case the analyst should re-calibrate the system, and reanalyze the affected samples.

Sevenson's Project Manager, CQCM, and/or Project Chemist will be notified of any surrogate compound recovery problems via DNF.

9.2.6.5 Matrix Spikes Exhibit Recoveries Outside the Acceptable Limits

When recoveries of spiked analytes from a matrix spike sample analysis are outside the acceptance limits, the apparent poor or enhanced recovery may be due to matrix effects. The matrix spike sample will be re-prepared and reanalyzed to assess this possibility. If the same phenomenon is observed with the re-prepared sample, it will be assumed that the failure to meet recovery criteria was in fact a matrix effect. This information will be included in the case narrative of the analytical result report and the results of both the original and re-prepared sample will be reported. The unacceptable matrix spike sample recoveries will be flagged with the "G" qualifier if the recovery is greater than the upper quality control recovery limit, or the "L" qualifier if the recovery is less than the lower quality control recovery limit.

If upon reanalysis the recovery of the spiked analytes falls within acceptable limits, the results of the reanalysis will be reported and the original analysis results rejected due to a potential procedural problem.

In some instances, it may be obvious from the data produced or from observations made during the preparation process that the samples matrix is causing the unacceptable recoveries. In these cases, the sample will not be re-prepared or reanalyzed and the observations made will be included in the case narrative of the analytical result report. Again, the unacceptable recoveries will be flagged with the "G" qualifier if the recovery is

greater than the upper quality control recovery limit, or the "L" qualifier if the recovery is less than the lower quality control recovery limit.

Notifications of matrix spike recoveries outside of the acceptable recovery limits will be made to the Sevenson Project Manager, CQCM, and/or Project Chemist via a DNF.

9.2.6.6 Relative Percent Differences from MS/MSD Samples or Duplicate Samples Analysis Outside the Acceptance Limits

When the relative percent difference (RPD) of an analyte from matrix spike/matrix spike duplicate sample analysis is outside the acceptance limits, the MS/MSD or duplicate samples will be re-prepared and reanalyzed to determine if the unacceptable RPD is due to sample matrix. If the RPD for the analyte is again observed to be outside the acceptance limit of the re-prepared samples, it will be assumed that the failure to meet RPD criteria was due to matrix effects. This information will be forwarded to Sevenson personnel via a DNF and included in the case narrative of the analytical result report and the results of both the original and re-prepared sample analyses will be reported. The unacceptable RPD will be flagged with the "#" qualifier.

If upon reanalysis, the RPD of the analytes fall within acceptable limits, the results of the reanalysis will be reported and the original analysis results rejected due to a potential procedural problem.

9.2.6.7 Sample Analyte Concentration Exceeds Calibration Range

If the concentration of analyte exceeds the calibration range for a particular analysis, the sample or sample extract will be reanalyzed at an appropriate dilution so that the analyte concentration in the diluted analysis is within calibration range. The results of both the undiluted analysis and the dilution analysis will be reported for the sample. The detection limit(s) reported for the affected sample(s) will be increase according to the required dilution.

9.2.7 Calculation Errors

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

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

Data review procedures are a set of computerized and manual checks applied at appropriate levels of the measurement process. Data review begins with the reduction (processing) of data, continues through verification of the data, and reporting of analytical results. Calculations are checked from the raw data to the final value prior to reporting results for each group of samples. The analyst who obtained the data can perform data reduction. Data verification starts with the analyst to assure the work is done correctly the first time. Data verification continues with review by a second reviewer who verifies that data reduction has been correctly performed and that the reported analytical results correspond to the data acquired and processed.

10.1 Data Reduction and Initial Verification

More than one analyst, depending upon the analytical method employed or laboratory policy, can perform data reduction and initial verification. Different analysts can review the preparation and analytical data independently. In these instances, each item may not be applicable to the subset of the data verified or an item may be applicable in both instances. It is the responsibility of the analyst to ensure that the verification of data in his or her area is complete. The data reduction and initial verification process must ensure that:

- Sample preparation information is correct and complete including documentation of standard identification, solvent lot numbers, sample amounts, etc.

- Analysis information is correct and complete including proper identification of analysis output (charts, chromatograms, mass spectra, etc.).

- Analytical results are correct and complete including calculation or verification of instrument calibration, QC results, and qualitative and quantitative sample results.

- The appropriate SOP has been followed and is identified in the project records.

- Proper documentation procedures have been followed.

- All non-conformances have been documented and reported.
- Internal COC is complete and documented, if applicable.
- Special sample preparation and analytical requirements have been met.

An analyst will process data in one of the following ways:

- Direct acquisition and processing of raw data by a computer.
- Manual computation of results directly on the data sheet or on calculation pages attached to the data sheets
- Input of raw data for computer processing

If an analyst manually processes data, all steps in the computation shall be provided including equations used and the source of input parameters such as response factors, dilution factors, and calibration constants. If calculations are not performed directly on the data sheet, they may be attached to the data sheets.

For data input by an analyst and processed using a computer, a copy of the input shall be kept and uniquely identified with the project number and other information as needed. The samples analyzed must be clearly identified.

If data is directly acquired from instrumentation and processed, the analyst must verify that the following are correct:

- Project and sample numbers;
- Calibration constants and response factors (RF);
- Units; and
- Numerical values used for reporting limits.

Analysis-specific calculations for methods are provided in the method SOP. In cases where computers perform the calculations, software must be validated or verified before it is used to process data.
The data reduction is documented, signed and dated by the analyst completing the process. Initial verification of the data reduction by the same analyst is documented on a data validation checklist, signed and dated by the analyst.

10.2 Data Verification

Following the completion of the initial verification by the analyst performing the data reduction, an experienced peer, technical person, or supervisor performs a systematic second-level verification of the data. The second level reviewer examines the data signed by the analyst. This review includes an evaluation of all items required in the raw data package. Any exceptions noted by the analyst must be reviewed. Included in this review is an assessment of the acceptability of the data with respect to:

- Adherences of the procedure used to the requested analytical method SOP.
- Correctness of numerical input when computer programs are used (checked randomly).
- Numerical correctness of calculations and formulas (checked randomly).
- Correct interpretation of chromatograms, mass spectra, etc.
- Acceptability of QC data.
- Documentation that instrument was operating according to method specifications (calibrations, performance checks, etc.).
- Documentation of dilution factors, standard concentrations, etc.

This review also serves as verification that the process the analyst has followed is correct in regard to the following:

- The analytical procedure follows the methods and specific instructions given on the project file.

- Non-conforming events have been addressed by corrective action as defined on a non-conformance memo.

- Relevant comments about sample or analysis problems are clearly stated.

- Valid interpretations have been made during the examination of the data and the review comments of the initial reviewer are correct.

- The package contains all of the necessary documentation for data review and report production, and results are reported in a manner consistent with the method used for preparation of data reports.

The specific items covered in the second stage of data verification may vary according to the analytical method, but this review of the data must be a documented list with the signature of the person performing the review.

10.3 Completeness Verification

The Laboratory Project Manager performs a third-level review. This review is required before results are submitted. This review serves to verify the completeness of the data report and to ensure that client project requirements are met for the analyses performed. The items to be reviewed are:

- Analysis results are present for every sample in the analytical batch or sample delivery group.

- Every parameter of target compound requested is reported with either a value or reporting limit.

- The correct units and correct number of significant figures are utilized.

- If specific data reporting forms were requested, all forms are present and are completed correctly.

- All non-conformances and data evaluation statements that impact the data quality are accompanied by clearly expressed comments from the laboratory.

- The final report is legible, contains all the supporting documentation required by the project, and is in either the standard format or in the client-required format.

A case narrative to accompany the final report will be prepared by laboratory project management. This narrative will include relevant comments from the earlier reviews as determined by the laboratory Project Manager.

10.4 Laboratory Analytical Data Reports

Data packages shall be prepared in accordance to the requirements of EM 200-1-6 (October 1997) and include the following:

- **Cover Sheet.** The cover sheet should specify the name and address of the laboratory, contract number, project name, site location, statement of authenticity, and official signature of release.

- **Case Narrative.** A case narrative should be included which outlines any problems encountered during sample analysis. The case narrative should also list all methods used and contain a table correlating field sample numbers and laboratory sample numbers. Samples that were received but not analyzed should also be identified. Extractions or analyses performed outside of holding times should be noted. The case narrative should identify all data qualifiers or flags. Deviations of QC sample results from laboratory acceptance criteria should be noted and associated corrective actions taken by the laboratory should be addressed. Any other factors that could affect the sample results (e.g., air bubbles in VOC sample vials; inappropriate sample temperature, pH, container type, or volume; etc.) should be discussed.

- **Analytical Results.** The results for each sample should contain the following information at a minimum:

    1. Project name and unique ID number

2. Field sample ID number as written on custody form
3. Laboratory name and location (city and state)
4. Laboratory sample ID number
5. Date sample collected
6. Date sample received
7. Date sample extracted or prepared
8. Date sample analyzed
9. Analysis time when holding time limit is less than 48 hours
10. Method number for all preparation and cleanup procedures
11. Analysis procedure including method numbers
12. Analyte or parameter
13. Detection limits adjusted for sample-specific factors (e.g., aliquot size, dilution or concentration factors)
14. Method quantitation limits
15. Analytical results with the correct number of significant figures
16. Concentration units
17. Dilution factor
18. Matrix (water, soil, oil, etc.)

- **Lower Reporting Limit.** The laboratory may use a reporting limit expressed in terms of method detection limit, method quantitation limit, regulatory action level, or project-specific threshold limit. If the non-detect "ND", "U", "<", or other lower limit reporting convention is used, then these terms must also be defined.

- **Sample Documentation.** Original chain of custody record, shipping documents, and sample cooler receipt forms should be attached to each data package.

- **QA/QC Information.** The minimum data package must include internal laboratory QA/QC data with their respective acceptance criteria. The data package should also include the laboratory's method quantitation limits. Method QC data include all spike recoveries, including surrogate spike recoveries; all measures of precision, including relative percent difference; and all control limits for accuracy and precision. This would include laboratory performance information such as results for

method blanks, recoveries for laboratory control sample and laboratory control sample duplicate (LCSD), RPD for LCS/LCSD pairs, and recoveries for QC sample surrogate; and matrix-specific information such as sample duplicate RPDs, MS and MSD recoveries, MS/MSD RPDs, and field sample surrogate recoveries. Any deviations from the control limits should be noted.

Any analytical results communicated verbally or by facsimile must be reviewed and approved prior to the communication. These results must be of the same quality as the hard copy report.

It is the responsibility of the laboratory to provide a reporting system that ensures that any problems associated with an analysis are properly documented on a non-conformance memo, communicated to the appropriate off-site laboratory associates, and addressed appropriately in the data report.

Raw data will be available for later inspection, and maintained in the job file. Results will be sent by facsimile and/or electronically to the site the day that the sample results are due and hard copy results will be mailed to the Sevenson project chemist for data validation within 21 days of the validated time of sample receipt by the laboratory.

11.0 PREVENTATIVE MAINTENANCE

In order to ensure that project-specific analytical requirements and analysis deadlines are met for this project, the project laboratories have instituted preventative maintenance programs. The program consists of a set of procedures that have been implemented on an ongoing basis to prevent instrument malfunction and minimize downtime, as well as to optimize instrument capabilities. These procedures include:

- Maintaining service contracts for all major analytical instruments.
- Performing routine maintenance on all analytical instruments.
- Maintaining an inventory of replacement parts for all analytical instrumentation.
- Keeping current instrument-specific logbooks to record instrument problems, maintenance activities, and calibrations.

In the unlikely event that the laboratory may be unable to perform a set of required sample analyses due to unforeseen circumstances and situations, the laboratory will subcontract the work to an approved laboratory, providing that appropriate certification requirements are satisfied. Note, however, that work will only be subcontracted after approval is obtained from the USACE Contracting Officer or a Designated Representative through the proper non-conformance/corrective action channels described previously in Section 9.0 of the FSP and Section 9.0 of this QAPP.

12.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits will be conducted at fixed intervals to independently assess the laboratory's ability to produce accurate quantitative analytical data within acceptable control limits. Two mechanisms will be employed to conduct these audits: external and internal performance /system audits.

12.1 External Performance/System Audits

The laboratories will routinely analyze performance audit samples, supplied by the USACE. The results of these analyses will be reported to the respective agencies and will provide the basis for ongoing laboratory certification. Moreover, onsite system audits may be conducted by any of these government agencies at their discretion. The laboratory will be responsible for scheduling and coordinating external system audits and also for reviewing data from performance audit samples, so that corrective actions, if any, may be implemented as soon as possible.

The Sevenson Project Chemist and Chemical Quality Control Manager will also perform system audits via data review. In addition, he may conduct quarterly, onsite system audits of the overall chemical data quality activities; this audit will consist of a review of sample collection, decontamination, and documentation procedures. Summary reports will then be prepared; any deficiencies and/or deviations will be documented and addressed on a formal basis. Checklists to be used during onsite system audits are included in Appendix A.

12.2 Internal Performance/System Audits

The laboratories' own quality assurance personnel will conduct performance and system audits regularly. The purpose of this routine monitoring is to ensure that quality data is produced, and if not, to supply the impetus for internal corrective actions. This monitoring will take place in two phases: system audits and performance audits.

The laboratory will conduct periodic in-house system or surveillance audits on a bimonthly basis during which overall laboratory practices, adherence to laboratory standard operating procedures and project specifications, and completeness of analytical data packages will be evaluated. Any deficiencies and/or deviations identified

during these system audit activities will be documented and rectified. In addition, the laboratory will maintain records of these procedural audits.

The laboratories will also initiate internal performance evaluation samples. These will be introduced into the laboratory system as blind samples. In this way, the laboratory may monitor the success of their analytical performance of all project analytical methods on a quantitative basis. Once again, the laboratory will address any analytical method nonconformances.

13.0 REFERENCES

1. Construction Quality Management for Contractors, USACE (ER 1180-1-6), 1997.

2. Data Quality Evaluation Guidance, USACE (CENWK-EC-EF), July 1999.

3. "Identification and Listing of Hazardous Waste", 40 CFR Part 261, 1999.

4. Requirements for the Preparation of Sampling and Analysis Plans, USACE-Environmental Quality (EM 200-1-3), February 2001.

5. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, US EPA SW-846, Final Update III, December 1996.

APPEND A

CHAI OF CUSTODY

WASTE STREAM TECHNOLOGY

Waste Stream Technology Inc.
302 Grote Street, Buffalo, NY 14207
(716) 876-5290 • FAX (716) 876-2412

OFFICE USE ONLY

GROUP # _____

DUE DATE _____

PAGE _____ _____

REPORT TO:

CONTACT

PH. # ( )

FAX # ( )

BILL TO:

PO#

PROJECT DESCRIPTION

SAMPLER SIGNATURE

DW DRINKING WATER
GW GROUND WATER
SW SURFACE WATER
WW WASTE WATER
O OIL
SL SLUDGE
SO SOIL
S SOLID
W WIPE
OTHER

TURN AROUND TIME: _____

QUOTATION NUMBER: _____

ARE SPECIAL DETECTION LIMITS REQUIRED:
YES NO
If yes please attach requirements.

Is a QC Package required:
YES NO
If yes please attach requirements

ANALYSES TO BE PERFORMED

SAMPLE I.D.	DATE SAMPLED	TIME OF SAMPLING	SAMPLE TYPE	TOTAL NO. OF CONTAINERS												TYPE OF CONTAINER/ COMMENTS:	OFFICE USE ONLY WST. I.D.
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

REMARKS:

RELINQUISHED BY:	DATE: / /	TIME:	RECEIVED BY:	DATE: / /	TIME:
RELINQUISHED BY:	DATE: / /	TIME:	RECEIVED BY:	DATE: / /	TIME:

CORRECTIVE ACTION FORM

Corrective Action No. _____ Date _____

To: _____ cc: Task Manager

You are hereby requested to take corrective actions indicated below and as otherwise determined by you (A) to resolve the noted condition and (B) to prevent it from reoccurring. Your written response is to be returned to the Project Manager.

Condition: _____

_____

Reference Documents: _____

_____

Recommended Corrective Actions: _____

_____

Originator _____ Date _____ QAM Approval Date _____

PM Approval Date _____

Response: _____

_____

Corrective Action: _____

_____

A. Resolution: _____

B. Pretension: _____

C. Affected Documents: _____

Signature _____ Date _____

Follow Up _____

Corrective Action Verified:

By: _____ Date _____

DATA EVALUATION CHECKLIST

Project Name/Sevenson Job Number: _____
Laboratory: _____
Laboratory Report Number: _____
Laboratory Sample IDs: _____
Sample Collection Date(s): _____
Sample Type/Matrix: _____
Analyses Performed: _____
Reviewed By: _____ Date Initiated: _____ Date Completed: _____

ATTACHMENTS:
_____ Sample ID Table
_____ Laboratory/Analytical Deficiency Notification (DNF)
_____ RPD Summary Table

REPORT CONTENTS: The following items should be included in the complete laboratory analytical data report. If any of the items are missing, contact the laboratory to obtain the missing items.

ITEM	PRESENT	MISSING	NOT APPLICABLE	COMMENTS
Field sample identifiers and corresponding laboratory ID numbers (also prepare a table that matches field sample IDs, laboratory IDs, rinsate blanks, trip blanks, duplicate samples, laboratory QC samples, and QA laboratory split samples)				
Case narrative				
Chain-of-custody form(s)				
Laboratory Sample Receipt Checklist and USACE Cooler Receipt Form				
Shipping papers and custody seals				
Data Qualifier Sheet that defines the data qualifiers used by the laboratory to report the analytical results				
Summary of methodologies, receipt dates, analysis dates, etc.				

DETAILED ASSESSMENT AND VALIDATION: Complete the assessment and validation for each laboratory data report by checking the appropriate column (yes "Y", no "N", or not applicable "NA"). If the answer to any of the questions is "no", an explanation of the non-compliance/deficiency and associated corrective action should be included in the case narrative and on a Laboratory/Analytical Deficiency Notification Form (DNF). If a DNF is available, attach to the Data Evaluation Checklist.

	Y	N	NA	COMMENTS/QUALIFIERS
CHAIN-OF-CUSTODY				
Was the chain-of-custody form properly completed and signed by the field personnel when relinquished and by the laboratory when received?				
Was the chain-of-custody form free of errors and discrepancies?				
SAMPLE PRESERVATION				
Are the Laboratory Sample Receipt Checklist and USACE Cooler Receipt Forms present and properly signed?				
Do the Laboratory Sample Receipt Checklist and USACE Cooler Receipt Forms indicate that the samples were received within proper temperature and in good condition?				
Were samples that required preservation properly preserved?				

	Y	N	NA	COMMENTS/QUALIFIERS
REQUESTED ANALYSES				
Were all chain-of-custody-requested analyses performed?				
Are analytical results reports present for all samples and for all analyses?				
Do the result reports for each analytical parameter for each sample list all of the required site-specific compounds or metals as specified in the QAPP?				
HOLDING TIMES				
Were extraction (when applicable) and analysis holding times for sample met?				
METHOD BLANKS				
Does the report contain method blank results for each analytical parameter performed?				
Were the method blanks free of target compounds? (If NO, list the parameter(s) detected below.)				
Were the site samples free of compounds detected in the method blank?				
If the site samples were not free of compounds detected in the method blank, did the laboratory flag the site samples with a "B" qualifier?				
Target compounds detected:				
FIELD BLANKS				
If the report contains results for aqueous volatile organic samples, does the report contain trip blank results?				
If the report contains results for samples collected using non-dedicated equipment, does the report contain rinsate blank results?				
Were the site samples free of compounds detected in the trip and/or rinsate blank? (If NO, list the parameter(s) detected below.)				
Target compounds detected: GWRB-01-042401:				
LCS RESULTS				
Does the report contain the results of LCS analyses with the corresponding control limits reported?				
Are the recoveries from the LCS analyses within the corresponding control limits?				
If NO, does the case narrative detail the reason and the corrective action taken? (Also, attach the applicable DNF, is available.)				
FIELD DUPLICATES				
Does the report contain a field replicate sample?				
Calculate the relative percent differences between the replicate *sample results and attach the RPD Summary Table.*				
Are the field duplicate sample results in agreement based on the acceptance criteria included in CENWK-EC-EF.				
SURROGATE RESULTS				
For the applicable organic compound analyses, are the surrogate compound recoveries and the corresponding control limits reported?				
Are the surrogate compound recoveries within the control limits?				
If NO, does the case narrative detail the reason and the corrective action taken? (Also, attach the applicable DNF, is available.)				
MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS				
Does the report contain, for each applicable analytical parameter, the results of matrix spike sample analyses including the recoveries and corresponding control limits?				
Does the report contain, for each applicable analytical parameter, the results of matrix spike duplicate and/or laboratory duplicate pairs, including the relative percent differences and corresponding control limits?				
Are the recoveries from the matrix spike, matrix spike duplicate, and/or laboratory duplicate pairs, including the relative percent differences, within the control limits?				
If NO, does the case narrative detail the reason and the corrective action taken? (Also, attach the applicable DNF, is available.)				

	Y	N	NA	COMMENTS/QUALIFIERS
QUANTITATION LIMITS				
Do the analytical results reports list the sample quantitation limits for each compound?				
Are the project-required quantitation limits included in the QAPP met?				
If the quantitation limits are out of range, does the case narrative document the cause(s) as to why the limits are above criteria?				
For the organic analysis parameters, are the results that are greater than the MDL but below the MQL properly flagged by the laboratory with the "J" qualifier?				
For the organic parameter results that have compounds that are flagged with the "D" qualifiers, does the result report state the dilution factor that was used to obtain the result and the date on which the dilution was analyzed?				

Additional Notes/Comments: _____

_____

_____

Data Assessment/Validation by: _____

Name Signature Date

CQC Systems Review by: _____

Name Signature Date

TASK SPECIFIC QC CHECKLIST
Work Task: Decontamination
Sevenson Checklist #009

Project Name/Job Number: _____
Inspection Date: _____

Complete this form for each day samples are taken. Answer each question by checking the appropriate column (yes, no, not observed (N/O), or not applicable (N/A)). If "no" is checked, provide an explanation of the non-compliance and associated corrective action(s).

	Yes	No	N/O	N/A
Was all sampling equipment decontaminated properly prior to use and between sample intervals?				
Was each decontamination event recorded in the logbook?				
Was investigation derived waste (IDW) (e.g., decontamination water, personal protective equipment (PPE), etc.) handled properly?				
Were the location, type, number and source of containers of IDW recorded in the logbook?				
Was Sevenson Technical Services notified if IDW requires offsite disposal?				

Notes/Comments

_____
_____
_____

QC Inspector Name and Signature

_____

_____

Date

_____

DEFICIENCY TRACKING LOG

Log #	Client	WST ID #	Client ID #	Description of Deficiency	Date Found	Client Notified [1]	Corrective Action	Document Reference [2]	Date Corrected	Remarks
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										
18.										
19.										
20.										
21.										
22.										
23.										

NOTES:
[1] Client to be immediately notified by telephone and via Facsimile with a Deficiency Notification Form
[2] Reference any/all document for specific corrective action requirements (i.e. SW-846, CENK-EC-EF, SAP, etc.)

LABORATORY/ANALYTICAL DEFICIENCY NOTIFICATION

Log # : _____ Date: _____ Client: _____

Site: _____ SDG: _____

Lab ID No.(s): _____

Client ID (s): _____

Deficiency: _____

_____

_____

_____

Explanation: _____

_____

_____

_____

Corrective Action: _____

_____

_____

_____

Comments: _____

_____

_____

_____

Client Contact: _____ Date Sent: _____

Telephone: _____

Reported By: _____ Date: _____

TASK SPECIFIC QC CHECKLIST
Work Task: Field Documentation
Sevenson Checklist #008

Project Name/Job Number: _____
Inspection Date: _____

Complete this form for each day samples are taken. Answer each question by checking the appropriate column (yes, no, not observed (N/O), or not applicable (N/A)). If "no" is checked, provide an explanation of the non-compliance and associated corrective action(s).

	Yes	No	N/A
Was all original field data recorded in black indelible ink?			
Were logbooks filled out properly, accurately recounting the day's events?			
Were all field forms completed and information accurately recorded?			
• Field Sampling Forms			
• Chain of Custody Forms			
• Field Log Books			
• Field Change Request Forms			
• Additional Forms (list below)			
Was field documentation forwarded to Sevenson office for peer/QC review?			
Were deficiencies reported to the Field Sampling Manager?			

Notes/Comments

_____
_____
_____

QC Inspector Name and Signature

_____

_____

Date

_____

DAILY CHEMICAL QUALITY CONTROL REPORT

Date: _____

Job Identification and Site Numbers: _____

_____

Weather: _____

_____

Subcontractors Present Onsite: _____

_____

Health and Safety Measures Necessary for Planned Activities: _____

_____

Health and Safety Violations and Corrective Actions: _____

_____

_____

Planned Daily Activities: _____

_____

_____

Description of Chemical Data Acquisition Work Performed: _____

_____

_____

Sample Shipments and Problems Regarding Sampling and Sample Shipments: _____

_____

Chemical Parameter Measurement Problems: _____

_____

_____

Contingency Sampling: _____

_____

_____

Non-conformance Problems: _____

_____

_____

Corrective Actions (including approvals): _____

_____

_____

Initials of Personnel Performing Corrective Actions: _____

Implemented Chemical Quality Control Activities (including summary of feedback resulting from corrective actions taken): _____

_____

_____

CERTIFICATION: As Chemical Quality Control Manager, I certify that the above report is complete and correct and that I, or my authorized representative, have inspected all work performed this day by key staff and have determined that all materials, equipment and workmanship are in strict compliance with the plans and specifications, except as my be noted above.

_____ _____

Signature Date

Field Change Request Form

PROJECT MANAGER:_____
PROJECT:_____
JOB NUMBER:_____
CONTRACT NUMBER:_____
DATE:_____
FIELD CHANGE REQUEST NUMBER:_____

Weather

	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Calm	Moderate	High		
Humidity	Dry	Moderate	Humid		

SUB-CONTRACTORS ON SITE:			
EQUIPMENT ON SITE:			
SAMPLING PERFORMED:			
NON-CONFORMANCE/PROBLEM ITEM(S):			
PROJECT QA/QC OFFICER NOTIFIED:	TIME	DATE	INITIALS
PROJECT MANAGER NOTIFIED:	TIME	DATE	INITIALS
CONTRACTING OFFICER NOTIFIED:	TIME	DATE	INITIALS
PROJECT TECHNICAL DIRECTOR NOTIFIED:	TIME	DATE	INITIALS
WORK STOPPED? _____ YES	_____ NO		
IF NOT, EXPLAIN			

Sheet _____ of _____

PROJECT _____ REPORT NO. _____

JOB NO. _____ DATE _____

ACTION TO BE TAKEN:

HEALTH AND SAFETY LEVEL CHANGES: _____No _____ Yes (explain)

HSO NAME/DATE:

PROBLEM RESOLUTION:

SPECIAL NOTES:

FOLLOW-UP TO BE FILED? _____ No _____ Yes (explain/attach)

FIELD CHANGE APPROVED: _____ No _____ Yes Initials: _____

Sheet _____ of _____

BY: _____ TITLE:

Final Phase Inspection Checklist
Lake Ontario Ordnance Works; Lewiston, New York

Date: _____ Specifications Paragraph: _____

Definable Feature of Work: _____

Description and Location of Work Inspected: _____

_____

Reference Contract Drawings: _____

A. Personnel Present

Name	Position	Company

B. Materials Used In Strict Compliance With The Contract Plans and Specifications?
YES _____ NO _____
If not, explain: _____
_____

C. Procedures and/or work methods witnessed are in strict compliance with the requirements of the contract specifications? YES _____ NO _____
If not, explain: _____
_____

D. Workmanship is acceptable? YES _____ NO _____
State areas where improvement is needed: _____
_____

E. Remarks: _____
_____
_____

_____ _____
Quality Control Representative Project Engineer

Initial/Follow-Up Phase Inspection Checklist
Lake Ontario Ordnance Works; Lewiston, New York

Inspection Type: ☐ Initial Phase ☐ Follow-Up Phase

Date: _____ Specifications Paragraph: _____

Description and location of work inspected: _____

_____

Reference contract drawings: _____

A. Personnel Present

Name	Position	Company

B. Materials being used are in strict compliance with the Contract Plans and Specifications?
YES _____ NO _____
If not, explain: _____

_____

C. Procedures and/or work methods witnessed are in strict compliance with the requirements of the Contract Specifications? YES _____ NO _____
If not, explain: _____

_____

D. Workmanship is acceptable? YES _____ NO _____
State areas where improvement is needed: _____

_____

E. Safety violations and corrective actions taken: _____

_____

F. Remarks: _____

_____

_____

_____ _____

Quality Control Representative Project Engineer

SAMPLE LABELS

Waste Stream Technology Inc.
302 Grote Street
Buffalo, NY 14207 (716) 876-5290

	DATE:	
	TIME:	
CLIENT/SITE NAME		
SAMPLE LOCATION	COMP	
SAMPLED BY	GRAB	

Waste Stream Technology Inc.
302 Grote Street
Buffalo, NY 14207 (716) 876-5290

	DATE:	LAB USE ONLY
	TIME:	LOG DATE:
CLIENT/SITE NAME		☐ TR ☐ PC
		☐ ST ☐ OG
SAMPLE LOCATION	COMP	☐ PD ☐ AN
SAMPLED BY	GRAB	☐ RETURN TO SITE

CUSTODY SEAL

SECURITY SEAL DATE _____
DO NOT TAMPER INITIALS _____

TASK SPECIFIC QC CHECKLIST
Work Task: Packing, Storing, and Shipment of Samples
Sevenson Checklist #007

Project Name/Job Number: _____
Inspection Date: _____

Complete this form for each cooler/shipment inspected. Answer each question by checking the appropriate column (yes, no, not observed (N/O), or not applicable (N/A)). If "no" is checked, provide an explanation of the non-compliance and associated corrective action(s).

	Yes	No	N/O	N/A
Were the samples handled according to the FSP and QAPP?				
Did the samples remain on ice or refrigerated (except for sample transfer from coolers or refrigerators) from collection until the cooler was taped for shipment?				
Were sample containers prepared for shipment (bubble-wrap, Zip-Lock™ bags, etc) per SAP procedures?				
Was a trip blank (for VOC samples only) and a temperature blank included in each cooler?				
Was loose ice double Zip-Lock™- bagged prior to placement in cooler?				
Was ice placed in equal proximity to all sample containers and the temperature blank to ensure samples arrive at lab at 4°C?				
Were Chain-of-Custody forms filled out accurately and completely, including the project name and number, sampling date and time, analytical parameters, preservatives, size and number of containers for each analytical parameter, and media sampled?				
Were Chain-of-Custody forms signed and dated by the preparer and the form taped to the inside of the cooler lid?				
Were signed and dated custody seals properly placed on the cooler and the cooler sealed with strapping tape?				
Was a shipping label attached to the cooler?				
Were COCs and shipping tracking labels faxed to lab?				

Notes/Comments

_____
_____
_____

QC Inspector Name and Signature

_____

_____

Date

_____

Preparatory Phase Checklist
Lake Ontario Ordnance Works; Lewiston, New York

Contract:	Date Preparatory Held:
Spec. Section & Paragraph:	Definable Feature of Work:
Drawing Sheet Numbers:	Major Definable Feature:

A. Personnel Present

Name	Position	Company

B. Has each spec. paragraph, drawing, and shop drawing detail been studied? Yes ___ No ___

C. Transmittals Involved

Number and Item	Code	Contractor/Government Approval

Have all items involved been approved? Yes _____ No_____

D. Are all materials on-hand? Yes ____ No_____

Are the materials on the job-site to be incorporated the same as those approved?
Yes _____ No _____

Have all materials been checked for contract compliance against approved shop drawings? Yes ___ No _____

Equipment to be used in executing the work:

Items not on-hand or not in compliance with transmittals:

E. Tests required in accordance with contract requirements:

Test	Paragraph

F. Accident Prevention Planning - Hazard Control Measures:

Activity Hazard Analysis

Activity	Hazard(s)	Controls

Operational Equipment Checklist

Attached For:

On File For:

G. Have procedures for accomplishing work been reviewed with appropriate people?

Yes ___ No

Scope of Work/Method of Construction:

Safety Issues:

Spill Prevention Issues:

H. Has all preliminary work been accomplished in accord with contract requirements and is this segment of work ready to start? Yes ___ No

Explain any problems:

I. Remarks:

USACE Comments:

Sevenson Comments:

CQC Systems Manager

Project Engineer

Radioactive Material Shipment Receipt Inspection Form

Receipt	Print Name	Initial	Date Time	Reviewed & Approved
Shipper Site and Sender Name				
Shipping Papers Carrier, Method, and ID	Carrier	Method	ID	
Label on Package		Isotope(s) and Activity		
Inspection Outer	Acceptable	Yes	No	Damage Noted
Type of Package Identify type used		Type of Packaging Identify materials used		
Inspection Inner	Acceptable	Yes	No	Damage Noted
Contents (Number per Matrix)	SO	AF	BA	GW	DW	S	Other

Radiation Survey
Survey to be done within 3 hrs of receipt

Survey meter	E600	E600	ASP2		XLB5	GA/GB- STF and Batch No.	
Serial No.	1698	1699	0526				
Calibration √ OK							
Daily √ OK							

Shipment and Packing Materials Survey Results
Attach Survey Map and/or Activity Report as needed

Record Actual Reading OR α <220, βγ <1000, <0.05mR	Outer Shipping Package Survey Results Record the highest reading. ANY result above stated limits requires documentation with a survey map.				Inner Shipping Package Survey Results Record the highest reading. ANY result above stated limits requires documentation with a survey map. Highest Readings off ANY ONE inner Package			
Results	BKGD.	@ 1 m	TOP	SIDE	BOTTOM	Results	TOP	SIDE	BOTTOM
mR/hr						mR/hr			
dpm α / 100cm²						dpm α / 100cm²			
dpm βγ / 100cm²						dpm βγ / 100cm²			

Material	mR/hr	dpm α / 100cm²	dpm βγ / 100cm²	Disposition
Package Container				
Plastic Bag (COC bag)				
Packing Material				

Notifications

CRITERIA:	IF Yes to ANY notification CRITERIA,
Radiation level @ 1 meter ≥10 mRem/hr Radiation level on contact ≥ 200 mRem/hr Removable Alpha/Uranium series contamination ≥ 220 dpm /100 cm² Removable Beta/Gamma contamination ≥ 2200 dpm /100 cm²	THEN Contact NYSDOL RHU – (518) 457-1202 and as directed US DOT (800) 424-8802 Contact appropriate Carrier FedEx (800/ 463-3339) UPS (800/744-7877)]
CRITERIA: Radiation or contamination levels exceed DOT labeling requirements.	IF Yes to ANY notification CRITERIA, THEN Contact Site Shipping Coordinator

Notification Required	Y / N	Notification By	Contact Person /Organization / Date and Time
Remarks			

Army Corp. of Engineers Sample Receipt Form

LIMS # _____ No. of Coolers _____

MRD Cooler # _____ Contract Cooler _____

PROJECT: _____ Date Received: _____

USE OTHER SIDE OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

A. PRELIMINARY EXAMINATION PHASE: Date cooler was opened:
by (sign): _____ (print): _____

1. Did cooler come with shipping slip (airbill ect): If yes enter carrier name & airbill number here: _____	YES	NO
2. Were custody seals on outside of cooler? How many, where, date, time: _____	YES	NO
3. Were custody seals unbroken and intact at the date and time of arrival?	YES	NO
4. Did you screen samples for radioactivity using a Geiger counter?	YES	NO
5. Were custody papers sealed in a plastic bag & taped inside to the lid?	YES	NO
6. Were custody papers filled out properly (ink, signed, ect)?	YES	NO
7. Did you sign the custody papers in the appropriate places?	YES	NO
8. Was project identifiable from the custody forms? If YES, enter project name at the top of this form.	YES	NO
9. If required, was enough ice used? Type:	YES	NO
10. Have designated person initial here to acknowledge receipt of cooler: _____ (date) _____		

B. LOG-IN PHASE: Date samples were logged-in:
by (sign): _____ (print): _____

11. Describe type of packing in cooler: _____		
12. Were all bottles sealed in separate plastic bags?	YES	NO
13. Did all bottles arrive unbroken and were labels in good condition?	YES	NO
14. Were all labels complete(ID, date, time, signature, preservation)?	YES	NO
15. Did all bottle labels agree with custody papers?	YES	NO
16. Were correct containers used for the tests indicated?	YES	NO
17. Were correct preservatives added to samples?	YES	NO
18. Was a sufficient amount of sample sent for tests indicated?	YES	NO
19. Were bubbles absent in VOA samples? If NO, list by sample #:	YES	NO
20. Was the project manager called and status discussed? If YES, give details on the back of this form.	YES	NO

21. Who was called? _____ Date: _____

By whom? _____

WASTE STREAM TECHNOLOGY

TASK SPECIFIC QC CHECKLIST
Work Task: Sample Cooler Shipment
Sevenson Checklist #010

Project Name/Job Number: _____

Inspection Date: _____

PREPARATORY PHASE

Yes	*No*	*N/A*		*Comment*
			Have sample shipment procedures in the SAP been reviewed by all field sampling personnel?	
			Are sufficient numbers of clean, hard plastic coolers available onsite to meet current sampling schedule?	
			Are sufficient packing supplies (i.e. Ziplock™ plastic bags, packing "peanuts", sealing tape, etc.) available onsite?	
			Are laboratory chain-of-custody forms, custody seals, and extra sample container labels available onsite?	
			Has a common carrier (Federal Express, UPS, etc.) been selected and have package pickup points and times been identified?	
			Will sample coolers be D.O.T. regulated for shipping purposes and are D.O.T. required shipping labels and logs available at the site?	
			Have the offsite primary and QA laboratories been contacted to verify anticipated sample collection and shipment schedules?	
			Does the primary and QA laboratory have a list of sample shipping site contacts should there be problems or questions?	
			Is an ice source available on or near the site?	

INITIAL PHASE OR FOLLOW-UP PHASE

Yes	*No*	*N/A*		*Comment*
			Has a Preparatory Phase meeting been conducted? Where sample containers received from the field properly labeled , prepared, and recorded in the field logbook and in the site sample summary log per the SAP?	
			Was the sample cooler inspected to verify that it was clean, undamaged, and had no external markings or shipping addresses unrelated to the project?	

Was the cooler inspected to verify that the site name, address, telephone number and contact name was written in indelible ink on the interior of the cooler lid? _____

Was the cooler drain plug (if present) securely taped shut on both the interior and exterior sides? _____

Was a clean, new plastic garbage bag placed into the cooler as a secondary liner? _____

Where all samples, field duplicates, QA splits, and rinse blanks verified by checking sample labels against field logbook entries as chain-of-custody forms were completed? _____

Were chain-of-custody forms completed per SAP? _____

Were sample containers placed into separate Ziplock™ bags before being placed in an upright position in the cooler? _____

Was packing material placed between sample containers to prevent shifting or breakage during shipment? _____

Was a temperature blank placed in close proximity to sample containers? _____

If required, was double Ziplock™-bagged ice placed in the cooler in contact with all sample containers? _____

Was the outer garbage bag sealed with a twist-tie or knot? _____

Were chain-of-custody forms placed inside a Ziplock™ bag and taped to the inner lid of the cooler? _____

Was the closed cooler lid checked to verify a proper closure and was fiber-reinforced strapping tape placed around both of its ends at least twice? _____

Were handling labels and D.O.T. hazard labels (if required) placed on the outside of the cooler? _____

Were a minimum of two (front and side) completed custody seals placed across the lid opening to verify cooler integrity? _____

Was an address label with both the "shipped from" and "shipped to" addresses applied to the top of the cooler? _____

Was the common carrier airbill (or other shipping form) properly completed and attached to the cooler? _____

Was the "shipper's copy" of the airbill retained at the site and attached to the DCQCR? _____

Were all destination laboratories notified of sample shipments? _____

Comments: _____

_____

_____

_____

Sevenson Project Manager _____

Name Signature Date

QC Reviewer _____

Name Signature Date

CQC Systems Manager _____

Name Signature Date

SITE QC INSPECTION REPORT

Project Name _____ Client/Generator _____

Sevenson Job # _____ Contract # _____

Project Location _____ Task Order # _____

Inspection Date _____ Inspection Time _____

Inspected By _____

Sevenson Project Manager _____ Client/Generator Project Manager _____

Site Telephone # _____ Contact Telephone # _____

Site Facsimile # _____ Contact Facsimile # _____

Site Email Address _____

Site Plans/Activities

Construction Management Plan/Work Plan

Original Approval Date _____

Revision Approval Date (if applicable) _____

YES	NO	
		Current Plan Copy Available Onsite
		Spill Response equipment/materials available?
		Soil erosion/sediment controls in-place?
		Work zones (EZ, CRZ, SZ) clearly delineated?
		All equipment inspections being documents (in and out)?

COMMENTS: _____

_____

_____

_____

_____

Health and Safety

Original Plan Approval Date _____
Revision Approval Date (if applicable) _____

YES NO

- Current Plan Copy Available Onsite
- Activity Hazard Analysis Complete and Updated
- Daily Safety Meetings Conducted and Documented
- Emergency Response Information Posted
- Medical and Training Documentation Current
- Daily Safety Logs Completed
- Chemical Inventory Updated
- Inspections Completed and Documented
- Map to hospital prominently displayed?
- Is work being conducted safely?

COMMENTS: _____

_____

_____

Sampling and Analysis

Original Plan Approval Date _____
Revision Approval Date (if applicable) _____

YES NO

- Is a current plan copy available onsite?
- Has a review of the Plan and all relevant SOPs with all site sampling been conducted?
- Are field logbooks and other site documentation maintained properly and in a secure area?
- Are Preparatory Inspections being conducted prior to each sampling event?
- Are Initial and Follow-up Inspections being conducted for each sampling event?
- Is the site Sampling Manager performing periodic field audits of all sampling activities?
- Is field documentation being reviewed by the site Sampling Manager prior to the completion of each days' sampling events?
- Is the Sampling Manager performing field audits of sample labeling, chain-of-custody, packing and shipping activities?
- Are Daily Chemical Quality Control Reports (DCQCR) being completed each day and properly?
- Are DCQCR, instrument maintenance and calibration, nonconformance/corrective action reports and sampling logs current?

COMMENTS: _____

_____

_____

Project Work Tasks	Sevenson Checklist #
(Check all that apply and attach completed QC Report)	
Monitoring Well Installation, Development, and/or Abandonment	SES 001
Groundwater Monitoring Well Sampling	SES 002
Surface Water Sampling	SES 003
Subsurface Soil Sampling	SES 004
Drum/Tank Sampling	SES 005
Mobile Laboratory	SES 006
Packing, Storing, and Shipment of Samples	SES 007
Field Documentation	SES 008
Decontamination	SES 009
Sample Cooler Shipment	SES 010
Onsite Waste Storage	SES 011
Offsite waste Transport/Disposal	SES 012

COMMENTS: _____

_____

_____

_____

Sevenson Project Manager _____

Name Signature Date

QC Reviewer _____

Name Signature Date

CQC Systems Manager _____

Name Signature Date

TNT SOIL TEST KIT WORKSHEET

Abs Background _____ Abs Control _____

1	2	3	4	5	6
SAMPLE #	Abs Initial	Abs Sample	Abs Initial x4	Abs Final (Column 3 - Column 4)	TNT CONC ppm (Column 5/0.0323)

WASTE STREAM TECHNOLOGY, INC.
SAMPLE SHIPMENT CHECKLIST

Client: _____ Date Shipped: _____
Client Contact: _____ Date Received: _____
Telephone: _____ Shipped Via: _____
Checked by: _____
Number of Shipping Containers (Coolers) _____

Container ID	Custody Tape Present?	Custody Tape Intact?	Temperature (°C)	Number of Sample Containers	Agree with COC?

Sample Description: Matrix _____

Visual Observations _____

Preservation: pH 1 2 3 4

Cyanide Interferences _____

QA/QC Volume requirements met? Yes No
If no, mark deficient analysis: 608 625 O&G BOD _____

Irregularities:

Sample ID and Description	Irregularity

Checker Signature _____ Date _____

RESOLUTION OF IRREGULARITIES WITH CLIENT

Client Rep _____ WST Rep _____
Date/Time _____ Written Follow Up?/Date _____
Decision _____

APPEND B

WASTE STREAM TECHNOLOGY INC.
ANALYTICAL LABORATORY
QUALITY ASSURANCE
AND
QUALITY CONTROL PLAN

Revision Number: 11
Effective Date: 08/05/02
Serial Number: QA-108

Prepared by:

Waste Stream Technology Inc.
302 Grote Street
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Laboratory Director: Brian S. Schepart, Ph.,D. _____ Signature

QA/QC Director: Daniel W. Vollmer _____ Signature

Radiochemistry Manager: Brian S. Schepart, Ph.,D. _____ Signature

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POLICY STATEMENT

The goal of the analytical laboratory of Waste Stream Technology (WST) is to provide reliable data to our clients in a manner that will facilitate the problem solving and decision making processes. Because we are aware that this data must be of the highest quality, we are committed to an intensive and comprehensive program for quality assurance and quality control.

In order to provide reliable data of the highest quality on a continuing and consistent basis, WST has implemented an internal Quality Assurance and Quality Control Program. The quality assurance guidelines of WST incorporate the requirements of the National Environmental Laboratory Accreditation Conference (NELAC) standards, The U.S. Army Corps of Engineers Shell Document, U.S. EPA SW-846, "Test Methods for Evaluating Solid Wastes" and US EPA Manual, "Handbook for Analytical Quality Control for Water and Wastewater Laboratories."

This Quality Assurance and Quality Control establishes and documents the procedures and practices that are routinely implemented to ensure the integrity and validity of the data generated by WST. The main objectives of this program are to:

1. Establish protocols for measuring the quality of each system through the use of internal audits.
2. Recognize and define deficiencies that affect the quality of data.
3. Provide a system of checks and balances to correct and document out-of-control conditions in a timely manner.
4. Define and document the limitations on the quality of the data to further enhance its utility for problem solving, decision making and reporting.
5. Provide a rational, well-defined format with credible, traceable documentation to assist in the internal and external evaluation of the overall program.

The purpose of this Quality Assurance/Quality Control Plan is to establish internal protocols, procedures and guidelines to define and document the validity of the data produced. In this way we engender a system dedicated to excellence, in which we and our clients can have the utmost confidence.

James B. Hyzy, Ph.D.
Operations Manager
Waste Stream Technology Inc.

Brian S. Schepart, Ph.D.
Laboratory Director
Waste Stream Technology Inc.

INTRODUCTION

1.1 General Description

Waste Stream Technology Inc. (WST) was founded in 1986 as a bioremediation company to address the need for alternative technologies to remediate water and soils contaminated with petroleum hydrocarbon products. In 1987, WST established its analytical laboratory to support its bioremediation processes and in July 1989, WST became a wholly owned subsidiary of Sevenson Environmental Services Inc. (SES) of Niagara Falls, New York. Since that time, the WST analytical laboratory has expanded and it soon became apparent that a certified public environmental laboratory could substantially benefit both WST's and SES's clients, as wells as the Western New York area.

1.2 Objectives

The objective of this manual is to present the Quality Assurance and Quality Control Plan used within WST's analytical laboratory to maintain the production of the highest quality data at all times. Specifically, this manual will address the areas of:

- -Organization and responsibilities of WST's personnel
- -Sample custody and tracking
- -Analytical procedures and the associated quality assurance and quality control
- -Data handling
- -Corrective actions

1.3 Implementation

All WST laboratory employees, and those whose job functions relate to the laboratory, will have access to copies of this manual for reference. Copies of the referenced SOP's will also be available for reference and guidance. It is the joint responsibility of the Laboratory Director, Assistant Laboratory Director, and the QA/QC Department to see that the operating criteria set forth are carried out to their satisfaction. Employees who, either willfully or through negligence, attempt to circumvent the QA/QC procedures will be reprimanded. Persistent violations may result in termination. Upper management levels will be routinely advised of the status, accomplishments, and success of the program through executive summaries.

1.4 Ethics and Integrity

All WST employees that generate and report analytical data are instructed on the importance of data integrity and are required to sign an Ethics and Integrity Agreement (Figure 1-1). Employees are encouraged to discuss any questionable data with the laboratory management prior to reporting the result and to notify the laboratory management of any accidental reporting of non-authentic data in a timely manner.

1.5 Confidentiality Procedures

To ensure the protection of the clients' confidentiality information and proprietary rights, the results of analytical testing will be mailed and transmitted by facsimile only to the person who's name appears on the chain-of-custody form received with the samples. Copies of the analytical results will be faxed or mailed to other parties but only with the permission of the client. Analytical results that are transmitted via facsimile will include a cover sheet that contains the following confidentiality notice:

"This transmission is intended for the use of the individual or entity to which it is addressed and may contain confidential information that is privileged and exempt from disclosure under applicable law. Please call the number listed above if you have received this transmission in error. Destroy the original transmission without reading or saving in any manner."

1.6 Amendments and Revisions

Amendments and/or revisions to this manual will be made in a timely fashion dependent on the urgency and impact of any changes. Changes in procedures or protocols by regulatory agencies at the federal, state, or local level that affect the content of this manual will be made immediately. In addition, changes in methodology or instrumentation that affect Quality Control (QC) limits will be made as soon as the effects of these changes can be measured, documented, and verified. The incorporation of new or additional analytical capabilities into the laboratory program will also be dealt with immediately.

The QC limits will be reviewed at least annually and updated should the data indicate a change. Editorial revisions will be made annually.

Responsibility for changes will be shared by the QA/QC Department, Laboratory Director, Assistant Laboratory Director, and any other technical/professional employees as they deem necessary to the process.

Figure 1-1

Waste Stream Technology Inc.
(Laboratory)

Ethics and Data Integrity Agreement

I. I, _____ (Name), state that I understand the high standards of integrity required of me with regard to the duties I perform and the data that I report in connection with my employment at Waste Stream Technology Inc. (Laboratory);

II. I agree that in the performance of my duties at Waste Stream Technology Inc. (Laboratory);

A. I shall not intentionally report data values that are not the actual values obtained;

B. I shall not intentionally report dates and times of data analyses that are not the actual dates and time of data analyses, and

C. I shall not intentionally represent another individual's work as my own.

III. I agree to inform Waste Stream Technology Inc. (Laboratory) of any accidental reporting of non-authentic data by myself in a timely manner.

IV. I agree to inform Waste Stream Technology Inc.(Laboratory) of any accidental or intentional reporting of non-authentic data by other employees.

_____
(Signature)

_____
(Date)

ORGANIZATION AND RESPONSIBILITIES

2.1 Organizational Chart

The organizational chart of Waste Stream Technology's analytical laboratory is depicted in Figure 2-2. Although WST has a small staff, it is logically arranged and the high degree of quality assurance can be maintained due to the ability and experience of each staff member (See Section 7.0 for Biographies of Laboratory Personnel. Figure 2-1 shows the corporate organizational chart for WST.

2.2 Responsibilities

The responsibilities of each position within WST's analytical laboratory are clearly defined and understood by each individual staff member. Each person is constantly aware that each task is performed carefully and attentively during the work day so that the highest quality data can be generated.

The specific responsibilities of each staff member are as follows:

The Laboratory Director has the overall responsibility for the performance of the laboratory staff and the quality of the data generated. He/she must also be sure that all laboratory personnel meet the requisite qualifications for their position in the laboratory. The Laboratory Director, or a designee, must also review and approve all outgoing reports and serve as a link for communication and liaison with clients. The Assistant Lab Director acts as delegates for the Laboratory Director in his/her absence.

The Assistant Laboratory Director, in conjunction with the laboratory staff, is responsible for the day-to-day operation of the laboratory, including, but not limited to: the scheduling of sample extraction and analysis; reviewing analytic data; assuring that all staff members are familiar with the Quality Assurance and Quality Control Plan (QA/QC); training of new staff; reviewing and approving outgoing reports as a designee of the Laboratory Director; evaluation of analytic procedures, both current and new; the review of new incoming work to ensure that WST=s facilities and resources are appropriate to perform the work prior to commencing with this work; the inventory and ordering of supplies, chemicals, and standards; and preventive maintenance contracts and the performance of scheduled preventive maintenance.

The QA/QC Officer coordinates all quality assurance responsibilities. The QA/QC Officer reports to the Laboratory Director for daily activities but is responsible to the Vice-President for reporting non-conformance with the QA/QC criteria if corrective actions are not undertaken in a timely manner. In order to maintain the integrity, independence and objectivity of the QA/QC program, the QA/QC Officer is independent of the analytical process. The primary responsibilities of the QA/QC Officer are to review data and reports submitted by the Analyst prior to release, to carry out system audits, initiate corrective actions, and ensure compliance with the QA/QC manual and Standard Operating Procedures (SOP). The QA/QC Officer has the authority to perform audits, submit blind control samples, access data files and notebooks, and reject data/reports for non-compliance with accepted standards.

The Radiochemistry Lab Manager is responsible for the implementation of the Quality Control and Quality Assurance Plan at it applies to radiochemical analyses. The responsibilities include but are not limited to the following:

1. General surveillance over all activities involving radioactive material (RAM), including the monitoring, storage, control, and use of RAM.
2. Ensuring compliance with rules, regulations, license conditions, and industry standards as they relate to Radiochemistry lab procedures and operations.
3. Monitoring and maintaining the Radiochemistry lab as well as the balance of the facility free of radioactive contamination and radiation exposure levels below regulatory concern.
4. Furnishing consulting services on all aspects of radiochemistry and health physics to clients and personnel at all levels of responsibility.
5. Ensuring all RAM shipments are received and sent to Waste Stream in accordance with controlling regulations.
6. Ensuring all personnel who are assigned to work with RAM are properly trained and qualified as Radiation Workers, and are monitored accordingly for exposure to radiation and RAM.
7. Instructing and training of personnel, who perform radiochemistry or handle RAM.
8. Ensuring the quality control and quality assurance objectives of the radioanalytical analysis are clearly defined and recognized by those individuals performing analyses, calculating data, entering data, and reviewing data form the Radiochemistry lab.
9. The authority to terminate any activity involving RAM or radiochemistry, or any action in the lab that is deemed unsafe or can pose a health and safety concern.

The Analyst is responsible for the operation and maintenance of their instrument. Each of the analysts has a specific analytical area and is familiar with the full range of duties in his/her respective area. Therefore, each analyst serves as his/her own area supervisor. Under this particular circumstance, each analyst, in conjunction with the Assistant Lab Director and Lab Director, is able to organize his/her own time and schedule each analysis independently. As area supervisors, they are also responsible for: implementing data verification procedures, initially through method detection limit and initial demonstration of performance studies, and then daily through analysis and review of tuning standard criteria (for the GC/MS), continuing calibration check standards, method and, if necessary, reagent blanks, and other QC samples; preparing data packages for review by the QA/QC Officer; evaluation and documentation of instrument performance; and correcting problems which result in a decline in data quality.

The Data Coordinators are responsible for the generation of final result reports for review by the Lab Director or his/her designee; the filing and storage of chain-of-custody forms, hard copies of organic and inorganic analysis data, and hard copies of final result reports sent to the client; and distribution of signed off analytical reports to the client via facsimile, next day air or by mail.

The Extraction Supervisor is responsible for the supervision of the Extraction Technicians and, in conjunction with the Assistant Lab Director and Lab Director, scheduling of samples to be extracted, exclusive of radiological samples. Supervision of reagent preparation, cleaning of glassware, and monitoring of consumable supplies, as well as the maintenance of the QC plan for all sample extraction procedures, exclusive of radiological procedures, are also the responsibilities of the Extraction Supervisor.

The Wet Chemistry Supervisor is responsible for the supervision of the Wet Chemistry Technicians and, in conjunction with the Assistant Lab Director and Lab Director, the scheduling of sample analysis. Supervision of reagent preparation, cleaning of glassware, and monitoring of consumable supplies, as well as the maintenance of the QC plan for all wet chemistry procedures are also the responsibilities of the Wet Chemistry Supervisor.

The Samples Custodian is responsible for receiving the samples, excluding radiological samples, upon their arrival at the laboratory. Detailed responsibilities of the Sample Custodian are described in Section 3.0, Sample Custody.

2.3 Training of Laboratory Personnel

The training of personnel is covered in a separate SOP. This SOP includes guidelines that define the positions within the laboratory and the minimum required qualifications for each position. It also identifies the appropriate SOP's to be read and understood by the new employee as well as the hands-on procedures used in the laboratory during training. Certification of the trainee is provided through the analysis of laboratory quality control samples Initial Demonstration of Performance studies). The SOP outlines the documentation required to prove the employee was properly trained and the documentation required to show that current laboratory personnel are qualified for the position they hold. Figure 2-3 shows the Demonstration of Capability Certification Statement used to document employee training.

Figure 2-1

WASTE STREAM TECHNOLOGY INC.
ABBREVIATED ORGANIZATION CHART

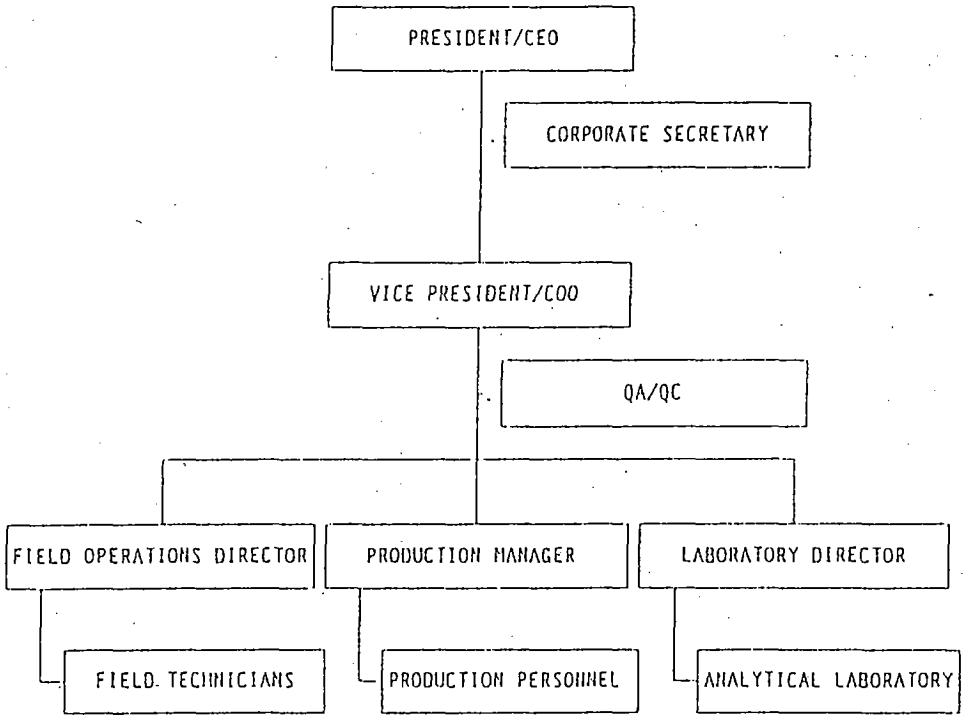


Figure 2-2

WASTE STREAM TECHNOLOGY INC.
ANALYTICAL LABORATORY
ORGANIZATION CHART

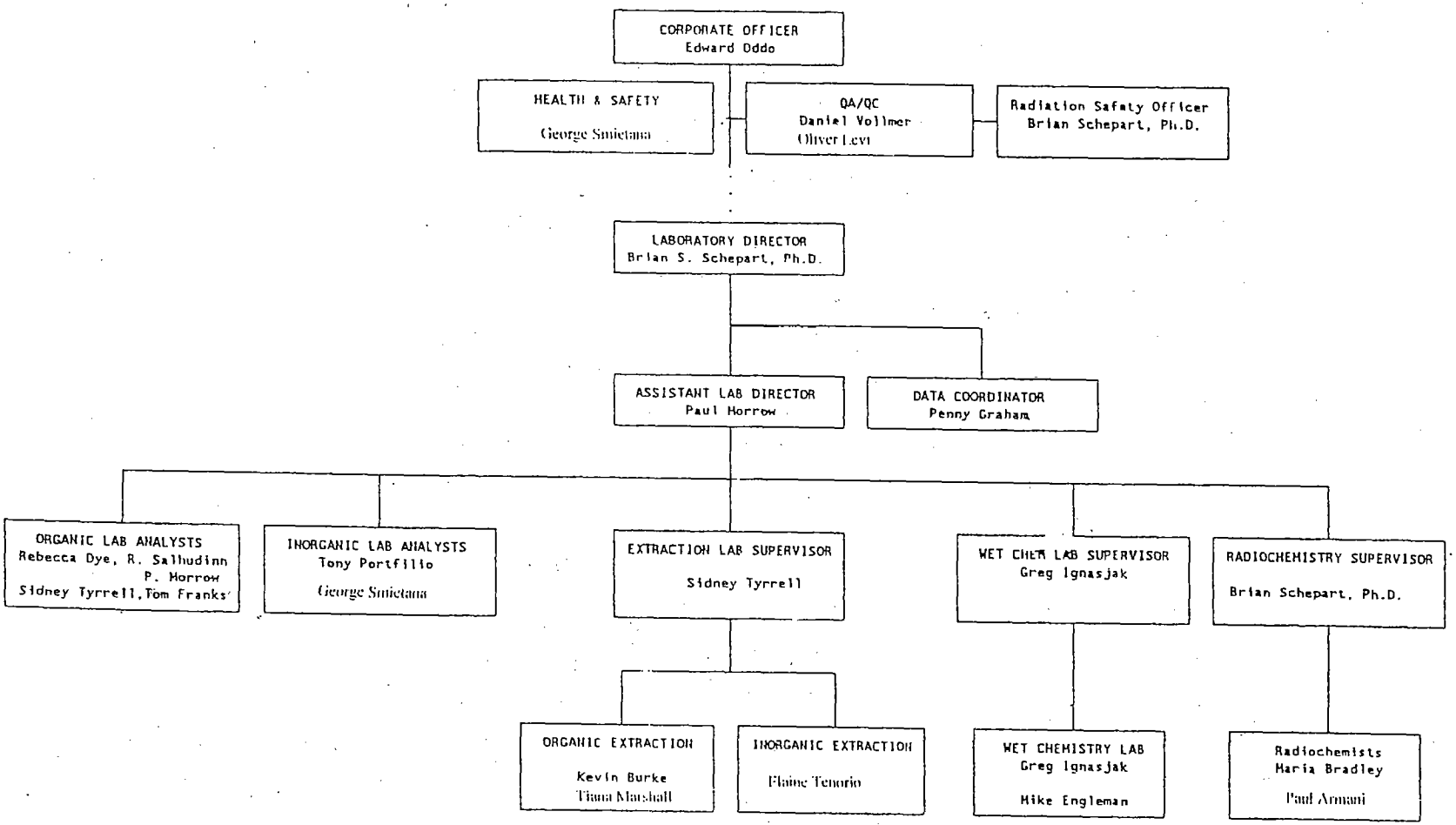


Figure 2-3

Demonstration of Capability
Certification Statement

Date: _____ Page__ of __

Analyst(s) Name(s): _____

Matrix: _____

Method/Analysis: _____

We, the undersigned, CERTIFY that:

1. The analysts identified above, using the cited test method, which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.

2. The test method was performed by the analyst(s) identified on this certification.

3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on-site, and the person identified in this form had read the following pertinent SOP and method reference:

   Name of SOP:_____ Date Read:_____

   Method Reference:_____ Date Read:_____

4. The data associated with the demonstration capability are true, accurate, complete and self-explanatory (1).

5. All raw data (including a copy of his certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized assessors.

_____	_____	_____
Technical Director's Name & Title	Signature	Date
_____	_____	_____
Quality Assurance Officer's Name	Signature	Date

This certification form must be completed each time a demonstration of capability is completed.

(1) Definitions

True:	Consistent with supporting data.
Accurate:	Based on good laboratory practices consistent with sound scientific principles/practices.
Complete:	Includes the results of all supporting performance testing.
Self-explanatory:	Data Properly labeled and stored so that the results are clear and require no additional explanation.

SAMPLE CUSTODY

It is essential that documentation is provided for all samples received at WST's laboratory which traces each sample, in a legally defensible manner, from sample collection, to the laboratory, and through the analytical procedures to disposal. Samples enter the WST analytical process in one of two ways; either from collection by WST Field Technicians or from collection by the client or agency other than WST. This section will address the chain of custody procedures used both outside and inside the laboratory. (Detailed procedures can be found in the Sample Custody SOP).

3.1 Field Collection by WST Field Personnel

When WST is contracted by a client to collect samples for analytic testing, and the types of analyses required are determined, the Sample Custodian will assemble the appropriate sample and shipping containers, and add the appropriate preservatives, if necessary. Table 3-1 lists the appropriate containers, preservatives, sample sizes, and holding times for the various analytical parameters tested by WST's laboratory. For all samples, the containers used will be new and pre-cleaned, from an approved vendor.

After the sample is collected, the Field Technician will label the sample containers with the following information: (A sample label is shown in Figure 3-5).

1. Site name and Client name
2. Location from where the sample was taken
3. Date and time of sampling
4. Whether the sample is a composite or a grab
5. Preservatives added, if appropriate
6. Name of the sampler

When all the appropriate samples have been taken and the sample containers have been properly labeled, the Sample Technician will complete a Chain of Custody Form (See Figure 3-1) by filling in all of the information listed in 1 through 6 above as well as the types of analyses to be performed. The samples will then be packed securely to prevent breakage and with cold packs when required to keep samples cold during shipment or delivery to the WST laboratory. The sampler will then sign the Chain of Custody (COC) Form and retain the pink copy for his/her records. The white, blue and yellow copies will accompany the samples throughout transportation. Each person handling the samples will sign the COC Form and record the time and date of transfer, both when receiving and relinquishing custody of the samples.

3.2 Collection from an Outside Agency

When a client or agency contacts WST to perform analytical testing, and the types of analyses to be performed are decided, the contact person at WST will fill out an Analytical Services Request Form (See Figure 3-2) and submit it to the Assistant Lab Director for review and scheduling. The Assistant Director will then forward the Request to the Sample Custodian to inform him/her of the samples impending arrival. If WST is to provide the sample containers, the WST contact person will also complete a Sample Container Request Form (See Figure 3-3) and submit it to the Sample Custodian. After comparing the Sample Container Request Form with the Analytical Services Request Form, the Sample Custodian will then collect the appropriate type and size containers, and, if required, add preservatives. The containers will then be securely packed into a cooler with a COC Form, and shipped to the location requested by the client. If requested, a trip blank and/or temperature blank will also be added to the cooler.

3.3 Sample Receipt

When non-radiological samples arrive at WST, custody is transferred to the lab via the Lab Custodian. Sample coolers or packages are taken to the Sample Control Room for receipt processing. When radiological samples (as identified by the client, originating location, labeling, or prior notification of Sample Receipt) arrive at WST, custody is transferred to the Radiochemistry Lab for receipt processing. Sample coolers or packages are taken to the Radiochemistry Lab for receipt processing

Non-radiological samples, arriving from a US Army Corps of Engineers remediation site, require a radiological survey of the package or cooler with a Geiger-Mueller radiation detector prior to opening and upon initial opening. The Sample Receipt Custodian will survey the package or cooler. If the level is 100 counts per minute above background as indicated by the meter or if the meter alarms a second time, the Custodian will

1. Notify the Radiochemistry Lab immediately
2. Proceed no further in handling the package or cooler.
3. Limit movement and contact with objects inside the Sample Control Room to limit the spread of contamination.
4. Secure access to Sample Control Room to minimize the spread of possible contamination.

Radiochemistry Lab supervision is responsible for surveying the Sample Control Room, the cooler or package, and any personnel in the Sample Control Room for release. If the material indicates

radioactivity above acceptable levels, it will be placed under the control of the Radiochemistry Lab. Evaluation of the radiological problem will be performed by the Radiochemistry Lab Manager (RLM). The client is to be immediately notified of the problem and the problem documented as prescribed by the RLM.

Radiological samples are surveyed in the Radiochemistry Lab within three hours of receipt to ensure that radiation and contamination levels are within acceptable limits of transport. The Radioactive Material Shipment Receipt Inspection Form (Figure 3-6) is completed to document the receipt of radiological samples.

Using the forms, Waste Stream Technology Inc. Sample Shipment Checklist (Figure 3-4) and US Army Corps of Engineers Sample Receipt Form (Figure 3-5), all sample shipments will be inspected for the following items.

1. Check the cooler/package for integrity, dents, crush points, soaked material. A damaged package can indicate possible damage to the samples within.
2. Look for a custody seal or tamper indicators on the cooler/package, identifying, if present, if the seal has been tampered with.
3. Open the sample cooler/package, and verify the Chain of Custody (COC) is present and in a sealed plastic bag. (Applicable for shipments not delivered by the client. When samples are personally delivered by the client, the client generally will hand deliver the COC).
4. Review the Chain of Custody to determine the quantity and types of samples sent.
    1. Review the sample analysis requirements for possible sample holding time and/or preservation requirements.
    2. Review the sample matrix for required temperature ranges.
5. Check and record the temperature inside the cooler as required dependent on the samples sent.
6. Check each sample for the following
    1. The sample container is not cracked, broken, corroded, or leaking.
    2. The sample, if liquid, is packed in a separate plastic bag containing absorbent material.
    3. Check the pH of samples requiring preservation. If the pH is low, the sample custodian is authorized to add preservative to a corrected pH value. The addition is to be recorded on the Sample Receipt Checklist.
    4. Observe samples sent for VOA analysis, checking for air bubbles.
    5. Note if sufficient sample quantity was sent.

6. Confirm the label on each sample corresponds to the information listed on the COC.
7. Complete the appropriate areas of the forms.

If an irregularity is noted during receipt inspection, the Sample Custodian is to immediately notify the QA/QC Manager for non-radiological samples, or the Radiochemistry Lab Manager for radiological samples. The QA/QC Manager, Laboratory Project Manager, or the Radiochemistry Lab Manager will contact the client and discuss the irregularity for resolution. The conversation time, date, and contacted person will be recorded on the Sample Shipment Checklist and US ACE Sample Receipt Form.

3.4 Custody in the Laboratory

After the samples are inventoried and the Sample Shipment Checklist is finalized, each sample is individually logged into the Master Log Book listing the following information:

1. A unique sequenced WST sample number assigned only to that sample;
2. Client name or name of agency representing the client;
3. Site name;
4. Client/Site Sample location or description;
5. Date received and date sampled;
6. Container size and number of containers;
7. Analytical tests to be performed;
8. Any comments/notes regarding the sample;
9. Sample group number; each group of samples received from a site will be assigned its own group number which is used to track the samples as a group;
10. Laboratory Information Management System (LIMS) login number;
11. Initials of the person logging in the samples (usually the Sample Custodian, or RSO).

The unique sample ID numbers are then recorded onto the label of each container associated with each of the samples. For aqueous samples, when multiple containers are received that are analysis specific due to a preservation requirement or volume requirement, each container is further designated by recording the appropriate analysis code on the container along with the sample ID number (e.g., WS77000-COD). The sample containers are then placed into a sample storage refrigerator or room temperature storage area until the time of analysis. Radiochemistry samples not requiring cooling are stored in the Radiochemistry Lab Sample Storage Area. The sequential WST sample ID numbers are also recorded on the COC adjacent to the corresponding client/site sample location or description. The sample group number is then recorded on the COC for tracking purposes. The Sample Shipment Checklist is then attached to the

white copy of the COC. NOTE: For radiochemistry samples, only personnel designated by the RSO are allowed to handle the samples. This includes sample inventory, labeling and storage. The Sample Custodian will only receive the COC for logging the samples into the LIMS database.

The Sample Custodian will then log the samples into the LIMS Labworks database. The following information is entered for each sample in the group:

1. The unique WST sample ID number assigned to the sample;
2. Date and time the sample was collected;
3. Date the sample was received (submitted);
4. Name of the client and the site;
5. The client/site sample description or location;
6. Date the analytical report is due;
7. Analyses required on the samples. Each analysis performed in the laboratory has a designated analysis code. The code for each analysis required on the sample will be assigned to the sample.
8. Date the analysis is due. For volatile organic compound analyses and wet chemistry analysis with short holding times, the analysis due date assigned will be the analysis expiration date.
9. Any comments/notes regarding the sample;
10. Date on which the sample will have exceeded its holding time, specifically for samples needing analyses that require a preparation step prior to analysis;
11. The sample group number.

When the sample log in is completed, the Labworks LIMS system will automatically assign the sample group a LIMS login number which will be recorded into the Master Login Book.

The COC and Sample Shipment Checklist are then submitted to the Data Coordinator for reporting and filing.

The Labworks LIMS system will be used to track the samples and all the data generated from the analytical tests performed on these samples throughout the analytical process. Each analytical section has access to the LIMS system and, on a daily basis, they generate a backlog report that shows them which samples require what analyses, when the results are due and when the sample holding time expires. The backlog report is then used by the technicians and/or analysts, in conjunction with the Extraction Lab Supervisor, Radiochemistry Analyst and/or RLM, and/or Assistant Lab Director to prioritize sample extraction and analysis.

When an analysis on a sample has been completed, the analyst will enter the results, either manually or by automatic computer file transfer, into the LIMS system under the appropriate analysis code for that sample. The data is then submitted to the QA/QC Department for review.

3.5 Sample Disposal

Unless specifically requested by the client, samples are usually held for 30 days after the issuance of the final report. The prospect of additional analyses on a sample must be viewed in the context of the recommended holding times.

Sample disposal occurs in one of two ways. The samples will either be sent back to the point of origination (i.e.,client or site) or eliminated as waste. Samples that are returned to the point of origin will be packed securely in a cooler. A list of the WST sample ID numbers contained within the cooler will be generated, signed and dated by the Sample Custodian or RLM. A photocopy of the signed and dated list will be placed in the cooler and the cooler shipped back to the site. The original copy will be placed into the Sample Custodian's or RLM=s disposal file. The date of return will be noted for each sample in the Sample Disposal Logbook

Samples which are eliminated as waste will be disposed of in appropriate, clearly labeled waste containers, based on the samples' matrix and the characteristics and properties of the waste. These characteristics and properties will be determined by a review of the analytical data and history of the samples. Care must be exercised in sample disposal so chemically incompatible wastes are not mixed together. Each disposal container is labeled to identify, in general terms, the type of material that was placed in each container. When disposal is complete, the person disposing of the containers will sign and date the drum labels. Samples that were found to be innocuous will be disposed of as either non-hazardous waste, or if aqueous, by pouring down the drain. When a sample is disposed the date of laboratory disposal will be recorded in the Sample Disposal Log Book.

3.6 Sample Security

In order to maintain the integrity and validity of the sample(s) within the laboratory, all samples are maintained under locked storage or in limited access areas under the jurisdiction of the Sample Custodian and/or Radiochemistry Lab Manager. Release of samples to laboratory personnel necessitates internal chain of custody procedures. Internal chain-of-custody is tracked by the Sample Custodian via a notebook. Entered into the notebook is WST sample ID number, the date and time the sample is

relinquished, the name of the person to whom the sample was given(responsible party), the date and time the sample is returned, and the Sample Custodian's initials. The responsible party is required to maintain the sample(s) in their physical possession or view at all times. The Sample Custodian, Assistant Lab Director, or QA/QC Officer may confiscate unattended samples, return them to storage, notify the appropriate supervisor, and reprimand the responsible party. Since radiological samples are stored in the Radiochemistry Lab Storage Area, they do not need to be logged in and out, but are required to be stored in the same designated area when not being manipulated or used.

CHAIN OF CUSTODY

WASTE STREAM TECHNOLOGY

Waste Stream Technology Inc.
302 Grote Street, Buffalo, NY 14207
(716) 876-5290 • FAX (716) 876-2412

OFFICE USE ONLY

GROUP # _____

DUE DATE _____

PAGE _____ OF _____

REPORT TO:

CONTACT

PH. # ( )

FAX # ( )

BILL TO:

PO#

PROJECT DESCRIPTION

SAMPLER SIGNATURE

DW DRINKING WATER
GW GROUND WATER
SW SURFACE WATER
WW WASTE WATER
O OIL
SL SLUDGE
SO SOIL
S SOLID
W WIPE
OTHER

TURN AROUND TIME: _____

QUOTATION NUMBER: _____

ARE SPECIAL DETECTION LIMITS REQUIRED:
YES NO
If yes please attach requirements.

Is a QC Package required:
YES NO
If yes please attach requirements

ANALYSES TO BE PERFORMED

SAMPLE I.D.	DATE SAMPLED	TIME OF SAMPLING	SAMPLE TYPE	TOTAL NO. OF CONTAINERS											TYPE OF CONTAINER/ COMMENTS:	OFFICE USE ONLY WST. I.D.
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																

REMARKS:

RELINQUISHED BY:	DATE: / /	TIME:	RECEIVED BY:	DATE: / /	TIME:
RELINQUISHED BY:	DATE: / /	TIME:	RECEIVED BY:	DATE: / /	TIME:

Figure 3-1

Figure 3-2

WASTE STREAM TECHNOLOGY

Waste Stream Technology Inc.
302 Grote Street
Buffalo, NY 14207

ANALYTICAL SERVICES REQUEST FORM

Request Taken By _____ Date Requested _____

Client _____ Telephone _____

Client Contact _____ Fax _____

Address _____

_____

Start Date _____ P.O. # _____

Lab/P.O. #	Number of Samples	Matrix	Analytical Parameters	Turnaround Time (Days)	Quoted Price

Sample Containers Required?

_____ NO _____ YES (Please Complete Sample Container Request Form)

Special Instructions _____

Laboratory Use Only: Sample Group # _____

Figure 3-3

WASTE STREAM TECHNOLOGY INC.
SAMPLE CONTAINER REQUEST FORM

Requested by: _____ Date requested: _____

Job number: _____

Shipping address: _____

_____

_____

Attention to: _____

Date needed by: _____

Amount	Type	Size	Preservation	Analytic Test	Expected Sampling date

Type: Glass or HDPE

WST received: _____
Date sent/initials: _____
Courier/Shipping No.: _____

Figure 3-4

WASTE STREAM TECHNOLOGY INC.
SAMPLE SHIPMENT CHECKLIST

Client: _____ Date Shipped: _____
Client Contact: _____ Date Received: _____
Telephone _____ Shipped Via: _____
Checked By: _____
Number of Shipping Containers(Coolers) _____

Container ID	Custody Tape Present ?	Custody Tape Intact ?	Temperature (C)	Number of Sample Containers	Agree with COC?

Sample Description: Matrix _____

Visual Observations _____

Preservation: pH 1 _____ 2 _____ 3 _____ 4 _____

Cyanide interferences: _____

QA/QC Volume requirements met? Yes No
if no, mark deficient analysis: 608 625 O&G BOD _____

Analysis Code Verification: _____ _____
Sample Custodian Secondary Reviewer

Irregularities:

Sample ID and Description	Irregularity

Checker Signature _____ Date _____

RESOLUTION OF IRREGULARITIES WITH CLIENT

Client Rep. _____ WST Rep. _____
Date/Time _____ Written Follow Up?/date _____
Decision _____

FIGURE 3-5

Army Corp. of Engineers Sample Receipt Form

'MS # _____ No. of Coolers _____

MRD Cooler # _____ Contract Cooler _____

PROJECT: _____ Date Received: _____

USE OTHER SIDE OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

A. PRELIMINARY EXAMINATION PHASE: Data cooler was opened:
by (sign): _____ (print): _____

1. Did cooler come with shipping slip (airbill ect): If yes enter carrier name & airbill number here: _____	YES	NO
2. Were custody seals on outside of cooler? How many, where, date, time: _____	YES	NO
3. Were custody seals unbroken and intact at the date and time of arrival?	YES	NO
4. Did you screen samples for radioactivity using a Geiger counter?	YES	NO
5. Were custody papers sealed in a plastic bag & taped inside to the lid?	YES	NO
6. Were custody papers filled out properly (ink, signed, ect)?	YES	NO
7. Did you sign the custody papers in the appropriate places?	YES	NO
8. Was project identifiable from the custody forms? If YES, enter project name at the top of this form.	YES	NO
9. If required, was enough ice used? Type:	YES	NO
10. Have designated person initial here to acknowledge receipt of cooler: _____ (date) _____		

B. LOG-IN PHASE: Date samples were logged-in:
by (sign): _____ (print): _____

11. Describe type of packing in cooler: _____

12. Were all bottles sealed in separate plastic bags?	YES	NO
13. Did all bottles arrive unbroken and were labels in good condition?	YES	NO
14. Were all labels complete(ID, date, time, signature, preservation)?	YES	NO
15. Did all bottle labels agree with custody papers?	YES	NO
16. Were correct containers used for the tests indicated?	YES	NO
17. Were correct preservatives added to samples?	YES	NO
18. Was a sufficient amount of sample sent for tests indicated?	YES	NO
19. Were bubbles absent in VOA samples? If NO, list by sample #:	YES	NO
20. Was the project manager called and status discussed? If YES, give details on the back of this form.	YES	NO

21. Who was called? _____ Date: _____

By whom? _____

WASTE STREAM TECHNOLOGY

Radioactive Material Shipment Receipt Inspection Form

Receipt	Print Name	Initial	Date Time	Reviewed & Approved
Shipper Site and Sender Name				
Shipping Papers Carrier, Method, and ID	Carrier	Method	ID	
Label on Package		Isotope(s) and Activity		
Inspection Outer	Acceptable	Yes	No	Damage Noted
Type of Package Identify type used		Type of Packaging Identify materials used		
Inspection Inner	Acceptable	Yes	No	Damage Noted

Contents (Number per Matrix)	SO	AF	BA	GW	DW	S	Other

Radiation Survey
Survey to be done within 3 hrs of receipt

Survey meter	E600	E600	ASP2		XLB5	GA/GB- STF and Batch No.	
Serial No.	1698	1699	0526				
Calibration √ OK							
Daily √ OK							

Shipment and Packing Materials Survey Results
Attach Survey Map and/or Activity Report as needed

Record Actual Reading OR α <220, βγ <1000, <0.05mR		Outer Shipping Package Survey Results Record the highest reading. ANY result above stated limits requires documentation with a survey map.				Inner Shipping Package Survey Results Record the highest reading. ANY result above stated limits requires documentation with a survey map. Highest Readings off ANY ONE inner Package			
Results	BKGD.	@ 1 m	TOP	SIDE	BOTTOM	Results	TOP	SIDE	BOTTOM
mR/hr						mR/hr			
$\frac{\text{dpm } \alpha}{100\text{cm}^2}$						$\frac{\text{dpm } \alpha}{100\text{cm}^2}$			
$\frac{\text{dpm } \beta\gamma}{100\text{cm}^2}$						$\frac{\text{dpm } \beta\gamma}{100\text{cm}^2}$			

Material	mR/hr	$\frac{\text{dpm } \alpha}{100\text{cm}^2}$	$\frac{\text{dpm } \beta\gamma}{100\text{cm}^2}$	Disposition
Package Container				
Plastic Bag (COC bag)				
Packing Material				

Notifications

CRITERIA:	IF Yes to ANY notification CRITERIA,
Radiation level @ 1 meter ≥10 mRem/hr Radiation level on contact ≥ 200 mRem/hr Removable Alpha/Uranium series contamination ≥ 220 dpm /100 cm^2 Removable Beta/Gamma contamination ≥ 2200 dpm /100 cm^2	THEN Contact NYSDOL RHU – (518) 457-1202 and as directed US DOT (800) 424-8802 Contact appropriate Carrier FedEx (800/ 463-3339) UPS (800/744-7877)]
CRITERIA: Radiation or contamination levels exceed DOT labeling requirements.	IF Yes to ANY notification CRITERIA, THEN Contact Site Shipping Coordinator

Notification Required	Y / N	Notification By	Contact Person /Organization / Date and Time
Remarks			

Table 3-1.1

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Vol. Req. (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
100 Physical Properties				
Color	50	P,G	Cool, 4°C	48 Hrs.
Conductance	100	P,G	Cool, 4°C	28 Days
Hardness	100	P,G	HNO_3 to pH < 2	6 Mos.
Odor	200	G only	Cool, 4°C	24 Hrs.
pH	25	P,G	None Req.	Analyze Immediately
Residue				
Filterable	100	P,G	Cool, 4°C	7 Days
Non-Filterable	100	P,G	Cool, 4°C	7 Days
Total	100	P,G	Cool, 4°C	7 Days
Volatile	100	P,G	Cool, 4°C	7 Days
Settleable Matter	1000	P,G	Cool, 4°C	48 Hrs.
Temperature	1000	P,G	None Req.	Analyze Immediately
Turbidity	100	P,G	Cool, 4°C	48 Hrs.
200 Metals				
Dissolved	200	P,G	Filter on site HNO_3 to pH < 2	6 Mos.
Suspended	200		Filter on site	6 Mos.[6]
Total	100	P,G	HNO_3 to pH < 2	6 Mos.

Table 3-1.2

Measurement	Vol. Req. (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
Chromium+6	200	P,G	Cool, 4°C	24 Hrs.
Mercury				
Dissolved	100	P,G	Filter HNO_3 to pH < 2	28 Days
Total	100	P,G	HNO_3 to pH < 2	28 Days
300 Inorganics, Non-Metallics				
Acidity	100	P,G	Cool, 4°C	14 Days
Alkalinity	100	P,G	Cool, 4°C	14 Days
Bromide	100	P,G	None Req.	28 Days
Chloride	50	P,G	None Req.	28 Days
Chlorine	200	P,G	None Req.	Analyze Immediately
Cyanides	500	P,G	Cool, 4°C NaOH to pH >12 0.6g ascorbic acid[6]	14 Days[7]
Fluoride	300	P,G	None Req.	28 Days
Iodide	100	P,G	Cool, 4°C	24 Hrs.
Nitrogen				
Ammonia	400	P,G	Cool,4°C H_2SO_4 to pH < 2	28 Days
Kjeldahl, Total	500	P,G	Cool, 4°C H_2SO_4 to pH < 2	28 Days
Nitrate plus Nitrite	100	P,G	Cool, 4°C H_2SO_4 to pH < 2	28 Days
Nitrate[9]	100	P,G	Cool, 4°C	48 Hrs.
Nitrite	50	P,G	Cool, 4°C	48 Hrs.

Table 3-1.3

Measurement	Vol. Req. (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
Dissolved Oxygen				
Probe	300	G bottle and top	None Req.	Analyze Immediately
Winkler	300	G bottle and top	Fix on site and store in dark	8 Hours
Phosphorus				
Ortho-phosphate, Dissolved	50	P,G	Filter on site Cool, 4°C	48 Hrs.
Hydrolyzable	50	P,G	Cool, 4°C H_2SO_4 to pH < 2	28 Days
Total	50	P,G	Cool, 4°C H_2SO_4 to pH < 2	28 Days
Total, Dissolved	50	P,G	Filter on site Cool, 4°C H_2SO_4 to pH < 2	24 Hrs.
Silica	50	P only	Cool, 4°C	28 Days
Sulfate	50	P,G	Cool, 4°C	28 Days
Sulfide	500	P,G	Cool, 4°C add 2 ml zinc acetate plus NaOH to pH >9	7 Days
Sulfite	50	P,G	None Req.	Analyze Immediately
400 Organics				
BOD	1000	P,G	Cool, 4°C	48 Hrs.
COD	50	P,G	Cool, 4°C H_2SO_4 to pH < 2	28 Days
Oil & Grease	1000	G only	Cool, 4°C H_2SO_4 to pH < 2	28 Days
Organic carbon	25	P,G	Cool, 4°C H_2SO_4 or HCl to pH < 2	28 Days
Phenolics	500	G only	Cool, 4°C H_2SO_4 to pH <2	28 Days

Table 3-1

SAMPLE CONTAINERS / PRESERVATIVES / HOLDING TIMES FOR WATER & SOLID / WASTE SAMPLES

ANALYSIS	SAMPLE VOLUME/CONTAINER	HOLDING TIME	PRESERVATIVE
VOCs			
water	2, 40 mL GT	14 days (d) to Analysis	Cool 4° C. Aqueous samples for Aromatic compounds, HCl to pH < 2. Aqueous samples for 524.2, 0.25mg ascorbic acid, then HCl to pH < 2.
soil	2, 2 oz GT or 2, 5g Encore Sampler	14 d, 48 hours for Encore transfers	
soil	2, 5g in 40 mL w/Sodium Bisulfate*	14 d to Analysis	
TCLP	2, 4 oz GT	14 d to TCLP Extraction; 14 d to Analysis	
SVOCs			
water	1, 1 L AG	7d Extraction; 40d to Analysis	Cool 4° C. (10% thiosulfate for water samples with residual cholrine)
soil	1, 8 oz G	14d Extaction; 40d to Analysis	
TCLP	1, 16 oz G	14d to TCLP; 7d to prep Extraction; 40d to Analysis	
Metals			
water	1, 500 mL P	180d to Extraction	Cool 4° C. (HNO_3 pH < 2 for Aqueous)
soil	1, 16 oz P,G	180d to Extraction	
TCLP	1, 16 oz P,G	180d to Extraction; 180d to Analysis	
Mercury - Water	1, 500 mL P,G	28d to Analysis	Cool 4° C. (HNO_3 pH < 2 for Aqueous)
Mercury - Soil	1, 16 oz P,G	28d to Analysis	
Mercury - TCLP		28d to Extraction; 28d to Analysis	
Chromium VI - Water	500 mL P	24 hours	Cool 4° C.
Chromium VI - Soil	1, 16 oz P,G	14d to Alkaline Digestion, 24 hours to Anal	
PCBs			
water	1, 1 L AG	7d to Extraction; 40d to Analysis	Cool 4° C (water & soil only)
soil; oil; wipes	1, 8 oz G; 1, 1oz; 1, wipe	14d to Extraction; 40d to Analysis	
Pesticides			
water	1, 1 L AG	7d Extraction; 40d Anal	Cool 4° C. pH 5-9, (0.008% $Na_2S_2O_3$ for Aqueous samples with residual chlorine)
soil	1, 8 oz G	14d Extraction; 40d Anal	
TCLP	1, 16 oz G	14d TCLP; 7d prep Extraction; 40d to Anal	
Herbicides			
water	1, 1 L AG	7d Extraction; 40d Anal	Cool 4° C. (0.008% $Na_2S_2O_3$ for Aqueous samples with residual chlorine)
soil	1, 8 oz G	14d Extraction; 40d Anal	
TCLP	1, 16 oz G	14 TCLP; 7d prep Extraction; 40d to Anal	
RCRA Char			
Ignitability	1, 16 oz P,G	7 d	Cool 4° C.
Corrosivity, pH	1, 16 oz P,G	14 d	
Reactivity	1, 8 oz P,G	7 d	

G = Clear Glass; AG = Amber Glass; P = Plastic; T = Teflon Lined Lid/SEPTA

*For soil VOCs collected in Encore samplers or preserved vials, two additional 2 oz jars should be collected for dry weight determination and in case the sample requires methanol extraction.

ANALYTICAL PROCEDURES

4.1 Statement of Procedures

All analyses performed at Waste Stream Technology Inc. are approved methods taken from the following sources: (A complete listing of reference methods is found in Table 4-4).

EPA-600/4-79-020, "Method for Chemical Analyses of Water and Wastes", Revised March 1983.

Federal Register, EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act", Revised July, 1991.

Federal Register, EPA 40 CFR Part 268, Appendix I, Revised June 1990.

EPA SW-846, "Test Methods for Evaluating Solid Wastes", 3rd Edition, through Update III, December, 1996.

Standard Methods for the Examination of Water and Wastewater, 20th edition.

HASL-300, 28th Edition, Feb. 97, Environmental Measurements Laboratory, US Department of Energy

Radiochemical Analytical Procedures for Analysis of Environmental Samples, EMSL LV053917, Mar. 97, Environmental Monitoring and Support Laboratory, US Environmental Protection Agency

Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600 4-80-032, Aug. 80, Environmental Monitoring and Support Laboratory, US Environmental Protection Agency

Radiochemistry Procedures Manual, EPA 520/5-84-006, Jun. 84, Eastern Environmental Radiation Facility, US Environmental Protection Agency

Appendix 5 contains copies of the certifications currently held by the laboratory along with the list of methods under which the laboratory performs its accredited testing.

4.2 Quality Assurance Objectives

The objective of the Quality Assurance and Quality Control plan at the WST laboratory is to generate analytical data of known, documented quality that is in compliance with established regulatory guidelines and protocols. This is accomplished through

a system of statistical measurement and documentation of accuracy, precision, and comparability of each analytical assay performed. These three parameters are established through a Quality Control (QC) program, a system of operations undertaken in the laboratory to ensure that the data produced is generated within known probability limits of accuracy and precision, and a Quality Assurance (QA) program, a system whereby the laboratory can assure clients, government agencies, and accrediting bodies, that the laboratory is generating data of proven and known quality. The latter system is accomplished through the QC program, by the analysis of external quality control and proficiency test samples, through the use of accepted analytical testing procedures and through external laboratory audits.

4.2.1 Accuracy

By definition, accuracy measures the ability of an analytical procedure to determine the true concentration of one or more constituents in a sample matrix. Initially, accuracy is determined by the analysis of a minimum of four laboratory control samples, blank samples which have been spiked with a known concentration of a reference standard. This standard contains all the analytes appropriate to the analytical procedure and will be prepared from a source which is independent from the source used to prepare the calibration standards. The four laboratory control samples are taken through each step of the entire analytical procedure. The spiked analytes are then recovered during analysis and the mean and standard deviation of the four recoveries for each analyte are calculated and compared to the accuracy limits published in the associated U.S. Environmental Protection Agency (EPA) method.

When the accuracy of the recoveries of each constituent of the analytical procedure have met the EPA criteria, accuracy will continue to be assessed by the analysis of one laboratory control sample for every ten samples analyzed. When a total of twenty laboratory control samples have been analyzed, the mean (X) and standard deviation (SD) of the percent recoveries of each analyte will be calculated and the upper and lower warning and control limits determined by:

$$\text{Upper Warning Limit} = X + 2SD$$
$$\text{Upper Control Limit} = X + 3SD$$

$$\text{Lower Warning Limit} = X - 2SD$$
$$\text{Lower Control Limit} = X - 3SD$$

All subsequent laboratory control sample analyses of will then be compared to the upper and lower control limits to track the accuracy of the procedure (See Figure 4-1 for Accuracy Control Chart).

4.2.2 Precision

By definition, precision is a measure of the ability of an analytical procedure to reproduce data. Precision differs from accuracy in that an analytical procedure can generate reproducible data yet still be inaccurate. Therefore, both accuracy and precision need to be assessed as singular entities. The precision of a procedure is determined by comparison of results from duplicate sample analyses (or matrix spike and matrix spike duplicate sample analyses). One sample per every ten samples (or for MS and MSD samples one per twenty) will be analyzed in duplicate and the relative percent difference (RPD) from the duplicate analyses will be calculated for each analyte measured by the procedure. When twenty RPD's for each analyte have been calculated, the mean of the twenty RPD's will be used to develop the precision limits for each analyte. The precision warning and control limits are calculated using the average RPD times 2.456 and 3.270, respectively. Subsequent duplicate analyses will then be assessed for acceptability based on these precision warning and control limits. (Figure 4-2; Precision Control Chart).

It should be noted that accuracy and precision are determined using the entire analytical procedure including extraction of the analytes from the sample matrix. Many methods use the same mode of analysis but have multiple extraction procedures depending on the matrix and/or the concentration of the analytes expected to be found in the matrix. In these cases, accuracy and precision must be established for each type of extraction procedure.

4.2.3 Comparability

Analytical results of the tests on a given compound must be comparable to test results performed by a different laboratory on like compounds. To obtain this goal, precision and accuracy of each analytical procedure must be compared to and fall within the acceptable limits prescribed by the EPA in their methodologies and protocols.

Comparability is also accomplished through that analysis of external QC samples and proficiency test samples, since the results from the analyses of these samples are assessed through inter-laboratory comparison.

4.2.4 Completeness

Completeness is a measure of the amount of data obtained from an analytical system compared to the total amount expected to be obtained under normal conditions. A ninety-five percent completeness figure is usually required for a particular analysis and overall project objective.

4.2.5 Reagents, Solvents, Water Glassware, and Gases

All reagents used within the laboratory for sample and standard preparation meet the American Chemical Society (analytical reagent grade) standards or better, if the procedure requires a higher grade of purity. Solvents used for sample extraction and standard preparation are of gas chromatographic quality. All chemicals, when received by the laboratory, will be labeled with the date of receipt, the date the container was opened and the initials of who opened it. A chemical logbook is maintained which lists the reagent, source, lot number, and date in service.

Reagents, when prepared, will be labeled as to the date of preparation and expiration, the composition and concentration of the reagent, the reagent ID number and the initials of the preparer. This information will also be recorded in a reagent preparation notebook. In addition to analyzing reagent and method blanks to check for reagent and solvent contamination, reagents and solvents are continuously observed for signs of degradation such as change of color, precipitation, or mold formation.

All water used in the laboratory for preparation of reagents and rinsing of glassware is ASTM Type II water. This is produced by passing tap water through two mixed bed deionization tanks and then passing the deionized water upward through a high capacity activated carbon filter. In addition, 18 megaohm water is produced through a Milli-Q high purity water system. The conductivity of this system is measured and recorded daily.

Disposable glassware will be used whenever possible within an analytical procedure to reduce the possibility of sample cross-contamination. When non-disposable glassware is used, it will be thoroughly cleaned and baked using a cleaning protocol established by WST (refer to WST Standard Operating Procedure M-CLEAN-01-XX).

Gases which are used in sample concentration and gas chromatography analyses are of high and ultrahigh purity and they are further purified by the use of in-line gas filtration units.

4.3 Quality Assurance and Quality Control

4.3.1 Standard Preparation

Every assay will require, at a minimum, a calibration standard or a quality control check standard. Other analyses will require initial calibration, continuing calibration and laboratory control sample standards, and still others will also require matrix spike, surrogate and internal standards.

A calibration standard is made by the appropriate dilution of a pure substance, the purity of which is traceable to a primary standard. Because of the high sensitivity of many analytical instruments, the calibration standard is an extremely dilute version of the pure compound. Because of the high dilution required, in order to be within the linear range of the instrument, the preparation of the calibration standard is frequently made by serial dilution rather than in a single step. In order to provide standard solutions at sufficiently low concentrations, a minuscule amount of the pure substance will be required, the measurement of which is subject to extreme error. Thus, it is preferable to deal with dilution errors, rather than with the large error associated with the measurement of a small amount of pure substance.

The initial pure standard is usually obtained as either a pure material or already in solution prepared as a certified solution of a given concentration of the pure compound or compounds. In preparing stock solutions and working solutions of the calibration standard, great care must be exercised in measuring weights and volumes as accurately as possible, since all analyses following the calibration will be based on the accuracy of the calibration, and the accuracy of any subsequent data ultimately cannot be any better than that of the calibration curve.

Each standard also has a definite lifetime in which it can be used. Standard holding times are listed in Table 4-1 and it is the responsibility of the analyst to assure that all standards used are within the standard solution holding time. It should be noted, however, that the holding times for stock standard solutions should only be used as a guide and that in preparing or using working standard solutions, the analyst must compare each standard run with the previous standard runs to assure that response factors fall within the historically accepted range.

For each standard solution that is prepared, accurate records will be kept in the standard preparation log for the analysis in which the standard will be used so that traceability can be maintained. The following information will be entered in

the log, and on the Standard storage container, at the time of stock standard preparation:

1. Date of preparation
2. Date of expiration (See holding time guide)
3. For each compound or solution of compounds, the supplier and the lot number of the primary standard, the ID number of the primary standard and the amount taken in the case of pre-prepared standard solutions
4. The solvent identification (compound, supplier, lot number)
5. Final volume of the stock standard
6. Identification number assigned to the newly prepared stock standard
7. Name of the analyst preparing the standard.

When preparing Secondary Stock solutions (e.g., calibration, continuing calibration, matrix spike, and surrogate standards) it will be the analyst's responsibility to make sure the Primary Stock solution is still viable. The preparation of these standards will also be documented in the Standard Preparation Log. The following information will be recorded:

1. Date of preparation
2. Date of expiration
3. Standard identification number of the primary or secondary stock standard used to prepare the working standard
4. Final volume of the diluted standard
5. Volume, lot# and manufacturer of solvent used to prepare the diluted standard
6. Final concentration of each compound in the diluted standard
7. Identification number assigned to the newly prepared diluted standard
8. Name of the analyst preparing the standard.

All standards and standard solutions will be maintained in appropriate containers as stated in the method SOP.

Storage of standards and standard solutions will typically be kept in the refrigerator at 4EC, or freezer at -10EC, however specific storage details will be listed in the SOP for the analysis in which the standard is to be used (e.g. standards for metal analysis, including radioisotopes, are stored at room temperature). Standards and standard solutions will also be stored in an area not used for storage of samples and sample extracts to prevent any possibility of cross-contamination.

4.3.2 Determination of Detection and Quantitation Limits

Most of the assays employed by WST require knowledge of detection limits in order to be able to bracket analytical results that are obtained. Several such limits exist, and since these limits can be defined in various ways, the definition and determination which we will use is given below.

4.3.2.1 Instrument Detection Limit

In simple terms, the instrument detection limit (IDL) is the smallest quantity of material the instrument can reliably detect. The manner in which the IDL is determined is instrument dependent. For GC and GC/MS analyses, the IDL is determined by the analysis of seven replicate standards at a concentration of 3 times to 5 times a concentration that yields a definitive, measurable signal. The IDL is calculated by multiplying by 3, the standard deviation obtained from the seven replicate measurements.

For ICP analysis, the IDL is the concentration equivalent to the analyte signal which is equal to 3 times the standard deviation of a series of ten replicate measurements of the calibration blank signal at the same wavelength.

For radiochemical parameters, detection limits will be determined according to EPA Method 600/4-80-032 (NIPDWR). Detection limits may also be conducted according to the Nuclear Regulatory Commission (NRC) Method 4.14 or American National Standard Institute (ANSI) 13.30.

The calculation for standard deviation is shown below:

$$SD = \text{Square Root of } \frac{\Sigma\,[x\,(i) - X\,(m)]^2}{(n-1)}$$

where, $x\,(i)$ = The value of the i'th reading of the set of replicate measurements

$X\,(m)$ = The mean value of the replicates

n = The number of replicate measurements

The mean, $X\,(m)$, is determined as follows:

$$X\,(m) = \frac{\Sigma\,x\,(i)}{n}$$

In order for the results to be useful, the standard chosen to obtain the detection limit should be such that the mean of its reading, X (m), is slightly greater than 3SD. This may require some trial and error initially when an IDL is determined for the first time on an instrument.

Although the determination of IDLs in not a requirement, IDL determinations may be desirable when the instrument is initially set up for analysis or if the instrument has undergone extensive maintenance. Records of performing the IDL will be maintained in the analysis notebook.

4.3.2.2 Method Detection Limit

The method detection limit is obtained in a manner very similar to that of the IDL. The principle difference is that in determining the method detection limit (MDL), the analyte(s) is subjected to the entire analytical protocol for the specific method that is being employed. This includes every step, from extraction to final analysis.

To determine the MDL, seven replicates of the appropriate volume of Type II water or, for soils, a clean solid matrix are spiked with a known amount of the analyte(s). The amount that is being added is the same for all seven replicates, and should be at least one to five times the estimated MDL for reagent water matrix and one to ten times the estimated MDL for clean solid sample matrices. The seven replicates are subject to the same extraction and analytical procedures as a sample would be, and the concentrations of the analytes of interest are measured. The MDL is defined as the standard deviation of seven readings multiplied by the student t-test at a 99%, single-sided confidence interval (t99) using n-1 degrees of freedom (df). The calculation of the MDL should be done using the same units as would be reported for a sample.

The equation that applies to the calculation of the MDL is:

MDL = SD (t99[1-sided];df=6); or SD x 3.143

where;

MDL = Method detection limit, in units of weight/ volume or weight/weight (i.e.,µg/L or µg/kg). Refer to 40 CFR, Part 136, Appendix B.

SD = The standard deviation of the seven readings from the mean, in units of weight or concentration

The MDL determination will be considered acceptable as long

as it falls within the range calculated as follows:

MDL = [S]/5 to [S] for reagent water or

MDL = [S]/10 to [S] for clean solid matrices

where,

[S] = average found for the replicate measurements.

The method detection limit will be determined for all analytes associated with the method prior to the analyses of samples by the method. The MDLs will then be verified on a quarterly basis through the analysis of a 2 time MDL check sample. This sample is taken through the same process as the initial MDL samples. If the analytes in the 2 times MDL check sample are detected, the MDLs are considered verified. The MDL study will need to be repeated if the analytes in the 2 times MDL check sample are not detected. A 2 times MDL check sample should also be analyzed immediately after an instrument undergoes a major repair or modification. If the analytes in the 2 times MDL check sample are detected, there is no need to perform a new MDL study.

However, if the sample preparation or extraction method is modified, the method detection limits must be determined through a complete MDL study.

4.3.2.3 Method Quantitation Limits

The method quantitation limit is determined at the same time as the MDL and from the same runs. The method quantitation limit(MQL) is defined as three to five times the MDL for water matrices or five to ten times the MDL for solid matrices. Thus,

MQL = 3-5 x MDL or 5-10 x MDL

Typically, however, the MQL is equal to the concentration of the lowest initial calibration standard.

4.3.2.4 Documentation of Detection Limits

Whenever IDLs, and MDLs are determined, the results will be maintained by the analyst based on the method used for determining the analytes of interest. The detection limit spreadsheet must include the analysis and preparation method references, the name of the associated laboratory SOP, preparation and analysis dates, the applicable matrix, the concentration used for the MDL study, the type of detection limit (IDL or MDL), the result obtained for each analyte in terms of

concentration units for each of the seven MDL samples, the average, standard deviation, and calculated MDL, the student t value used, and the name of the analyst who performed the determination.

A copy of all detection limit determinations will also be submitted to the QA/QC Department for review and approval.

4.3.2.5 Minimum Detectable Activity (Radiochemistry Analyses)

Minimum Detectable Activity (MDA) is the lowest amount of activity/specific activity within a given confidence level that can be assuredly measured by the counting system based on the parameters of background count rate, sample count rate, length of counting time, chemical yield, and mass of the sample. The applied MDA for each analysis is set at 10% of the action level of the analysis at a minimum. This is an internally applied level. Guidelines from the US DOE and US NRC set MDA at a range of 10% to 50% of determined measurement objectives. Essentially, the longer the counting time the lower the MDA, with diminishing returns. As deemed necessary the client, after discussion with the RLM, may set the MDA applied.

The operating programs of the counting systems employed perform the required calculation of the MDA. The technician/analyst enters the sample size (mass). Yield is applied as detected from the pre-identified Region of Interest for an internal tracer for Thorium and Uranium analyses. Yield is applied to the MDA by spreadsheet calculation for Ra226/228. The applied MDA conforms to the general guidelines set by the Nuclear Regulatory Commission (US NRC). In gamma spectrometry analyses, compensation is made for moisture content, soil density, and Z-number of soil samples.

4.3.3 Instrument Calibration

Instrument and equipment calibration must be rigorously and routinely performed in order to provide reasonable assurances that the data generated is valid and acceptable.

Three principle types of calibration are performed. The first is initial calibration, which determines the linear range of the instrument and its response factor. The second is initial calibration verification which verifies the initial calibration response factors through the analysis of a standard prepared from an independent source. The third is continuing calibration, which serves, during the course of running samples, to ascertain that the instrument calibration has not drifted unacceptably. The frequencies of performing the initial and continuing calibrations

are listed in Table 4-2. The calibration verification only needs to be performed after an initial calibration is performed. In addition, laboratory control samples, or reference samples, are run on a routine basis for additional verification as indicated in Table 4-5.

4.3.3.1 Initial Calibration

All instrumental methods of analysis are subjected to an initial calibration, consisting of the measurement a minimum of 5 different standard solutions of the analytes of interest. The standard solution of the lowest concentration should have a concentration of the analytes of interest at 3 to 5 times the concentration that corresponds to the MDL; and the standard solution of the highest concentration should have a concentration of the analytes of interest at or near the upper end of the linear range of the detector.

In performing the analyses of standards to determine the response factor and linear range, the standard solutions are prepared as mentioned in Section 4.3.1, and the surrogates and internal standards are added to them when appropriate. This information must be documented in the analysis records and placed in the method file for future reference. Listed should be working standard ID numbers used for calibration, the date the calibration was performed, and the name of the analyst performing the calibration.

When the standard analyses are completed, the calibration curve of each analyte is generated either one of two ways. For GC/MS analyses, the response factor (RF) for each calibration level is determined as follows;

$$RF = (A_x C_{is}) / (A_{is} C_x)$$

where:
A_x = area of compound being measured
A_{is} = area of specific internal standard
C_x = concentration of compound being measured
C_{is} = concentration of specific internal standard

The average response factor (RF_{avg}) and the standard deviation of the response factors is then calculated and the percent relative standard deviation (%RSD) is determined by:

$$\%RSD = \frac{SD}{RF_{avg}} \times 100$$

If the %RSD falls within the criteria specified in the method, then the curve is considered linear and the average response factor can be used to quantitate results.

All other instrument calibration curves are generated using a straight line linear regression equation in the form: $y = mx + b$ (or, for ICP of graphite furnace analyses, $y = ax$, and the line is forced through zero), where y = the measured response (area units, absorbance etc.); x = the known concentration of analyte; m = the slope of the curve, and b = the y intercept.

In addition to determining the values of m and b, the correlation coefficient is determined as a measure of how closely the five points are to a straight line. The correlation coefficient is determined by the equation:

$$r = \frac{n \Sigma (x\,y) - \Sigma (x)\, \Sigma (y)}{\text{Sq. Root } [n \Sigma x^2 - (\Sigma x)^2]\ [n \Sigma y^2 - (\Sigma y^2)]}$$

where, r = Correlation coefficient, x = The known amount of analyte, y = The measured response, and n = The number of standards run to obtain the calibration curve.

In order for the curve to be valid, r must be 0.995 or higher, and the absolute ratio b/m should be no greater than the method detection limit. If r is <0.995 it usually implies that either the lowest or highest concentration of standard is outside the linear range. To correct this, the analyst should rerun the highest standard and also another high standard which has a slightly lower concentration than the initially used high standard. Then r can be calculated again using the response from the lower of the two standards. Similarly, the effect of slightly increasing the concentration of the lowest standard should be examined. However, this concentration should still be within 3 to 5 times the determined MDL.

If the ratio b/m criterion is not met, the problem may be with contamination in the system, a change in linear range or a change in noise level of the instrument. The system should be checked for contamination through the analysis of reagent or method blanks. The linear range can be checked by dropping the highest calibration standard, performing the linear regression and re-calculating the b/m ratio. If noise level of the instrument has in fact changed, instrument maintenance may be required to correct the problem.

Certifiable standards are used in the preparation of solutions for calibration as much as possible. However, it is always possible that the manufacturer made a mistake. To circumvent this possibility of error due to a mistake in the manufactured primary standard, a calibration verification check standard or quality control (QC) check standard will be analyzed whenever an initial calibration curve is constructed. The QC

check standard will contain all of the analytes of interest, and at a known concentration, but will be prepared using a different source than the calibration standards. When the analyte concentrations in the check standard are calculated, they should meet the continuing calibration criteria set forth by the method(e.g. GC within 15%, GC/MS within 20%, and ICP within 10% of the known concentration). If the criteria is not met, a determination of the source of inaccuracy will be performed.

After the calibration curve has been validated, a dated and initialized hard copy of the calibration table listing the response factors for each calibration level, the average response factor, the SD, and the %RSD for each analyte is placed in the method file for future reference. If the curve was generated using linear regression then a hard copy of the curve listing the x values used, the corresponding y values generated, the slope and intercept of the curve and the correlation coefficient for each analyte will be placed in the analysis file for future reference.

4.3.3.2 Continuing Calibration

Continuing calibrations serve to ensure that the instrument, during the course of running samples, is remaining sufficiently stable so the response factor calculated in the initial calibration remains valid

In performing a continuing calibration, a midrange standard containing the all of the analytes of interest, and internal and surrogate compounds, if applicable, is analyzed. For GC/MS analysis, the response factor for each analyte is determined from the continuing calibration analysis (Some methods specify that the RFs be determined for specific continuing calibration check compounds). The percent difference (%D) of the continuing calibration response factor from the average response factor of the calibration curve is then calculated by:

$$\%D = \frac{(RF_{avg} - RF_{ccc}) \times 100}{RF_{avg}}$$

If the percent differences from the continuing calibration analysis are within the acceptable criteria, as specified in the method, the instrument is considered to be within calibration, and analysis may continue using the curve. If the response factor is determined to be outside the acceptance range, the instrument must be recalibrated by using the initial calibration process. Samples that have been analyzed since the last acceptable calibration will also need to be reanalyzed after the instrument has been recalibrated. Generally, the acceptable criteria for

GC/MS is between 20% to 30%.

For linear regression curves, the concentration of each analyte in the midrange standard analysis, which has been calculated from the current calibration curve, is compared with the expected value of each analyte in the standard and a percent true value (%TV) is determined by dividing the value found by the expected value times 100%. The %TV must be within the method criteria for the calibration curve to still be considered acceptable (e.g. GC 85-115%; ICP 90-110%).

Each time a continuing calibration analysis is performed, it must be documented and placed in the method files to track the validity of the calibration curve over time. Recorded will be the analytes, the average response factor, the response factor from the continuing calibration analysis, and the percent difference of the response. For the liner regression curves, the analytes, the concentration found, the expected concentration and the %TV will be recorded. Frequencies for continuing calibration can be found in Table 4-2.

In performing continuing daily calibrations for ICP, the high level standard is analyzed immediately after the initial calibration is performed and the results of the analyses must be within 5% of the true value. Also, a midrange continuing calibration verification standard (CCV) will be analyzed after every ten samples analyzed and at the end of the analysis sequence. The results must be within 10% or 20% of true value depending on the method being performed. Re-calibration must be performed if the CCV results do not met criteria.

4.3.4 Analysis of Quality Control Samples

Routine quality control samples are analyzed to assure that the operation is within control as established for the laboratory on the basis of historical data. The routine quality control consists of blanks, spiked blanks or laboratory control samples, spiked samples, duplicate samples, and in some cases, external check samples analyses. These are discussed in the following sections.

4.3.4.1 Blanks

There are two types of blanks associated with internal quality control. They are the reagent blank and method blank.

4.3.4.1.1 Reagent Blank

The reagent blank is the reagent(s) and/or solvent(s) that are normally used for sample preparation, but without going

through any of the preparation steps. The reagent blank is normally not analyzed unless the method blank (See section 4.3.4.1.2 below) shows the presence of contamination which may have arisen from the reagent(s) and/or solvent(s).

4.3.4.1.2 Method Blank

The method blank is a known amount of the reagent or solvent which is carried through the all of the preparatory steps of a method prior to its analysis, adding internal and surrogate standards if appropriate for the method. The method blank is prepared with every batch of samples that is being prepared at the same time, provided the batch is no greater than twenty samples. For batches which are greater than twenty samples, a method blank will be prepared for every sub-batch of twenty samples.

The instrument background count for radiological analyses, a count of a planchet or vial containing no sample, is another form of laboratory blank. The instrument blank confirms that the counting instrument is contamination-free. The instrument blank may be used as a background correction factor subtracted from the sample count in the calculation of radiological concentration. For most analyses, an instrument background count is collected for each day that radiological samples are counted. They are run at a frequency of 10% for radiochemical parameters, corresponding to analytic batches of 10 or less samples.

In addition, a method blank is prepared whenever the lot number of any reagent is changed. The preparation log will then indicate which samples are associated with the new lot number of reagent(s). The method blank is analyzed and the data is reviewed prior to the analysis of samples.

4.3.4.2 Spiked Blank (Laboratory Control Sample)

The spiked blank, or laboratory control sample (LCS), serves as a measure of accuracy of the analytical procedure independent of matrix effects. The spiked blank is prepared by adding known amounts of specific analytes to the appropriate volume of reagent grade water or clean solid matrix and subjecting the spiked sample to the entire extraction procedure. For radiologic analyses, NIST traceable standards or equivalent will be used.

One spiked blank is prepared for every ten samples of the same matrix that are subjected to sample preparation at the same time. The spike contains all the analytes which are specified in the method of analysis to be performed.

Preparation of the spiking mixture is done in the same manner as the preparation of standard solutions for calibration except that it will be prepared from a source independent of that used for the calibration standard preparation. The preparation of the mix will be recorded in the Standard Preparation Logbook and assigned a standard ID number (per Section 4.3.1).

The spiked blank is then carried throughout the entire extraction and analytical procedure, and the concentrations of the spiked analytes determined. These results will be compared to pre-established acceptance criteria (See Section 4.2) to determine the degree of accuracy of the data in the laboratory. If the spiked blank does not meet the established criteria, it is assumed that the sample preparation or analysis have been faulty, and the batch of samples associated with the spiked blank will be re-prepared and/or re-analyzed after the reason for failure has been determined.

4.3.4.3 Spiked Sample

Spiked samples, or matrix spike samples, serve to identify whether the sample matrix provides certain effects which preclude the ability to recover analytes through the prescribed method. Thus the spiked sample is used to determine the accuracy of a method based on the matrix being analyzed.

One sample per every twenty samples of the same matrix will be selected at random and two aliquots of this sample will be extracted and analyzed, one spiked with the appropriate spiking solution and one without. The recovery of the spiked analytes will then be determined. After the analysis of twenty spiked samples of each matrix and/or each extraction method has been performed, the upper and lower control limits of recovery for each of the spiked analytes will be calculated. All subsequent analyses of spiked samples will then be compared to the control limits appropriate for the matrix and/or extraction method.

4.3.4.4 Duplicate Sample

One sample for every twenty samples of the same matrix will be selected at random, and two aliquots of this sample will be extracted and analyzed to track the precision of the analytical procedure. The results of the two analyses will be compared and the relative percent difference (RPD) between each analyte detected in the duplicate analyses will be calculated and compared to the previously established acceptance criteria (See Section 4.2.2), or per the duplicate error ratio (DER) for low-level radiological results (Science Applications International Corporation (SAIC). December 1992. Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyses. U.S. Department

of Energy. November 1990. Environmental Measurements Laboratory Procedures Manual, 27th ed. HASL-300). For some wet chemistry procedures, where spiking the sample matrix is not applicable, duplicate sample analyses will be performed for every 10 samples of the same matrix.

4.3.4.5 Matrix Spike Duplicate Sample

In some instances, a matrix spike duplicate sample (e.g. for GC and GC/MS analyses) is analyzed as opposed to a duplicate sample (e.g. for various wet chemistry analyses). Typically the matrix spike (MS) and matrix spike duplicate (MSD) are extracted and/or analyzed as a set, one set for every twenty samples of the same matrix. The recovery of the spiked analytes from both the MS and MSD are determined and used to assess the method accuracy as it relates to the specific matrix. Also, the RPDs between the concentration found for each spiked analyte in the MS and MSD analyses will be calculated to assess the precision of the method based on the matrix being tested. Control limits will be calculated after a minimum of 20 analyses for recovery and RPDs for the MS and MSD analyses.

It should be noted that in some instances, as in GC/MS methods, where there are a large number of compounds being analyzed, it is not always practical to produce recoveries and RPDs for every analyte. In these cases, the recoveries and RPDs of selected analytes, usually project or site-specific target compounds will be used to assess accuracy and precision.

4.3.4.6 Documentation of Quality Control Analyses

The analysis of quality control samples must be recorded and submitted with the sample data for review. The results are compared to the established acceptance criteria so as to document that the extraction and analysis scheme was in control when the site samples were analyzed. This is necessary for final approval and release of the analytic results of any site sample.

4.3.4.7 Normalized Absolute Difference

Normalized Absolute Difference (NAD) is the latest statistical tool applied to data to determine precision and bias. Formerly, the use of Relative Percent Difference (RPD) or Duplicate Error Ratio (DER) was applied to radiochemistry data. Currently, NAD is the applied measurement tool. This tool is also referred to as the *t* test. NAD is used to statistically determine the number of units of standard error of difference between means and the measure results differ from zero. This analytic tool accounts for a 95% confidence level or a 2σ acceptance.

To ensure that contamination is not introduced, the NAD between the sample and blank is tracked. The difference should be higher than 2.58 or the equivalent of a 99% confidence level. This difference decreases, however, when the sample approaches background activity. Therefore, blank levels must be tracked to determine if contamination is the cause.

The NAD is also applied to the sample and sample duplicate for determination in variation of results. The NAD between the two samples should be less than 1.96. This indicates that the two data points along with their associates errors are within a 2σ confidence of acceptance.

4.3.5 Establishment of Acceptance Criteria

The establishment of acceptance criteria is necessary in order to be able to determine regularly whether or not quantitative data generated by the laboratory is within control limits. The following section discusses the parameters for which acceptance criteria must be established.

4.3.5.1 Method Blanks

Method blanks are used to establish a known baseline level of contamination which may be contributed from four principal sources, namely:

1. The environment the analysis is performed in;
2. The reagents used in the analysis;
3. The apparatus used;
4. The analyst performing the analysis.

The following criteria shall be used to evaluate the acceptability of the method blank data if project DQOs do not specify otherwise: The concentration of all target analytes shall be below approximately two times MDL concentration for each target analyte, or less than 5 percent of the regulatory limit associated with that analyte, or less than 5 percent of the sample result for the same analyte, whichever is greater for the MB to be acceptable. When this criterion is exceeded, corrective action should be taken to find/reduce/eliminate the source of this contamination in the method blank. However, sample corrective action may be limited to qualification for blank contamination (i.e., B-flag). When the concentrations of any target analytes within the MB are above the MDL check sample for the majority of target analytes or above the MQL for target analytes known to be common laboratory contaminants, assess the effect this may have had on the samples. If an analyte is found only in the method blank, but not in any batch samples, no further corrective action may be necessary. Steps shall be taken

to find/reduce/eliminate the source of this contamination in the method blank. The case narrative should also discuss the situation. If an analyte is found in the method blank and some, or all, of the other batch samples, additional corrective action is required to reanalyze the method blank, and any samples containing the same contaminant. If the contamination remains, the contaminated samples of the batch would be reprepared and re-analyzed with a new method blank and batch specific QC samples. Sporadic cases of contamination may be difficult to control, however, daily contamination would not be acceptable.

4.3.5.2 Recovery of Spiked Blank Samples

Spiked blank samples are used to establish the accuracy of the method as previously discussed in Section 4.2.1. Initially four replicate spiked blank samples are prepared. They are then extracted and analyzed following precisely the appropriate protocol, and the concentrations of the analytes are determined. From these values, the mean and standard deviation for the recovery of each analyte are determined. The deviation of the mean from the known spiked amount is a measure of accuracy of the method and is expressed as percent recovery of the analyte. The percent recovery is calculated as follows:

$$R = 100 \times \frac{C(m) - C(b)}{C(s)}$$

Where, R = Percent recovery of the analyte

C (m) = The measured concentration of the analyte

C (b) = The background concentration of the analyte in the sample (For spiked blank samples C (b) = 0)

C (s) = The actual concentration of analyte spiked into the sample

The mean and standard deviations of the recoveries of each analyte are then calculated and compared to the criteria found in the appropriate EPA method. Upon meeting EPA criteria, control limits for each analyte will be calculated from the recoveries of twenty spiked blank sample analyses.

For gas chromatography methods, the appropriate internal and surrogate spike standards should be added to all spiked reagent blanks and samples. Again, acceptable recovery limits should be compared to the recoveries listed in the QA/QC section of the appropriate EPA method.

4.3.5.3 Duplicate Analyses

Non-spiked samples or matrix spike samples will be extracted in duplicate and the resultant concentrations for each analyte will be used to establish the precision of the method. Once again, precision is defined as a measure of the differences from the mean of repetitive measurements. Thus the standard deviation will be used as a measure of precision. More frequently, the relative percent difference will be used because at best, measurements are performed in duplicate. The relative percent difference is determined by the equation:

$$\% \text{ RPD} = 100 \times \frac{x(1) - x(2)}{x(m)}$$

where, $x(1)$ = High value for the analyte

$x(2)$ = Low value for the analyte

$x(m)$ = Mean value for the analyte = $\frac{x(1) + x(2)}{2}$

The results of the determinations of 20 relative percent differences will be used to calculate the upper warning (2.456 x Average RPD) and control limits (3.27 x Average RPD). Future data will be considered acceptable if the relative percent differences of duplicates fall within the acceptance criteria.

4.3.5.4 Spiked Sample Analyses

Samples will be spiked with a known amount of the appropriate analytes. The resultant recoveries of each analyte will be used to establish the accuracy of the method based on the matrix being analyzed. From these values the mean and standard deviation for the recovery of each analyte added to the sample matrix will be determined. The recoveries will be calculated using the same equation used for spiked blank samples (Section 4.3.5.2). When the recoveries of twenty spiked samples of the same matrix have been determined, the mean and standard deviation will be used to calculate control limits for each of the spiked analytes. Future data will be considered acceptable if the recoveries of the spiked analytes fall within the acceptance criteria.

4.3.5.5 Use of Surrogates

Surrogates are compounds that are expected to behave analytically in a manner similar to target analytes, but are not

naturally found in the environment. The surrogates are added into the sample prior to extraction and their recoveries are a measure of the efficiency of the extraction.

The use of surrogates in organic analysis serves as an additional measure of the acceptability of the results. The significant advantage of the use of surrogates is in measuring recovery against the historically established acceptance range in the performance of each analysis. Thus, data does not depend solely on the spiked blank sample to assess the quality of each analytical run.

The acceptable ranges of surrogate recoveries are established based on the recoveries of thirty sample analyses. The mean and standard deviations from these thirty surrogate recoveries are used to determine the upper and lower acceptable limits of surrogate recoveries as previously discussed (See Section 4.2.1). Surrogate recoveries also need to be established based on the type of matrix and the method of extraction. All subsequent surrogate recoveries will be considered acceptable if the recoveries fall within these established acceptance ranges (i.e. defined by method limits).

NOTE: Acceptance criteria must be established for each method of extraction and for each matrix type. Recoveries from soil are not expected to be within the acceptance limits as determined for water, and recoveries from sonication extraction may not show the same recovery as would a soxhlet extraction. Thus, acceptance criteria must be determined matrix by matrix and method by method.

4.3.5.6 Retention Times in Gas Chromatography Methods

While accuracy and precision form the backbone of quantitative data, qualitative identification in GC methods is more difficult to translate into quantitative measures. The principle criterion for chromatographic analysis is the retention time, or relative retention time. Relative retention time is used in those methods employing internal standards. It is a more reliable measure because it is less dependent on such physical parameters as the length of the column. In all cases, the relative retention time for each analyte will be based on the data obtained from the nearest standard.

To determine the acceptance window for retention times, the continuing calibration data will be employed. For each compound, the retention times obtained in performing the continuing calibrations over a 72 hour (minimum) period will be averaged and their standard deviations determined (See Figure 4-3). The acceptance window will consist of three standard deviations from

the mean retention time for each compound. The retention time acceptance windows will be redetermined whenever the chromatographic column is changed or the chromatographic conditions are altered. It is the responsibility of the analyst to maintain the records for retention time criteria. These records are kept in the method file for future reference. In mass spectrometric analysis, in addition to retention time, the mass spectral match of the compound to the standard will be used to verify its identity.

4.3.6 Standard Operating Procedures

All standard laboratory and analytical procedures will be written as Standard Operating Procedures (SOP's). SOPs will be available in the laboratory for the analysts and will serve as a comprehensive source of reference. General laboratory procedures covered by SOP's will include:

1. Writing, Control and Revision of SOPs
2. Laboratory Notebook Control, Use, Review and Approval
3. Standards Preparation, Traceability, and Storage
4. Nonconformances and Corrective Action
5. Sample Receipt, Login, Custody and Storage
6. Internal Quality Assurance (QA) Audits
7. Reagent Water Generation and Monitoring
8. Balance Calibration, Use and Maintenance
9. Data Reduction, Review and Validation
10. Storage Temperature Monitoring
11. Thermometer Calibration
12. Reagent Control
13. Technical Training
14. Significant Figures
15. Records Storage, Tracking and Disposal
16. MDLs, MQLs and Laboratory Reporting Limits
17. Trip Blank Preparation
18. Subsampling of Containers
19. Method Equivalency Demonstration
20. Data Reporting, Data Package Assembly and Shipment
21. Compressed Gas Quality and Traceability
22. Syringe, Pipet and Autosampler Vial Calibration Procedures

Analytical SOP's should include:

1. Scope and Application
2. Method Summary
3. Method Validation
4. Safety Precautions

5. Interferences
6. Apparatus and Materials
7. Reagents and Standards
8. Sample Preservation and Storage
9. Holding Times
10. Operating Conditions and Calibration
11. Sample Preparation
12. Sample Analysis
13. QA/QC Requirements
14. Reporting Limits
15. Qualitative Identification Information
16. Recovery Limits
17. Data Deliverables
18. Preventative Maintenance
19. Pollution Prevention
20. Waste Minimization
21. Method Flow Chart
22. References and Associated SOPs

QA/QC Schedules

As stated in Sections 4.3.3 and 4.3.4, most analyses will require calibration and the analysis of QC samples. Listed below are the QA/QC schedules of the various types of analyses performed in the WST laboratories. See Table 4-5.

4.4.1 Non-instrumental Wet Chemistry Analyses

Total Suspended Solids is an example of this type of analysis. The QA/QC required for these analyses are: a method blank, LCS and a duplicate analysis for every batch of twenty or fewer samples. For analyses which require an analytical balance, the balance will be checked daily for accuracy with two ASTM Type I weights near the weight range applicable to the method.

4.4.2 Instrumental Analyses

4.4.2.1 Non-GC Instrumental Analyses

Total petroleum hydrocarbon determination by infrared spectrophotometry is an example of this type of analysis. Requirements for this type of analysis are: initial calibration; daily continuing calibration; laboratory control samples, one for every ten samples analyzed; method blank and duplicate analyses, one per batch of twenty samples or less; and when available, external QC samples. For metals analysis, some wet chemistry analyses, and radiochemical analyses, matrix spike and, in some instances MSD, will also be performed.

4.4.2.2 GC and GC/MS Analyses

GC and GC/MS analyses require the following: initial calibration; daily continuing calibration (GC: one per ten samples and at the end of each batch; GC/MS one every 12 hours); reference samples, one per ten samples; method blanks, one per batch of twenty or fewer samples; matrix spike and matrix spike duplicate samples, one for twenty samples of the same matrix; surrogates and internal standards (when applicable), added to each standard and sample analysis; and external QC samples. Matrix spikes and matrix spike duplicates may also be analyzed according to project specific requirements.

The QA/QC requirements for each analysis are detailed in the corresponding analytical SOP.

Instrumentation

Table 4-3 lists the instrumentation and equipment available at Waste Stream Technology's Analytical Laboratory.

Audits

WST employs four types of audits to measure performance, define problem areas, and ensure conformance and compliance with formalized certification programs.

4.6.1 External Audits

External audits are performed by certifying agencies or clients through the use of performance evaluation samples and/or on-site inspections. Potential clients are welcome to audit the WST laboratory and submit evaluation samples as necessary.

4.6.2 System Audits

System audits are primary responsibility of the QA/QC Officer. System audits evaluate the procedures and documentation in the laboratory. A system audit checks for conformity to the QA plan and the SOP criteria for an analysis. Items covered include, but are not limited to, sample custody procedures, calibration frequency and checking, quality control, data reduction and validation, method validation (startup QC), and record keeping and retention. The entire range of analyses performed by the laboratory is reviewed as least annually by the QA/QC Officer. Quarterly audits are conducted by the QA/QC Officer in the company of the Laboratory Director and Assistant Lab Director.

4.6.3 Report Audit

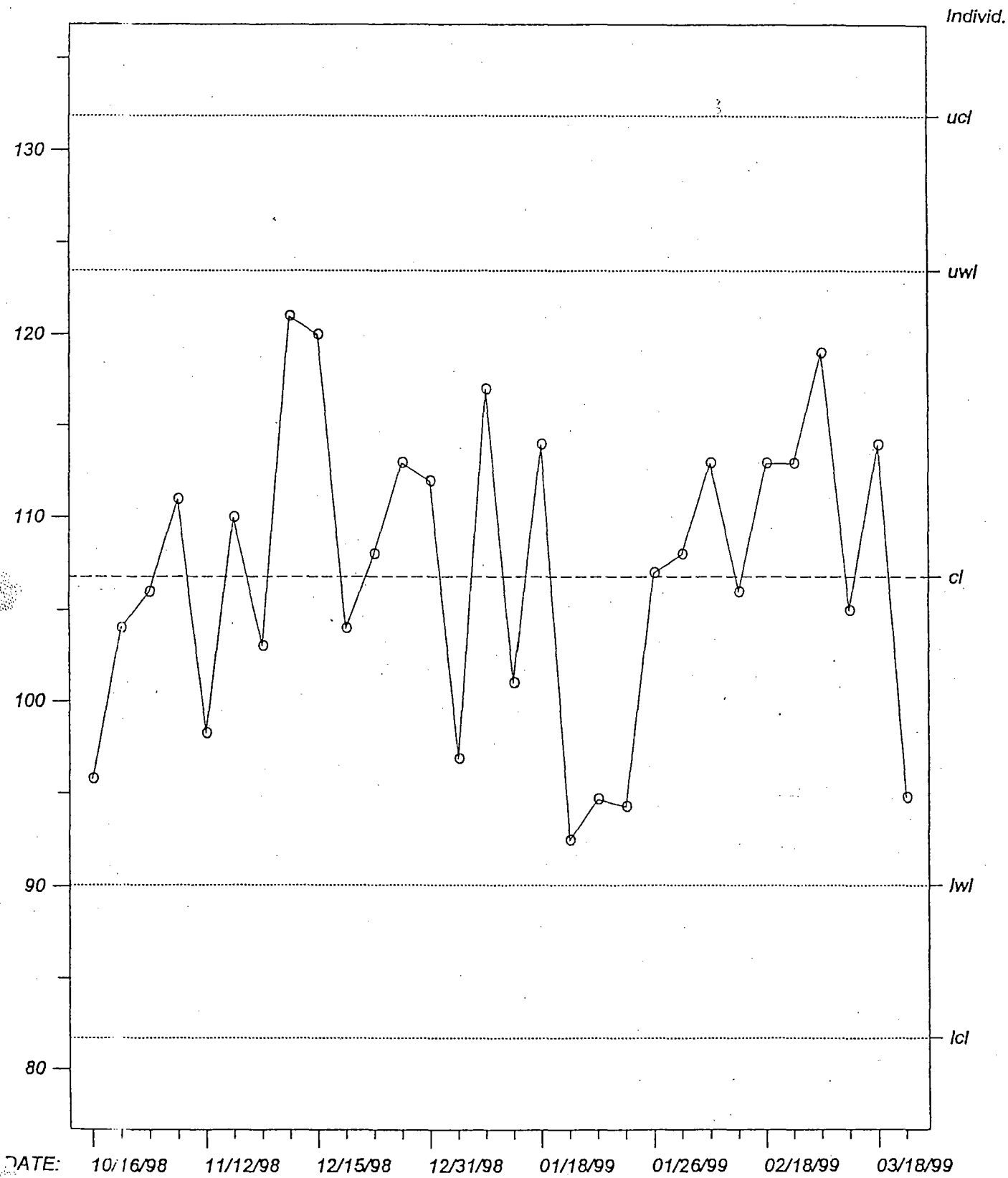
Report audits evaluate the correctness and appearance of the laboratory reports and are performed routinely by the QA/QC Officer. The report audit assures that the data reported is of consistent quality and content.

4.6.4 Blind Sample Audit

Blind sample audits are conducted by submitting samples of known concentrations through ordinary sample handling procedures and comparing the reported concentrations with the known values. Blind sample audits are carried out annually.

Figure 4-1

8260B Water TCL Matrix Spike %Rec Charts
benzene

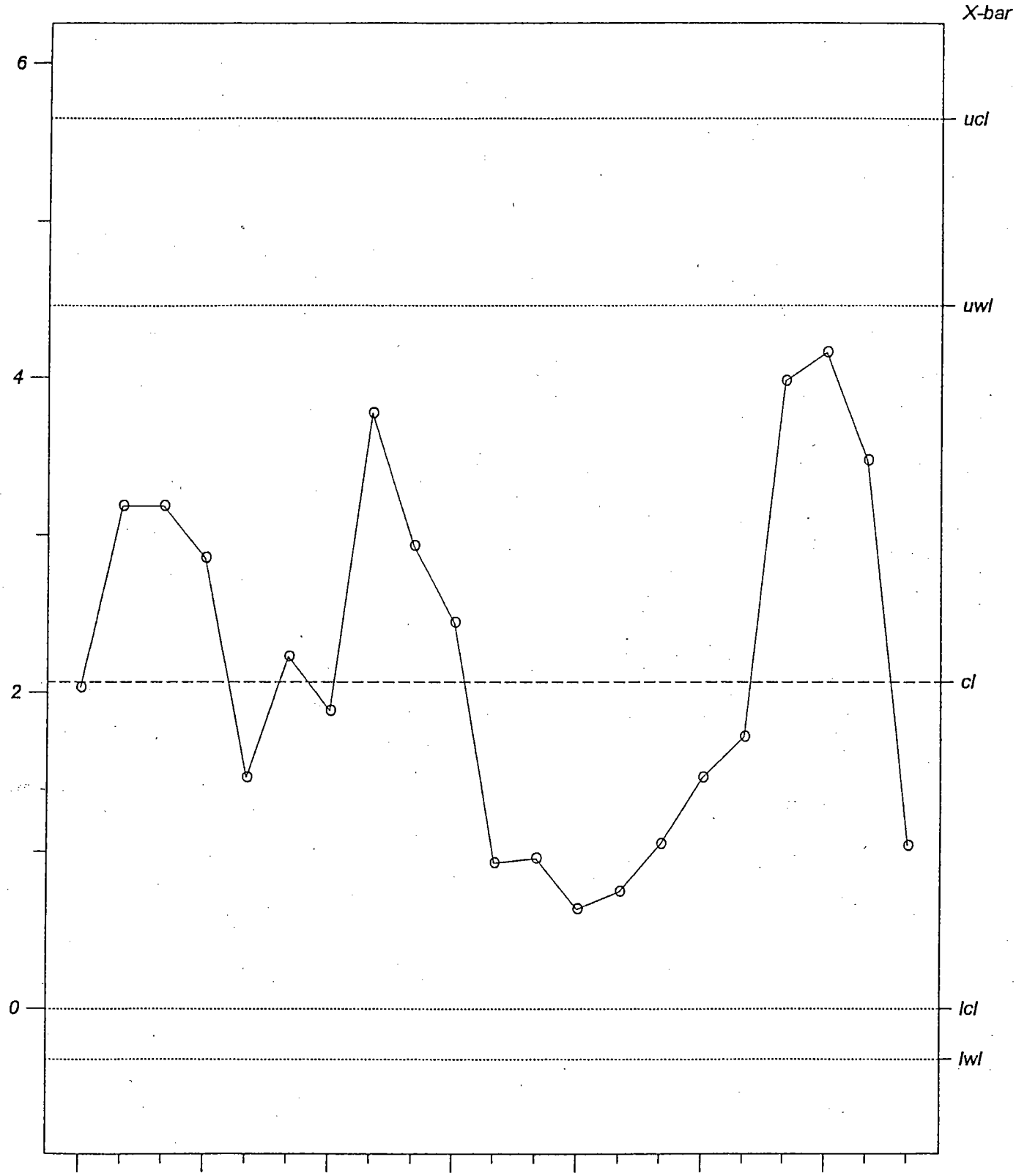


Individ.: cl: 106.81 ucl: 131.881 lcl: 81.7389

Subgrp Size 1

Figure 4-2

8260B Water MS/MSD RPD Charts
benzene



X-bar: cl: 2.0695 ucl: 5.65453 lcl: 0

Mov Ave of 3

Method 8021B Relative Retention Time Window Calculation Sheet

Compound	R.T.-1	RRT-1	R.T.-2	RRT-2	R.T.-3	RRT-3	Avg. RRT	SD RRT	3 X SD Window
fluorobenzene IS	15.022		15.013		15.054				
MTBE	8.008	7.014	7.991	7.022	8.041	7.013	7.016	0.004933	0.015
benzene	14.408	0.614	14.399	0.614	14.442	0.612	0.613	0.001155	0.003
a,a,a-TFT SS	16.345	1.323	16.337	1.324	16.374	1.320	1.322	0.002082	0.006
toluene	19.768	4.746	19.761	4.748	19.790	4.736	4.743	0.006429	0.019
ethylbenzene	23.868	8.846	23.864	8.851	23.890	8.836	8.844	0.007638	0.023
m,p-xylene	24.074	9.052	24.069	9.056	24.095	9.041	9.050	0.0078	0.023
o-xylene	25.220	10.198	25.216	10.203	25.242	10.188	10.196	0.007638	0.023
isopropylbenzene	26.164	11.142	26.162	11.149	26.187	11.133	11.141	0.008021	0.024
n-propylbenzene	27.212	12.190	27.209	12.196	27.234	12.180	12.189	0.008083	0.024
1,3,5-trimethylbenzene	27.625	12.603	27.623	12.610	27.648	12.594	12.602	0.008021	0.024
tert-butylbenzene	28.556	13.534	28.581	13.568	28.577	13.523	13.542	0.023459	0.070
1,2,4-trimethylbenzene	28.640	13.618	28.638	13.625	28.663	13.609	13.617	0.008021	0.024
sec-butylbenzene	29.099	14.077	29.097	14.084	29.122	14.068	14.076	0.008021	0.024
p-isopropyltoluene	29.454	14.432	29.452	14.439	29.476	14.422	14.431	0.008544	0.026
n-butylbenzene	30.512	15.490	30.509	15.496	30.534	15.480	15.489	0.008083	0.024
naphthalene	35.840	20.818	35.836	20.823	35.862	20.808	20.816	0.007638	0.023

Comments:

R.T. denotes Retention Time
R.R.T. denotes Relative Retention Time

Figure 4-3

Table 4-1
STANDARD and SOLUTION HOLDING TIMES

MATERIAL	HOLDING TIME 1°Stock Sol'n	HOLDING TIME 2°Stock Sol'n	HOLDING TIME Working Sol'n[c]
Volatiles GC & GC/MS	1 month @-10°C[a]	1 week @-10°C	24 hr @-10°C
Semivolatiles GC & GC/MS	1 year @-10°C	6 months @4°C	1 week @4°C
TPH for IR	6 months @4°C	3 months @4°C	1 week @4°C
TPH for GC	6 months@-10°C	3 months @-10°C	1 week @-10°C
Metals for ICP & GFAA	1 year[b]	3 months[b]	2 weeks (ICP) Daily (GFAA)[b]
Radioisotopes	1 year	3 months	Daily

a Pre-prepared standard in an unopened ampule: expiration date on ampule @ -10°C. Opened ampules: 1 mo @ -10°C. For gases: 1 week after opening.

b 10% HNO_3 for ICP; 2% HNO_3 for GFAA.

c Working continuing calibration solution.

Table 4-2
Calibration Frequencies

Instrument	Application	Initial Cal.	Continuing
GC/MS	Volatiles	Once/Month*	Every twelve hours
GC/MS	Semivolatiles	Once/Month*	Every twelve hours
GC	Volatiles	Once/Month*	At the beginning and at the end of a sequence of runs, and after every 20 samples.
GC	Extracts	Once/Month*	At the beginning and at the end of a sequence of runs, and after every 10 samples.
ICP	Metals	Daily	At the beginning and
GFAA	Metals	Daily	at the end, and after
Mercury	Metals	Daily	0 samples.
Alpha Spectrometry	Alpha Isotopes	Annually	Daily***
Eberline Survey Meters	Alpha/Beta Gamma Isotopes	Annually	Daily
Gamma Spectrometry	Gamma Isotopes	Annually	Daily source check, Monthly background
Gas Proportional Counter	Alpha/Beta Isotopes	Annually	Daily ****
Gamma Spectrometry	Gamma Isotopes	Annually	Daily source check, Monthly background
pH Meter	All pHs	Daily	Every ten tests at the end of a test sequence
Spectro-photometer	Various Wet Chemistry	Annually	Every run of samples
Balances:			
Analytical	Weighing of samples & stds	Weekly**	Daily
Top-loader	Weighing of samples & stds	Monthly**	Daily

*After repair, column change, or failure on continuing calibration check and/or quality control check standard. As long as continuing calibration analyses and LCS recoveries pass criteria, initial calibration will remain acceptable.
**Performed by WST; performed annually by manufacturer representative.
***Daily Pulser Check; Monthly Background Check and Secondary Cal Check.
****Self-Absorption Annually; Daily Source Check & Monthly Background Check.

Table 4-3.1
INSTRUMENT AND EQUIPMENT LIST

GC/MS:

Hewlett-Packard Model 5890 Series II GC with capillary split/splitless injector, Model 5972 Mass Selective Detector (MSD), HP Windows NT Chemstation for complete operation of GC/MS, Tekmar Model LSC 3000 Purge and Trap Concentrator, and EST Model Archon Purge and Trap Autosampler.

Hewlett-Packard Model 5890 Series II GC with capillary split/splitless injector, Model 5971A Mass Selective Detector (MSD), HP Windows 95 Chemstation, Tekmar Model LSC 2000 Purge and Trap Concentrator, Tekmar Model 2016 Purge and Trap Autosampler with heater pockets.

Hewlett-Packard Model 5890 Series II GC with capillary split/splitless injector, Model 5972 Mass Selective Detector (MSD) with direct capillary interface, HP Windows NT Chemstation, Model 7376A Autosampler.

Hewlett-Packard Model 5890 Series II GC with capillary split/splitless injector, Model 5972 Mass Selective Detector (MSD), HP Window NT Chemstation, Model 7376B Autosampler.

GC:

Perkin-Elmer Model Autosystem Gas Chromatograph with Autosampler, Capillary Columns, Dual PID Detectors and split/splitless injector ports, Tekmar Model LCS 2000 Purge and Trap Concentrator, Tekmar Model LCS 2016 16 Place Autosampler, PE Nelson Turbochrome Software.

Perkin-Elmer Model 8500 Dual Channel GC with single packed column injector with purge and trap interface, PID and ELCD Detectors, Perkin-Elmer Model 2600 PC Integrator with PE Nelson Turbochrome Software, Tekmar Model LSC 2000 Purge and Trap Concentrator, Tekmar Model ALS 2016 16 Place Autosampler.

Hewlett-Packard Model 5890 Series II GC with Dual capillary split/splitless injectors, Model 7673B Autosampler, Dual ECD detectors, with PE Nelson Turbochrome Software.

Perkin-Elmer Model Autosystem Gas Chromatograph with Autosampler, Capillary Columns, Dual ECD Detectors, Dual split/splitless injector ports with PE Nelson Turbochrome Software.

Tracor Model 540 GC with packed column injection port and FID detector with PE Nelson Turbochrome Software.

Perkin-Elmer Model Autosystem Gas Chromatograph with Autosampler, Capillary Columns, FID and ECD Detectors, Dual packed column injector ports with PE Nelson Turbochrome Software. Tekmar Model LSC 2000 Purge and Trap Concentrator connected to FID channel.

Table 4-3.2

Hewlett-Packard Model 5890 Series II GC with capillary split/splitless injectors, Dual tandem PID/ELCD detectors, Tekmar Model LSC 2000 Purge and Trap Concentrator, Tekmar Model 2016 Purge and Trap Autosampler with heater pockets and PE Nelson Turbochrome Software.

IR:

Perkin-Elmer Model 1310 Dispersive Infrared Spectrophotometer with:

- scan range of 4000 to 600 cm - 1 wavenumbers
- fixed or variable wavelength

Metals Analysis:

Perkin-Elmer Model 4100ZL Atomic Absorption Spectrometer with Transversely Heated Graphite Atomizer (THGA)

Perkin-Elmer Optima 3300 XL Spectrometer with AS-90 Autosampler

Leeman AP200 Automated Mercury Preparation System

Leeman PS200 Automated Mercury Analyzer

Buck Scientific Atomic Absorption/Emission Spectrophotometer(2).

Buck Scientific Model-420 Hydride Continuous Flow Analyzer.

CEM Model MDS-2100 Microwave Sample Preparation System

CPI 24 position digester hot block (MOD Block)

Radiochemical Analysis:

Oxford S5XLB Series 5 Automatic Low Background Computer Assisted Alpha/Beta Counting System.

Canberra 7200-12 Chamber System Alpha Analyst.

Eberline Smart Alpha/Beta Survey Meter: SHP380AB Smart Alpha/Beta Probe, CA-100-60 Smart Probe Cable, E600 Smart Portable, E600OPT & Windows Program for E-600.

Eberline Micro R Survey Meter: ASP-2/SPA-8 with NaI scintillator. Range: 0-10,000 uR/h.

EG&G ORTEC GEM Series High Purity Germanium (Photopeak Efficiency >45%) Coaxial Detector; DSPec DSP-Based Gamma-Ray Spectrometer with GammaVision-32 Gamma-Ray Analysis Software.

Table 4-3.3

Eberline Ion Chamber Survey Meter: RO-20.
Range: 0-5 mR/h, 0-50 mR/h, 0-500 mR/h; 0-5R/h, 0-50 R/h.

Spectrophotometers:

Beckman Model 25 UV/Vis Spectrophotometer and Chart Recorder
Milton Roy Spectronic 20-D
Milton Roy Spectronic 20-D Plus

TCLP Equipment:
Associated Design and Manufacturing Model 3740-6-BRE Six Place Rotary Agitator
(2) 24 Place Rotary Agitators
(1) 18 Place Rotary Agitator

Extractors/Concentrators:

Soxhlet Extraction Apparatus including:
- Neslab Model CFT-75 Refrigerated Recirculator
- Precision 6 unit Heater
- Electromantle Model EM 250/C Heating Mantle (12 units; 6 for soxhlet extractors and 6 for distillation)
- Soxhlet Extractors and Condensers (13 sets)

Tecator Soxtec System HT Model 1046 Service Unit with:
- (2) Tecator Soxtec System HT2 Model 1045 Extraction Units

Heat Systems Model W-385 & Model XL2020 Ultrasonic Processors

Millipore Zero Headspace Extractors

Zymark Model ZW 640-3 TurboVap Automated Nitrogen Evaporator/Concentrator

Kuderna-Danish concentration glassware

Gel Permeation Chromatography Equipment:
Zymark BenchMate Workstation, Scientific Systems Model 300 LC Pump, Jordi Associates Stainless Steel Column, Foxy 200 Fraction Collector, Isco UA-6 UV/Vis Detector.

Anion Analyzer (300 series):

Dionex DX-120 Ion Chromatograph with Windows 95 Peaknet vs.5.2 software and Model AS40 Autosampler.

Table 4-3.4

Flashpoint Tester:

Koehler Instrument Co, Model K16200 Closed Cup Flashpoint Tester.

Boekel Model 152800 Set-a-Flash Flashpoint Tester.

Balances:

Mettler Model H33 Analytical Balance, 160g capacity at 0.0001g readability.

Mettler Model PN323 Top Loading Balance, 320g capacity at 0.001g readability.

Fisher Model XD4000 Top Loading Balance, 400g/100g capacity at 0.01g/0.001g readability (3)

Fisher Model XD800 Top Loading Balance, 800g capacity at 0.01 readability (2)

Centrifuges:

Sharples ARE 15MV Super Centrifuge, Vaportite Design

Jouan Model CR4-11 Bench Top Refrigerated Centrifuge

Sorvall RC2-B Super Speed Centrifuge, Refrigerated Floor Model

Fisher Microcentrifuge

pH Meters:

Markson Model 93 Portable pH meter, 0.0 to 12.0 range at 0.01 readability

Soiltest Model 425-500 pH meter, 0.0 to 14.0 range at 0.01 readability

Cole Parmer Model L-01489-30 Conductivity Meter

Ovens/Incubators:

Fisher Model 349 Isotemp Oven

Fisher Model 630F Isotemp Oven

Fisher Model 655F Isotemp Oven

AC-Lab 15 cu.ft. Incubator

Table 4-3.5

Water Purification Equipment:

Deionized Pre-treatment System fed into a D8904 High Capacity Activated Carbon Filter or into a Milli-Q Water Purification System

Laboratory Information Management System (LIMS):

LABWORKS Laboratory Information Management System (LIMS), Analytical Automation Specialists; Novell Network with 25 work stations.

Freezers, Freeze-Driers & Refrigerators:

So-Low Environmental Chest Freezer (to-150ÉC)

Labconco Freeze Dry-5 Lyophilizer

18 cu.ft. Refrigerator Freezers (5)

Fisher Isotemp Refrigerator Circulator

Scienceware Frigimat Dry Ice Maker

14 cu.ft. Freezers (3)

216 cu. ft. Walk-in Coldrooms (2)

Laminar Flow Hoods:

Flow Laboratories Gel Aire AIRONE Hoods (3)

Laminar Flow Hoods (9)

Autoclave - All American Electric Pressure Steam Sterilizer

Table 4-4.1

ANALYTICAL METHODS

The procedures employed by WST for the analysis of samples are taken from a variety of references. These analytical methods are condensed in the SOP's used in the laboratory. Specific method reference materials are also included.

Analytical procedures employed are based on the following:

1. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020, March 1979, Revised 1983, U.S. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268.
2. Federal Register, 40 CFR Part 136: Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act. Revised July 1991.
3. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. Third Edition, Revised December, 1996 United States EPA SW-846.
4. Superfund Contract Laboratory Program. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada. SOW for Inorganic and Organic Analysis #ILM03.0 and #OLM03.0.
5. Annual Book of ASTM Standards, Volume II. ASTM, 1916 Race Street, Philadelphia, Pennsylvania 19103.
6. Standard Methods for the Examination of Water and Wastewater. (20th Edition). American Public Health Association, 1105 18th Street, NW, Washington, D.C. 20036.
7. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. EPA 600/4-82-057, July 1982, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268.
8. Verification of PCB Spill Cleanup by Sampling and Analysis. EPA 560/5-85-026, August, 1985, U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, D.C.
1. HASL-300, 28th Edition, Feb. 97, Environmental Measurements Laboratory, US Department of Energy
2. Radiochemical Analytical Procedures for Analysis of Environmental Samples, EMSL LV053917, Mar. 97, Environmental Monitoring and Support Laboratory, US Environmental Protection Agency
3. Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600 4-80-032, Aug. 80, Environmental Monitoring and Support Laboratory, US Environmental Protection Agency
4. Radiochemistry Procedures Manual, EPA 520/5-84-006, Jun. 84, Eastern Environmental Radiation Facility, US Environmental Protection Agency

Table 4-5
Schedule of Analysis for Quality Control Samples

Analysis	Method	Method Blanks	Dupli-cate	Matrix Spike	Surro-gates	Ref. (LCS)
GC-Purge	601-602	Daily	5%*	10%	100%	Daily
GCMS-Purge	624	Daily	5%*	5%	100%	Daily
GC-Pest/PCB	608	PB	5%*	5%	100%	10%**
GCMS Semivols.	625	PB	5%*	5%	100%	10%**
Oil&Grease	1664	PB	5%*	5%	N/A	10%
Pet. Hydro	418.1	PB	5%	5%	N/A	10%
GC-Purge	8021B	Daily	PB/5%*	PB/5%	100%	PB/10%
GCMS-Purge	8260B	Daily	PB/5%*	PB/5%	100%	PB/10%
GC-Pest GC-PCBs	8081A 8082	PB	PB/5%*	PB/5%	100%	PB/10%
GCMS-Semivols	8270C	PB	PB/5%*	PB/5%	100%	PB/10%
Pet.Hydro.	3550 418.1 8015B	PB	PB/5%	PB/5%	N/A; 100%#	PB5%
Radium 226/228	Ra-05 SM 7500	PB	PB/10%	PB/5%	N/A	PB/5%
Isotopic Thorium	HASL-300 Se-02	PB	PB/10%	PB/5%	N/A	PB/5%
Total Uranium	HASL-300 Se-03	PB	PB/10%	PB/5%	N/A	PB/5%
Gross Alpha/Beta	900,9310 SM 7110	PB	PB/10%	PB/5%	N/A	PB/5%
Metals	200 Series	PB	PB/5%*	PB/5%	NA	PB/10%
Metals	6010B 7000	PB	PB/5%*	PB5%	NA	PB/10%

PB - per batch
PB/5% - one QC sample per analytical batch or 5%, whichever is greater
PB/10% - one QC sample per analytical batch or 10%, whichever is greater
* Duplicate matrix spikes may replace duplicate samples
**Reference Samples (Laboratory Control Samples) will also be analyzed after every matrix spike outside control limits.
8015 (modified)
N/A - Not Applicable

DATA HANDLING

Since the objective of Waste Stream Technology's Analytical Laboratory is the production of data of known, documented quality, it is of the utmost importance that all the data regarding each sample is recorded and reduced in an accurate and precise manner. The greatest responsibilities to the production of this data are with the individual extraction technicians and analysts. They are, after all, the producers of the data. This section will address the procedures of handling the data. This section will also deal with the procedures used by the extraction technicians and the analysts for record keeping and ultimately, the traceability of the data within the laboratory. This section will then be followed by a brief discussion of data reduction, validation, review, and final reporting.

5.1 Record Keeping in the Laboratory

As mentioned in Section 3.4, Sample Custody in the Laboratory, the samples are logged into the Labworks LIMS database which is then used to track the progress of the samples throughout the analytical process. The traceability of a sample or group of samples which require extraction prior to analysis begins with the sample preparation logbook.

5.1.1 Sample Preparation Logbooks

The sample preparation logbooks are hard covered and bound notebooks with pre-numbered pages. The following information must be recorded into these logbooks:

1. The date of extraction and the initials of the technician performing the extraction.
2. The identification numbers of the surrogate, internal and laboratory control sample standards used in the extraction.
3. The method of extraction used and the subsequent method of analysis to be performed.
4. The QA/QC Batch Number. This alphanumeric number is used to track all the samples associated with the corresponding method blank, spiked blank, duplicate sample, and matrix spike samples which were extracted with this group of samples. The number consists of the method number of the analysis to be performed on the sample extract followed by: the date of extraction, in the form ddmmyr (year written as 4 digits); the initials of the extraction technician; the method number of extraction used; and then a -1, -2, -3, etcetera for the first, second, or third batch of samples extracted for that method of analysis on the

same day. PCB and pesticide analyses will use the Julian Calendar date for identifying the QA/QC batch. This number is use to identify the QA/QC sample associated with the site samples extracted within the same sample batch.

5. The WST sample ID number of each sample extracted and the weight or volume of sample extracted.
6. The final volume of extract.
7. The volume of laboratory control sample standard added to the spiked blank sample and the volume of surrogate and/or internal standard added to each sample or sample extract.
8. The WST sample ID number of the sample selected for matrix spike analysis, the volume of matrix spike added, and ID number of the matrix spike standard used.
9. Any comments or observations on occurrences during the extraction procedure, especially if they may effect the results of the data generated.
10. The lot number and manufacturer of the solvents used to extract the samples and the ID number of each reagent used.

Upon completion of the extraction, the extracts and a photocopy of the sample preparation logbook will be given to the appropriate analyst. The copy of the preparation logbook will then be submitted by the analyst as part of the data package for review.

5.1.2 Wet Chemistry Logbooks

Since the preparation of samples for wet chemistry analyses is typically not as involved as the extraction of samples for organic, radiochemical, or metals analyses, the preparation and analysis data for wet chemistry analyses will be recorded in the same logbook. Each wet chemistry analysis will have its own individual logbook designed to record all the data pertinent to that analysis, including, the date of analysis, the initials of the technician performing the analysis, the WST sample ID numbers being analyzed, the final results obtained for each sample analyzed, the results of all QC sample analyses, and the lot number or ID number of the reagents and standards used for the analysis. Some of the other records kept in association with the wet chemistry analyses, such as reagent preparation, may be maintained in separate notebooks.

All notebooks used to record wet chemistry data are bound with hard covers and have pre-numbered pages. They are issued to the analysts by the QA/QC Officer. The QA/QC Officer assigns each

notebook a number and records the date of issuance, the notebook title and the name of the analyst to whom the notebook was issued alongside of this number on a Notebook Distribution Sheet which he/she maintains.

Users of the notebook will maintain good laboratory practices in their use. All entries will be made with indelible ink. No pages will be torn out of the notebook. Corrections will be made by marking a single horizontal line through the mistake, followed by initializing and dating the correction. Tape or liquid paper will not be permitted when making corrections.

5.1.3 Radiochemistry Sample Preparation

Since the preparation of samples for radiochemistry analyses involves numerous steps, it is recorded using three documents, the sample tracking form, an index tracking form and the preparation logbook. Each batch of samples is assigned an STF number from the SFT form that is used to track the preparation. Also recorded on the STF are, the date assigned, technicians initials, WST group and sample ID numbers of the samples being prepared, the number of samples in the batch, the analysis being performed, the client name and any applicable comments. The sample tracking form is used to record the weight or volume of sample and the QC samples associated with the batch while the sample preparation logbook is used to record each step of the digestion performed on the batch. The STF number, the date the step is performed and the name of the technician performing the step are recorded at the beginning of each day's entry.

5.1.4 Record Keeping In Instrumental Analysis

The analysis of samples by GC, GC/MS, ICP, graphite furnace AA, and Gas Proportional Counter will be documented using an analysis sequence log. The sequence log may be in the form of a notebook or a computer generated log sheet that is filed in an analysis sequence binder. In either case, the analysis log must contain, at a minimum, the following information;

1. The date of the analysis.
2. The WST sample ID numbers analyzed.
3. The ID of the instrument used for the analysis. Each instrument will have its own analysis sequence log.
4. The ID numbers of the initial, continuing or QC check standards used through out the analysis sequence. In the case of GC/MS analyses, the tune standard ID number must also be recorded.
5. The ID numbers of the QC samples analyzed in the sequence.
6. The dilution factor, if the sample required dilution prior to analysis.

7. The name of the data file associated with each analysis of the sequence (For ICP and graphite furnace AA there is only one date file name for the entire analysis sequence).

The analysis log must show the sequence in which the samples standards and QC samples were analyzed. The log may also contain data used in the reduction of data to obtain final results such as sample weights or volumes and final extraction volumes.

For GC/MS analyses and some GC analyses, the analysis logbook also contains the retention time, area found and the percent area recovery for all of the internal standards as well as the recovery of each surrogate compound added to the analyses. Upon completion of the analysis, the analyst will enter the sample results into the Labworks database using the appropriate analysis code. Data entry is performed either manually or by computer file transfer. The analyst will also enter the results of method blank, laboratory control sample, matrix spike, and duplicate or matrix spike duplicate sample analyses into Labworks for review.

A copy of the analysis log or notebook will be submitted as part of the data package for review. The data package will also include a copy of the preparation log, the hard copy print outs of all continuing calibration standard, QC sample and site sample analyses and, for soils, a copy of the percent solids log. A copy of the Labworks backlog report that indicates which samples are contained within the data package will also be submitted.

5.2 Data Reduction

Reducing the data to a reportable form is the responsibility of the analyst performing the analysis. It is of utmost importance that the analyst pay close attention to the data being reduced by him or her since the data is only spot checked beyond analysis. In reducing the data generated by an analysis, the analyst must review the following:

1. The continuing calibration analysis to assess the validity of the current calibration.
2. The method blank analysis to assure that no analyte concentrations are above the method detection limit.
3. The recoveries of each of the analytes from the laboratory control sample analysis to assure that they meet acceptable criteria.
4. The concentration of each integrated analyte to assess if the concentration has exceeded the upper linear range, making further dilution of the sample or sample extract necessary, or if the concentrations are below the detection limit.

For GC and GC/MS analyses the following must also be reviewed:

1. The retention times of each of the integrated analytes to assure that they are within the acceptable windows and that the analyte peaks were correctly identified.
2. The integration of each analyte peak.
3. For GC/MS analyses, the tuning standard must be reviewed to assure that it meets acceptable criteria.
4. For GC/MS analyses, the spectrum of each identified peak must be verified to assure that it meets acceptable criteria.

For Radiochemical analyses the following must also be reviewed:

1. For Alpha Spectrometry, daily Pulser check, monthly background and secondary calibration checks.

2. For Gas Proportional Counting, daily source and monthly background checks, and annual Self-Absorption check.

3. For gamma spectrometry, daily source and monthly background checks.

When the above reviews are completed and satisfactory, the concentration of each analyte in the sample can be determined using the following calculation:

$$C = \frac{I}{RF} \times \frac{1}{Vi} \times \frac{Ve}{As} \times DF$$

Where, C = Concentration of the analyte in the sample, in appropriate units [µg/L (ppb), mg/L (ppm), or µg/Kg (ppb), mg/Kg (ppm)]

I = Signal size, in units appropriate to the method

RF = The response factor, in units of signal size per unit weight of the analyte. This response factor is essentially a mean response factor determined through regression of the initial calibration curve.

Vi = The aliquot size of the prepared sample taken for analysis, in units of ml. For some analyses this value is 1 since the same volume is used for initial calibration and for sample analyses.

Ve = The total volume of the prepared sample in ml.

As = The amount of sample taken for preparation. For liquid samples, the volume in liters is used; for solid samples, use the weight in Kg. If the results are to be determined on the basis of dry weight, use the following to determine sample size:

$$As\ (dry) = As\ (wet) \times \frac{\%\ Solids}{100}$$

DF = Dilution factor. The dilution factor is 1 for samples that are prepared exactly as prescribed in the protocol. If the soil or water extract required dilution, then the dilution factor differs from unity. For example, if an extract is diluted from 1 ml to 10 ml, the dilution factor becomes 10.

In most instrumental analyses, a computer is used that will automatically calculate the ratio I/RF for each analyte from the current calibration table or linear regression curve based on the initial calibration. The I/RF ratio is given in units of weight for each of the analytes found in the volume of sample analyzed. These weights are then either used manually or entered into a second computer program along with the values for Vi, Ve, As (usually dry weight for soils), and DF obtained from the preparation and analysis logs, to calculate C for each analyte found in the sample.

Although computerized data reduction alleviates the need for extensive manual data reduction, the results from each batch of results will be checked by the analyst, QA/QC Officer, and Laboratory Director during data review, using manual calculations to verify that the data was correctly reduced. These calculations will be signed and dated as proof of the review.

5.3 Data Validation

Before data from an analytic batch can be incorporated into reports, it must be validated by the QA/QC Officers through the review of all the data associated with the analytic batch. The QA/QC Officers check each batch for completeness, accuracy, and precision.

Although it is not the responsibility of the QA/QC Officers to check and verify every value generated and reported from the analyses, he or she will check the items listed below, using a checklist to document the review. Figure 5-1 shows the form which is used for the review of organic analysis data, Figure 5-2 for metals analysis data, and Figures 5-3, 5-4 and 5-5 for radiochemistry data.

1. Is the batch complete?
2. Have all the analyses been performed within the holding times of the samples?
3. Is there a valid continuing calibration for each analyte associated with the analyses of the individual samples within the batch?

4. For metals analyses, is there a valid initial calibration curve for each analyte and were initial calibration verification, interference check and quality control check standards analyzed where appropriate?
5. For GC/MS analyses, is there a valid tune analysis associated with the sample batch?
6. Is the sequence of runs in which the samples were analyzed proper for the method? Were method blanks, continuing calibrations, duplicates, matrix spikes, and spiked blanks run within the frequency listed in the method?
7. For GC and GC/MS analyses, are the surrogate recoveries from the samples within established control limits for the sample matrix analyzed? If not, has the sample preparation and analysis been repeated, and have recoveries been acceptable in the repeated analysis?
8. Is the recovery of spiked compounds in the laboratory control sample acceptable?
9. Is the recovery of the spiked compounds in the matrix spike sample acceptable? If not, has there been an acceptable explanation or a repeat of the analysis?
10. Do duplicate analyses in the run sequence exhibit precision within the control limits?
11. Is the documentation in order? Are dates, QA/QC Batch Numbers, standard ID numbers, and reagent information complete?

If the answer to all of the above questions is "yes", the QA/QC Officer can release the data for reporting. The QA/QC Officer will also check the results for each sample in the Labworks database to assure that it is correct since the results from Labworks will be used to generate the finalized result report.

If the answer to any of the above questions is "no", corrective actions will be initiated by the QA/QC Officer in association with the analyst. If, after implementation of corrective actions, all criteria are met, the data can then be released for reporting. If some criteria are not met, the batch can be released, depending on what is not met and if there is sufficient explanation. However, regardless of the rationale, data will not be released if the following conditions exist:

1. GC/MS did not meet tuning criteria
2. Continuing calibration was not performed or did not meet acceptance criteria.
3. Laboratory control sample analysis (spiked blanks) did not meet acceptance criteria.
4. The data set was not complete.

Corrective actions for these situations will be addressed in Section 6.0, Corrective Actions.

Once the QA/QC Officer reviews and approves the data, he or she will sign off on the checklist, attach it to the data package and submit the data to the Data Coordinator.

5.4 Final Reporting

After all of the analyses on a sample or group of samples is completed and reviewed for accuracy, a final analytical result report is generated by the Data Coordinator. The data from the Labworks database is exported into an Access database which contains all of the report forms used to produce a final result report.

The final reports generated by the Data Coordinator are then submitted to the Laboratory Director or a designee for final review. The reviewer will sign off on the report and return it to the Data Coordinator. A copy of the report is made and filed according to client and/or site and the original copy is sent to the client or the client's agent. As part of WST's confidentiality policy, a lead sheet that includes a confidentiality notice (Figure 5-6) must be used when results are transmitted via facsimile.

5.5 Data and Report Storage and Retention

Hard copies of generated data packages and final result reports will be archived in a locked storage area. Tapes containing electronically stored data will be stored in a locked, fireproof filing cabinet while archived laboratory notebooks will be stored in a locked, fireproof room. Any items retrieved from these rooms need to be recorded on an Archive Room Access Log Sheet. Recorded will be the person retrieving the item, the date and time taken, a description of the item retrieved and the date and time the item was returned.

Records for QA documentation are retained according to the schedule shown in Table 5-1. In the unlikely event that Waste Stream Technology Inc.'s laboratory transfers ownership or goes out of business, our clients will be contacted immediately and given the opportunity to obtain any available records associated with the analysis of their samples. Records older than the retention times listed in Table 5-1 may not be available.

Table 5-1

QUALITY ASSURANCE RECORDS

Records	Location	Retention
Analysis Report Hardcopy	Client File	5 years
Audit Reports	QA File	7 years
Certification Records	QA File	5 years
Correspondence		
Project-related	Project File	Project Specific
Non-project-related	QA File	5 years
Instrument/Equipment Calibration and Maintenance Records	QA File	5 years
Methods Manual, Revisions, Transmittal Records	QA File	7 years
Quality Assurance Manual, Revisions, Transmittal Records	QA File	7 years
Non-conformance/Corrective Action Reports	QA File	5 years
Procurement Documents	Procurement Log	1 year
Quality Control Acceptance Criteria, Control Charts, and Current Data	QA File	5 years
Quality Control Reports	QA File	5 years
Raw Data Notebooks, Discs, Printouts, Recorder Tracings	Laboratory Files	5 years
QA Project Plans	Project File	Project Specific
Standard Curves	Laboratory Files	5 years
Training Records	QA Files	5 years

Table 5-1

QUALITY ASSURANCE RECORDS

Records	Location	Retention
Analysis Report Hardcopy	Client File	5 years
Audit Reports	QA File	7 years
Certification Records	QA File	5 years
Correspondence		
Project-related	Project File	Project Specific
Non-project-related	QA File	5 years
Instrument/Equipment Calibration and Maintenance Records	QA File	5 years
Methods Manual, Revisions, Transmittal Records	QA File	7 years
Quality Assurance Manual, Revisions, Transmittal Records	QA File	7 years
Non-conformance/Corrective Action Reports	QA File	5 years
Procurement Documents	Procurement Log	1 year
Quality Control Acceptance Criteria, Control Charts, and Current Data	QA File	5 years
Quality Control Reports	QA File	5 years
Raw Data Notebooks, Discs, Printouts, Recorder Tracings	Laboratory Files	5 years
QA Project Plans	Project File	Project Specific
Standard Curves	Laboratory Files	5 years
Training Records	QA Files	5 years

Figure 5-1

ORGANICS - Data Validation Checklist

Method: _____
Date Analyzed: _____

Group #'s : _____

Sample #'s : _____

Analyst: _____
Ext. Tech: _____

Holding Time Summary
Date(s) Sampled: _____
Date(s) Received: _____
TCLP Date(s): _____
Date(s) Extracted: _____
Date(s) Analyzed: _____
Extracted w/I Holding Time? _____

Report Forms Summary
Extraction Log? _____
Solids Log? _____
Analysis Log or Seq.? ____
I.S. Recovery Sum.? ____
Surr Recovery Sum.? ____
TCLP Log. (if app.)? _____
Misc Logs? _____
Init. Cal. Included? ____

GC/MS Tune Form? ___
Cont. Cal. Rpt.? _____
MB Included ? _____
LCS Included ? _____
Results Rpt.? _____
MS/MSD Rec.? _____

Batch Complete? ____

1. Date of last Initial Calibration? _____.
2. GC/MS tune results acceptable? _____. Samples anlz'd in 12hr. clock? _____.
3. Endrin/DDT deg. acceptable? _____. (GC pest. Only) Inj. Port Primer anlz'd? _____. (GC pest. Only)
4. Continuing Calibration Check: acceptable? _____. unacceptable? _____. (see notes)
   _____ Continuing Cal. ran for a _____ Sample sequence (12hr. / 20 sample max.)
5. Method Blank Summary:
   Method Blk. ext'd./anlz'd w/ batch? _____. Analysis acceptable? _____.
   MB_____ w/Sample _____. MB_____ w/Sample _____.
   MB_____ w/Sample _____. MB_____ w/Sample _____.
6. LCS Summary:
   LCS ext'd/anlz'd w/ batch?_____. Analysis acceptable? _____.
   _____ w/Sample _____. _____ w/Sample _____.
   _____ w/Sample _____. _____ w/Sample _____.
7. I.S. Recovery Summary:
   I.S. acceptable? _____. I.S. unacceptable?_____. (see notes)
8. Surr. Recovery Summary:
   S.S. acceptable? _____. S.S. unacceptable? _____. (see notes)
9. Spike / Dup Results Summary:
   M.S. acceptable? (if appl.) _____. M.S.D. acceptable? (if appl.) _____. RPD acceptable? _____.
   Duplicate Analysis acceptable? (if appl.) _____. RPD acceptable? _____.
   "B" Flags? _____. "D" Flags? _____.
10. Data Validation Summary: (notes) _____

11. Reviewer's Signature / Date: _____

FIGURE 5-2

DATA VALIDATION CHECKLIST - METALS ANALYSIS

_____	Date Reviewed	Sample ID Number(s) Analyzed:
_____	Reviewed By	_____
_____	Analytical Method	_____
_____	Analyst	_____
_____	Extracted By	_____
_____	TCLP Date	_____
_____	Date Digested	_____
_____	Date Analyzed	_____
_____	W/I Holding Time?	_____

QC Criteria NA (Not Applicable)	Analyzed Y/N	Acceptable Y/N	Comments
___1) Initial Calibration			
___2) Initial Cal. Verif.			
___3) QC Check Standard			
___4) ICP Interference Chk.			
___5) Reference Sample (LCS)			
___6) Preparation Blank			
___7) Calibration Blank			
___8) Continuing Calibration			
___9) Duplicate Sample (RPD)			
___10) Matrix Spike (%R)			
___11) Matrix Spike Dup. (%R)			
___12) MS/MSD RPD			
___13) GFAA Post-Dig. Spike			

Validation Summary

Acceptable: YES / NO / Comments X

Comments X: _____

_____

_____

_____

_____

_____

_____

_____

Corrective Action: _____

_____

_____

Reviewer Signature & Date: _____

Figure 5-3

DATA VALIDATION CHECKLIST – RADIOISOTOPE ANALYSIS

ANALYSIS:	STF#			Group No(s).:		
GS SO		Client/Site			Sample #s:	
Preparer	Initials / Date:					
Requirement	Criteria Review QA/QC SOPs for exact requirements	Sample Number		Determined Values		Data Flags
Sample Tracking Data	Verify data correct by reviewing Chain of Custody, Sample Tracking Form, and Lab Notebooks					
Holding Time	< 4 t1/2 for critical Isotope	ALL Samples	t 1/2			
Preservation	Within 5 days of sampling	Water Samples	pH =			
Background File	Current Month File Used					
Sample Tracking Form Data	STF complete and accurate					
Sample Related Data	Verify data correct by reviewing sample data printouts and spectrum, and known or certified sample values					

		GX-625 Cal Check Data				
	Daily OR First Use	Isotope	Energy Delta	Data Flags	Recovery	Data Flags
Calibration Standard Check	Peak Energy -1 to +1 "Y" -1.5 to -1 OR 1 to 1.5 "J" <-1.5 OR > 1.5 "R"	Co57				
		Co60				
		Sr85				
	% Recovery 80 - 100 "Y" 50 - <80 OR >100 - 130 "J" <50 OR >130 "R"	Y88				
		Cd109				
		Sn113				
	CALIBRATION CHECK FILE NO.	Cs137				
		Ce139				
		Hg203				
		Am241				
Key Energy Line Agreement	Isotope/Energy Smpl. vs. Cal Std.	Ac228		Y88		

		LCS				
	One per Matrix, Batch, or 20 samples	Isotope	Energy Delta	Data Flags	Recovery	Data Flags
Lab Control Standard Check	Peak Identified at ± 2 keV % Recovery GW Samples 80 - 120 "Y" 50 - <80 OR >120 - 150 "J" <50 OR >150 "R" Flag SO,S,AF,VE Samples 70 - 130 "Y" 40 - <70 OR >130 - 160 "J" <40 OR >160 "R" Flag	K40				
		Cs137				
		Bi212				
		Pb212				
		Bi214				
		Pb214				
		Ac228				

	One per Matrix, Batch, or 10 samples	Isotope	NAD	Isotope	NAD	Data Flags
Duplicate / Sample Noramalized Absolute Difference	<1.96 no flag 1.96>X<3.92 - J flag >3.92 - R flag	K40		Ac228		
		Tl208		Pa234m		
		Bi212		Th234		
		Pb212		U235		
		Bi214				
		Pb214				
		K40		Ac228		
		Tl208		Pa234m		
		Bi212		Th234		
		Pb212		U235		
		Bi214				
		Pb214				
Comments OR Extra data Notes	Add ANY other sample data responding to areas noted above OR ANY other problem affecting sample data					

Rad Lab Manager Review			
COMMENTS:	Control Charts Updated		
	Data Anomalies Accounted (All "R" Flags)		
	Data Acceptable		
	Reviewed and Authorized By: Initials / Date		

Quality Control Review			
COMMENTS:	Data Properly Flagged		
	Data Entered Into Lab Works Correctly		
	Data Authorized to be Released for Reporting		
	Reviewed and Authorized By: Initials / Date		

Figure 5-4

DATA VALIDATION CHECKLIST -- RADIOISOTOPE ANALYSIS

ANALYSIS:	STF#			Group No(s).:		
GA/GB GW		Client/Site			Sample #s:	
Preparer		Initials / Date:				
Requirement	Criteria Review QA/QC SOPs for exact requirements	Sample Number	Type	Determined Values	Comments and Notes	Data Flags
Sample Tracking Data	Verify data correct by reviewing Chain of Custody, Sample Tracking Form, and Lab Notebooks					
Holding Time	< 4 t1/2 for most radical isotope	ALL Samples	t 1/2			
Preservation	Within 5 days of sampling	Water Samples	pH =	< 2.0		
Background File	Current Month File Used					
Sample Tracking Form	STF complete and accurate					
Method Blank (MB)	One MB per batch		MB			
Method Blank Spike (MBS)	One MBS per batch		MBS			
Sample Duplicate (DUP)	One DUP per 10 samples		DUP			
			DUP			
Spike (S)	One S per 10 samples		S			
			S			
Sample Data	Verify data correct by reviewing sample data printouts and spectrum and known or certified sample values					
LCS Measurement			LCS-Alpha			
			LCS-Beta			
Gross Alpha Recovery			MBS/MB			
Gross Beta Recovery			MBS/MB			
Sample \ Spike Recovery	50-100% no flag 20-50 or 100-150 - J flag <20 -X- >150 - R flag		Alpha			
			Alpha			
			Beta			
			Beta			
Sample DUP \ Spike Recovery			DUP-Alpha			
			DUP-Alpha			
			DUP-Beta			
			DUP-Beta			
Method Blank / Sample Normalized Absolute Difference (lowest sample value)	>2.58 no flag 1.96>X<2.58 - J flag <1.96 - R flag		Alpha			
			Alpha			
			Beta			
			Beta			
Duplicate Analysis / Sample Normalized Absolute Difference	<1.96 no flag 1.96>X<3.92 - J flag >3.92 - R flag		Alpha			
			Alpha			
			Beta			
			Beta			
Comments OR Extra data Notes	Add ANY other sample data responding to areas noted above OR ANY other problem affecting sample data					
Rad Lab Manager Review						
COMMENTS:				Control Charts Updated		
				Data Anomalies Accounted (All "R" Flags)		
				Data Acceptable		
	Reviewed and Authorized By: Initials / Date					
Quality Control Review						
COMMENTS:				Data Properly Flagged		
				Data Entered into Lab Works Correctly		
				Data Authorized to be Released for Reporting		
	Reviewed and Authorized By: Initials / Date					

Figure 5-5

DATA VALIDATION CHECKLIST – RADIOISOTOPE ANALYSIS

ANALYSIS:	STF#			Group No(s).:		
Isotope matrix		Client/Site			Sample #s:	
Preparer		Initials / Date:				
Requirement	Criteria Review QA/QC SOPs for exact requirements	Sample Number	Type	Determined Values	Comments and Notes	Data Flags
Sample Tracking Data	Verify data correct by reviewing Chain of Custody, Sample Tracking Form, and Lab Notebooks					
Holding Time	< 4 t1/2 for critical isotope	ALL Samples	t 1/2			
Preservation	Within 5 days of sampling	Water Samples	pH = <2			
GS Energy Cal. Check	Daily OR First Use	File Name	Calibration File			
Background File	Current Month File Used					
Sample Tracking Form Data	STF complete and accurate					
Method Blank (MB or MBT)	One MB per batch	0 MB				
Method Blank Spike (MBS)	One MBS per batch	0 MBS				
Sample Duplicate (DUP)	One DUP per 10 samples	DUP				
		DUP				
Spike (S)	One S per 10 samples	S				
		S				
Sample Data	Verify data correct by reviewing sample data printouts and spectrum, and known or certified sample values					
LCS Measurement	50-100% no flag 20-50 or 100-150 - J flag <20 -X- >150 - R flag	LCS				
MBS Recovery		MBS/MB				
Matrix Spike Recovery						
Matrix Spike Duplicate Recovery						
		DUP				
Sample Tracer Recovery		Identify highest and lowest Recovery measured				
					High Recovery	
					Low Recovery	
Sample Spectrum Alpha or Gamma Spectrometry Review of Key Isotope(s) Alpha - Ra226 Gamma - Ba133 Check ALL samples Note any sample requiring flag	Check Isotope Energy and FWHM Gamma FWHM < 1.4 - no flag 1.4>FWHM<2.8 - J flag >2.8 - R flag Alpha FWHM < 150 - no flag 150>FWHM<350 - J flag >350 - R flag	Identify FWHM values requiring flagging. Report additional samples in comments.				
Method Blank / Sample Normalized Absolute Difference	>2.58 no flag 1.96>X<2.58 - J flag <1.96 - R flag					
Duplicate Analysis / Sample Normalized Absolute Difference	<1.96 no flag 1.96>X<3.92 - J flag >3.92 - R flag	DUP				
		DUP				
Comments OR Extra data Notes	Add ANY other sample data reqponding to areas noted above OR ANY other problem affecting sample data					
Rad Lab Manager Review						
COMMENTS:				Control Charts Updated		
				Data Anomalies Accounted (All "R" Flags)		
				Data Acceptable		
		Reviewed and Authorized By: Initials / Date				
Quality Control Review						
COMMENTS:				Data Properly Flagged		
				Data Entered Into Lab Works Correctly		
				Data Authorized to be Released for Reporting		
		Reviewed and Authorized By: Initials / Date				

Figure 5-6

FAX LEAD SHEET

WASTE STREAM TECHNOLOGY

302 GROTE STREET
BUFFALO, NY 14207
Phone (716)876-5290

Environmental Laboratory Services, Radiological Laboratory Services, and Bioremediation Supplies and Services

If this fax is incomplete or illegible, please call the number listed above.

DATE: NUMBER OF PAGES (including cover):

TO:

FROM: FAX NUMBER:

MESSAGE:

Confidentiality Notice:

CORRECTIVE ACTIONS, PREVENTIVE MAINTENANCE, AND INSTRUMENT MAINTENANCE LOGS

6.1 Identification and Documentation of Problems

There are many areas throughout an analysis where corrective actions may be required. The decision to undertake corrective actions and ensuing actions must be documented so that traceability can be maintained. Corrective actions can be initiated by both the analyst and the QA/QC Officer. However, the QA/QC Officer is more likely to initiate corrective actions since he/she is the most exposed to malfunctions of the laboratory as they reflect upon the data produced. Any actions taken that affect the quality of the data must be documented and become part of the laboratory's permanent record.

During the course of data review, the QA/QC Officer may make an observation that will prompt a decision to pursue corrective actions. The QA/QC Officer is responsible for informing the analyst that a problem appears to exist. The types of problems that are observed usually fall into three categories; procedural problems, sample matrix effects, and equipment or instrument problems. All three categories may prompt the QA/QC Officer to request that a sample or group of samples be re-extracted and/or re-analyzed. When this situation arises, the QA/QC Officer will initiate the corrective action by filling out a Sample Re-extraction/Re-Analysis Form (Figure 6-1). The following information will be entered on the form;

1. The date of the request.
2. The Request Number. This number is assigned by the QA/QC Officer for purposes of tracking the distribution of request forms. When a request form is distributed, the QA/QC Officer records the request number in the tracking logbook. When the request form is returned the logbook is checked to indicate the return.
3. The ID number(s) of the sample(s) to be re-analyzed.
4. The analysis method to be performed and whether the sample(s) requires re-extraction and re-analysis or just re-analysis.
5. The reason for the request. This entry will detail the problem encountered and the corrective actions required prior to re-extraction or re-analysis of the sample(s).
6. The person to whom the request was submitted and the corresponding laboratory department.
7. The date by which the corrective actions and sample re-analysis must be completed.

Upon completion of the re-analysis, the analyst will return the Request Form to the QA/QC Officer along with all of the data Pertinent to the required corrective action and subsequent sample re-analysis. The QA/QC Officer will review the data and record any comments regarding the review. When the review is completed, he/she will sign and date the form. A copy of the form will be attached to the data package and the original will be placed in a 3 ring binder as part of the QA/QC Officer's files.

Other corrective actions may be required that do not involve sample re-analysis. In these cases, the QA/QC Officer will notify the analyst or technician of a problem through a QC Memo. The memo will list the date of distribution, the name of the QA/QC Officer writing the memo, the person(s) to whom the memo was given, the memo reference number used by the QA/QC Officer for tracking memos that have been distributed, a detailed description of the problem and the corrective action(s) to be taken, and the date by which the actions need to be completed. If the problem identified by the QA/QC Officer is sufficient enough to significantly impact the quality of the data, the QA/QC Officer may stop the analysis of any additional samples until the problem is resolved. The analyst or technician must then record onto the memo a description of the corrective action(s) taken and the date it was performed. The analyst will then return the memo to the QA/QC Officer for review. If the QA/QC Officer is satisfied that the corrective action has mitigated the problem, analysis of samples can be resumed. If not, he/she may issue another memo detailing the additional actions that need to be taken in order to resolve the problem.

If, upon repeated attempts, the QA/QC Officer feels that the actions taken have not satisfactorily corrected the problem, he/she will inform the appropriate corporate officer of the problem. The problem will then be resolved through a joint effort between the laboratory management, the QA/QC Officer, and the corporate officers.

In some situations, the need to correct an operation is apparent to the analyst and does not originate from the data validation process. For example, instrumental failures are determined by the analyst and corrective action is taken by repairing the instrument, either through a service call or through laboratory personnel. In this case, the corrective action must be recorded in the Instrument Maintenance Log (See Section 6.5) of the effected instrument.

6.2 Problems and Actions (See Figure 6-2)

6.2.1 Continuing Calibration Outside Acceptance Limits

When the continuing calibration is outside the acceptable range, the problem should be identified by the analyst and corrected before any sample analysis is undertaken. On some occasions, the non-acceptability of the continuing calibration will not be determined by the analyst. In these cases, the QA/QC Officer will notify the appropriate analyst that a new initial calibration curve must be prepared or the continuing calibration standard should be checked.

The data on all the samples that have been analyzed following the last time that the calibration was within specification, will be rejected by the analyst or the QA/QC Officer, depending on the stage of the process at which the non-acceptability of the calibration curve was determined. The samples will be reanalyzed after a new initial calibration has been performed.

6.2.2 Calibration Standards Exceeding the Permitted Holding Time

If calibration standards have been continuously used beyond their permitted shelf-life, the QA/QC Officer will inform the responsible analyst. The analyst will then be responsible for preparing fresh calibration standards and the instrument will be checked against the new standards. If the previous runs performed with the expired standards meet the acceptance criteria based on the new standards, the data generated will be considered valid, in spite of the use of expired standards. This data will be flagged.

If the calibration performed with the expired standards do not meet the acceptance criteria when measured against the new standards, the samples that have been analyzed against the expired standards will be re-analyzed.

6.2.3 Laboratory Method Blanks Exceed Method Detection but Are Below Quantitation Limit

When target analytes are detected laboratory blanks at concentrations greater than the method detection limit, but less than the quantitation limit, the QA/QC Officer will notify the responsible analyst. The analyst will then check the reagent blanks that have been retained at the time the reagents were first used, in order to determine if contamination or interferences are due to impurities in the reagents. If this is the case, the reagent batch will be discarded and new reagents from fresh containers will be used. If the reagents appear to be sufficiently pure, the cleanliness in the laboratory will be inspected and reinforced to establish if the source of the problem may have been contamination of the apparatus.

The data associated with the blank will be reviewed. If the analytes detected in the method blank are detected in the samples, the results reported for that analyte will be flagged with the AB@ qualifier (which indicates that the analyte was found in the associated method blank as well as the sample).

6.2.4. Laboratory Method Blank Exceeds Quantitation Limits

When the laboratory method blank exceeds the quantitation limit, the QA/QC Officer will immediately notify the responsible analyst. The analyst will check the reagents and apparatus for potential contamination. If reagents are contaminated, the existing batch will be rejected and a fresh batch from a new container will be prepared. If the problem arose from the apparatus, whether glassware or instrumental, the problem will be corrected by the analyst and/or extraction technician. The corrective action will be documented before any further analyses can be undertaken. The analyst will then notify the QA/QC Officer of the corrective action.

The samples will be re-extracted and re-analyzed to produce acceptable data. However, in instances where the analyte found in the blank is not detected or detected below the quantitation limit in the samples associated with the blank, the data may be accepted. If re-extraction or re-analysis of a sample is not an option (e.g. sample holding is exceeded or not enough sample available) the sample data will be flagged using the AB@ data qualifier.

6.2.5 Laboratory Control Sample (Spiked Blank) Exhibits Recoveries Outside the Acceptance Limits

When the laboratory control (LC) sample recoveries do not meet the acceptance criteria, the samples in the batch associated with the failed LC sample will be re-analyzed with a new LC sample and the original data will be rejected. However, if the analyte recovery is greater than the upper quality control recovery limit and the analyte is not detected in the associated sample, re-preparation and re-analysis will not be required.

Before repeating the re-preparations of samples, the calibration of the instrument shall be checked by analyzing a continuing calibration check standard. If the instrument is within calibration, the samples will be re-prepared and re-analyzed.

If the instrument calibration has drifted, re-calibration will be performed and the samples will be re-analyzed.

If re-extraction or re-analysis of a sample is not an option (e.g. sample holding is exceeded or not enough sample available) the sample data will be flagged using the AJ@ data qualifier as follows:

1. If the analyte was detected in the sample above the method quantitation limit, the result will be flagged the AJ@ data qualifier to indicate that the result is estimated due to a non-compliant LC sample recovery.

2. If the analyte was not detected in sample and the analyte recovery from the LC sample was less than the lower quality control recovery limit, then the Anot detected@ result will be flagged with both the AU@ and AJ@ data qualifers. This indicates that the reported detection limit(s) is estimated since the low recovery may indicate that the reported detection limit is not achievable.

3. If the analyte was not detected in sample and the analyte recovery from the LC sample was greater than the upper quality control recovery limit, then the AJ@ data qualifier does not need to be assigned.

6.2.6 Surrogate Compound Recoveries Outside the Acceptance Limits

If surrogate compound recoveries are outside the acceptance limits, but the laboratory spiked blank is within acceptance limits, the sample exhibiting the unacceptable recovery will be re-prepared and re-analyzed.

If surrogate recovery is out-of-control upon re-analysis and the deviation is in the same direction as the original analysis (i.e., the surrogate recovery was either high or low for both analyses) the original data will be reported. The unacceptable surrogate recovery will be flagged using a A#@ qualifier. The results for any detected compounds associated with the out-of-control surrogate recovery will be flagged as estimated using the AJ@ qualifier. The detection limit for non-detected compounds associated with a *low* out-of-control surrogate recovery will be flagged using the AU,J@ qualifiers, since the low recovery may indicate that the reported detection limit is not achievable. The possibility of matrix effect will be discussed in the report to the client

If, upon re-analysis, the recovery of the surrogates or spiked analytes fall within acceptable limits, the results of the re-analysis will be reported and the original analysis results rejected due to a potential procedural problem.

If the surrogate recovery is out-of-control upon re-analysis and the deviation is in the opposite direction as the original analysis (i.e., the surrogate recovery was high in one analysis and low in the other) the results of both analyses will be reported. The unacceptable surrogate recovery will be flagged using a A#@ qualifier. The results for any detected compounds associated with the out-of-control surrogate recovery will be flagged as estimated using the AJ@ qualifier. The detection limit for non-detected compounds associated with a *low* out-of-control surrogate recovery will be flagged using the AU,J@ qualifiers.

The possibility of matrix effect will be discussed in the report to the client.

In some instances it may be obvious from the data produced, or, from the observations made during the preparation process that the sample matrix is causing the unacceptable recoveries. In these cases, the sample may not be re-prepared or re-analyzed. The observations made will be included in the report to the client, and the data will be flagged.

If the surrogate recovery in a method blank or reference sample is outside the acceptance limits (but the analytes in the reference sample are within acceptance limits), the analyst may need to analyze the surrogate standard solution to check for degradation or contamination. If the standard solution is determined to be the problem the analyst will immediately prepare a new standard and the affected samples will be re-extracted and re-analyzed. It is also possible that the calibration of the surrogate compound has drifted, in which case the analyst should re-calibrate the system, and re-analyze the affected samples.

6.2.7 Matrix Spikes Exhibit Recoveries Outside the Acceptance Limits

If recoveries of spiked analytes are outside the acceptance limits, but the laboratory spiked blank is within acceptance limits, the apparent poor or enhanced recovery may be due to matrix effect. The matrix spike sample should be re-prepared and re-analyzed to assess this possibility.

If the matrix spike recoveries are out-of-control upon re-analysis, both analyses will be reported. The unacceptable matrix spike recoveries will be flagged with the AG@ qualifier if the recovery is greater than the upper QC limit, or an L qualifier if the recovery is less than the lower QC limit. The AG@ and AL@ qualifiers will only be used with respect to the actual matrix spike sample results.

Positive detections in the associated field sample of compounds which were out-of-control in the matrix spikes will be flagged as estimated using the AJ@ qualifier. The detection limit for non-detected compounds associated with low out-of-control matrix spike recoveries will be flagged using AU,J@ qualifiers since low recovery may indicate that the reported detection limit may not be achievable. The possibility of matrix effect will be discussed in the report to the client.

If, upon re-analysis, the recovery of the spiked analytes fall within acceptable limits, the results of the re-analysis will be reported and the original analysis results rejected due to a potential procedural problem.

In some instances it may be obvious from the data produced or from the observations made during the preparation process that the sample matrix is causing the unacceptable recoveries. In these cases, the sample will not be re-prepared or re-analyzed. The observations made will be included in the report to the client, and the data will be flagged using the AJ@ qualifier as stated previously.

6.2.8 Relative Percent Differences from MS/MSD or Duplicate Sample Analysis Outside the Acceptance Limits

When the relative percent difference (RPD) of an analyte from MS/MSD sample or duplicate sample analyses is outside acceptance limits, the MS/MSD or duplicate samples will be re-prepared and/or re-analyzed.

If RPD is out-of-control upon re-analysis, the results of both analyses will be reported. The unacceptable RPD will be flagged with the A#@ qualifier. The possibility of matrix effect will be discussed in the report to the client.

If, upon re-analysis, the RPD falls within acceptable limits, the results of the re-analysis will be reported and the original analysis results rejected due to a potential procedural problem. Figure 6-3 shows the Data Qualifier Sheet which is incorporated into the final result reports when applicable.

6.3 Flagging Requirements for Radiochemistry Data

Samples can be identified by quality control objectives as one of four possible results. The results are either estimated (J / NJ), unacceptable (R / NR), less than Minimum Detectable Activity (<MDA), or an outlier to normal data (O). J and NJ flags denote data that is estimated based on the results of tracer , spike, or LCS recovery (J flag), or the results of the Normalized Absolute Difference (NAD) to a 2 σ confidence level (NJ flag). R and NR flags denote data that is unusable based on the results of tracer, spike, or LCS recovery (R flag), or the results of the Normalized Absolute Difference (NAD) to a 2 σ confidence level (NR flag). The flags <MDA and O can be applied to either J or R data, or to they may stand separately or together.

The Radiochemistry Lab at Waste Stream, will review ALL data pertinent to sample analysis prior to final assignment of qualifying flags. As a rule R flagged data will not be reported. Rather, the data problem is first reviewed for a root cause of the result error and secondly, if necessary, discussed with the client. Once a root cause is determined, it is possible to determine if a corrective action can be applied. If applicable, the corrective action will be applied and the

analysis re-performed. In the case of lack of sample for re-analysis, or in the case of non-correctable root cause, the sample is flagged R and the case narrative of the report will discuss the problem for the client's determined resolution. Data flagged J, O, or <MDA may be re-analyzed as requested by the client. Figure 6-5 shows the Radiochemistry Data Qualifier Sheet that is included in all radiochemistry analysis reports.

6.4 Preventive Maintenance

Preventive maintenance is necessary in order to keep the system operating properly. Not all preventive maintenance measures need to be documented, except those that are considered a repair or a replacement. These types of preventive maintenance will be documented in the Instrument Maintenance Log of the affected instrument. Each instrument will have a preventive maintenance schedule which can be found in the analytical SOP. The schedule may also include preventive maintenance performed by the manufacturer as per the terms of the service contract, which is purchased for laboratory instruments.

Routinely scheduled preventive maintenance consists of the following:

1. General
   a. Maintenance logs are maintained for each major instrument (See Section 6.4).
   b. Room temperature and humidity are maintained according to the manufacturers' specifications.

2. Gas Chromatograph and Gas Chromatograph/ Mass Spectrometer (GC and GC/MS)

Daily Procedures
   a. Purge traps are baked out. Changes of the traps are logged.
   b. Columns are baked out.
   c. Volume of gas cylinders is checked.

As Required Procedures
   a. Teflon ferrules are replaced.
   b. Injection port liners are cleaned or replaced.
   c. GC septa are changed after 50 injections.
   d. Detectors are baked out.

Quarterly Procedures
   a. Instrument electronics are visually inspected and cleaned.
   b. Detectors are cleaned on a schedule recommended by the manufacturer or more frequently as needed.

Annual Procedures
   a. Electron capture detectors are wipe tested.
   b. Preventive maintenance performed by manufacturer as per service contract terms

Spare Parts
a. Septa
b. Purge and trap sparger
c. Purge and trap traps
d. Tubing and fittings
e. Thermal conductivity leak detector
f. Column ferrules
g. U.V. lamp for PID detectors
h. Nickel catalyst tubes for ELCD detectors
i. Syringes for spiking
j. Mass spectrometer source filaments
k. Jet separator
l. Pump oil
m. Analytical columns
n. Flow meter bubble solution
o. Flow meters
p. Spare guard columns
q. Injection port liners

3. Infrared Spectrometer
Daily Procedures or After Each Use
a. Clean IR cells, store in desiccator

Weekly Procedures
a. Run spectrum of polystyrene.

Spare Parts - IR cells, chart paper & pens

4. Inductively Coupled Plasma Spectrometer (ICP)
Daily Procedures
a. Check gases before operation
b. Monitor detector response and instrument performance through calibration and verification.

Procedures as Needed
a. Clean nebulizer and spray chamber
b. Replace peristaltic pump tubing
c. Clean plasma torch assembly when discoloration is evident or after analyzing high dissolved solids.

Spare Parts - Spare plasma torch, argon chamber and pump tubing

5. AA/Graphite Furnace
Daily Procedures
a. Warm up AA lamp for 15 minutes prior to analysis
b. Check and align source lamp
c. Check autosampler alignment and deposition

Procedure as Needed
a. Change graphite contact rings
b. Change background correction lamp

c. Clean furnace housing and injector tip
d. Replace pyrollytic graphite furnace tubes as indicated by instrument performance

Spare parts- Contact rings, furnace tube assemblies, lamps

6. Gas Proportional Counter
Daily Procedures
a. Check gas flow

Weekly Procedures
a. Clean sample tray

Monthly Procedures
a. Check bubbler oil level

7. Alpha Spectroscopy
Every 6 months
a. Change vacuum pump oil

Procedure as needed
a. Clean sample holder

6.5 Instrument Maintenance Logs

All instrument repair and maintenance which will effect the steady state of the analytical system must be documented in the Instrument Maintenance Log. A description of the problem and the corrective actions taken to remedy the problem will be recorded.

If a service representative is called in to make the repair, a copy of the Field Service Report, if available, is filed into the Instrument Maintenance Log. The corrective actions explanation will reference the number of the Field Service Report.

When a major repair is performed or when the column is replaced, a 2 times method detection limit sample should be analyzed to see if it has changed significantly. If it has, new method detection limits need to be established and documented. If the MDL check sample passes, a new MDL study need not be performed.

6.6 Handling Complaints

Procedures for receiving, reviewing, and evaluation of complaints are necessary. This ensures that all complaints are processed in a uniform and timely manner., They must be documented so that traceability can be maintained.

Customer complaints can be received by the Project Manager, QA/QC

Officer, or Laboratory Director. These designated personnel initiate corrective actions since they are the client contacts, are the most exposed when it comes to the functions of the laboratory, and have the ability to prioritize laboratory activities to respond to the needs of the complainant. Any actions taken must be documented and become part of the laboratory's permanent record.

Upon verbal or written receipt of a complaint, the complainant's information is recorded on a Complaint Form Figure 6-4) and complaintive actions taken. The person who receives the complaint is responsible for investigating the nature and details of the complaint, identifying personnel that will be involved in its resolution, and following through with its corrective actions.

Figure 6-1

Sample Re-Extraction/Re-Analysis Request Form

Date _____ Request Number _____

Requested By _____

Sample ID # _____

Analysis Method Requested _____

_____ Re-extract and re-analyze

_____ Re-analyze only

Reason for Request _____

_____

_____

_____

Request Submitted To : _____

Department : _____

Submit Results By (Date) _____

==========

Return this form along with a copy of the re-analysis results to the person listed at the top of this form. If re-extraction was required, and if the sample extract is to be analyzed by a different person or department, submit this form along with the extract to the appropriate analyst. The analyst must then submit this form along with the results of the re-analysis.

==========

Re-analysis Results Reviewed By :

_____ Date _____

Comments: _____

_____

_____

Figure 6-2

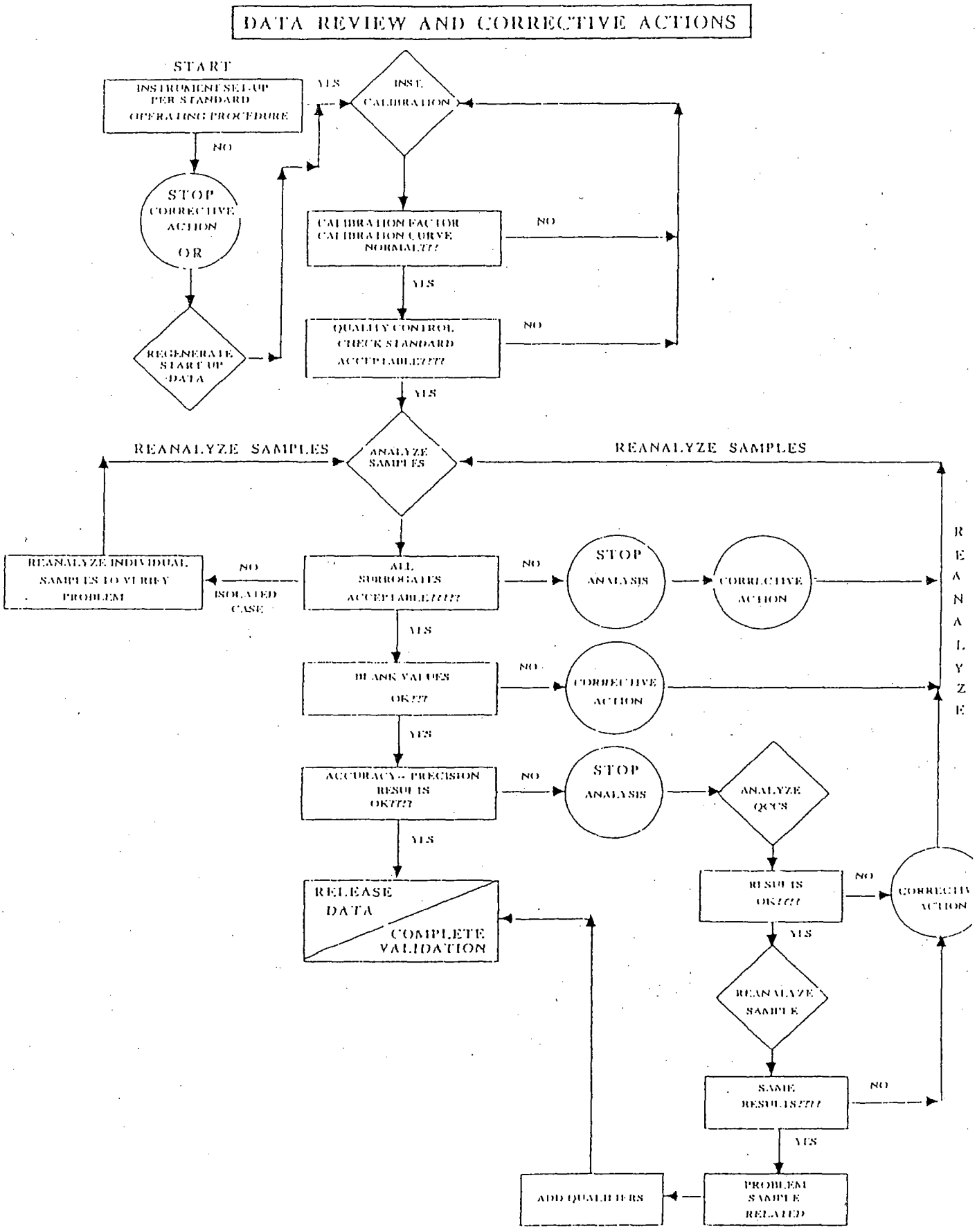

DATA REVIEW AND CORRECTIVE ACTIONS
START
INSTRUMENT SET-UP PER STANDARD OPERATING PROCEDURE
YES
INST. CALIBRATION
NO
STOP CORRECTIVE ACTION OR
REGENERATE START UP DATA
CALIBRATION FACTOR CALIBRATION CURVE NORMAL???
NO
YES
QUALITY CONTROL CHECK STANDARD ACCEPTABLE????
NO
YES
REANALYZE SAMPLES
ANALYZE SAMPLES
REANALYZE SAMPLES
REANALYZE INDIVIDUAL SAMPLES TO VERIFY PROBLEM
NO
ISOLATED CASE
ALL SURROGATES ACCEPTABLE?????
NO
STOP ANALYSIS
CORRECTIVE ACTION
YES
BLANK VALUES OK???
NO
CORRECTIVE ACTION
YES
ACCURACY -- PRECISION RESULTS OK????
NO
STOP ANALYSIS
ANALYZE QC'S
YES
RELEASE DATA
COMPLETE VALIDATION
RESULTS OK????
NO
CORRECTIVE ACTION
YES
REANALYZE SAMPLE
SAME RESULTS????
NO
YES
ADD QUALIFIERS
PROBLEM SAMPLE RELATED
REANALYZE

Figure 6-3

DATA QUALIFIER SHEET

U - Indicates compound was analyzed for but not detected.

J - Indicates an estimated value. This flag is used to qualify the following: when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed; a compound is detected in the sample but the result is less than the method quantitation limit but greater than the statistically calculated laboratory method detection limit; the result for a compound is estimated due to the analysis of a sample beyond th USEPA defined holding time; the result for a compound is estimated due to a quality control sample result that is outside the laboratory quality control recovery limits.

C - This flag applies to pesticide results where the identification has been confirmed by GC/MS.

B - This flag is used when the analyte is found in the associated blank as well as the sample.

E - This flag identifies all compounds whose concentrations exceed the calibration range of the GC/MS instrument of that specific analysis.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

G - Matrix spike recovery is greater than the expected upper limit of analytical performance.

L - Matrix spike recovery is less than the expected lower limit of analytical performance.

- Indicates that a surrogate recovery, LCS recovery or RPD was found to be outside the expected limits of analytical performance.

$ - Indicates that the surrogate compound was diluted out. The sample had to be diluted to obtain analytical results and a recovery could not be calculated.

(%) - Indicates that the compound is a surrogate and that the value reported for this compound is in percent recovery. The quality control recovery limits are indicated in the detection limit or QC limits column.

Figure 6-4

Complaint Form

Date ______________ Request Number ______________

Requested By ________________________

Sample ID #(s) ____

Name of Complainant __________________________________

Address ____

Phone __________________ FAX __________________ E-mail __________________

Nature & Details of Complaint

____

____

Date & Results of Investigation

____

____

____

Corrective Actions

____

____

Reply to Complainant

____

____

Name______________________ Signature _____________________ Date _________

= =

Return this form along with a copy to the QA/QC Officer

Figure 6-5

RADIOCHEMISTRY DATA QUALIFIERS

<MDA - Indicates compound was analyzed for but determined to be below Minimum Detectable Activity.

J - Indicates an estimated value based on the sample tracer, the associated matrix spike or the Lab Control Sample.

R - Indicates data that is unacceptable based on the sample tracer, the associated matrix spike, or the Lab Control Sample.

NJ - Indicates an estimated value based on the Normalized Absolute Difference between the sample and sample duplicate or the sample and the blank.

NR - Indicates an unacceptable value based on the Normalized Absolute Difference between the sample and sample duplicate or the sample and the blank.

BIOGRAPHIES OF KEY PERSONNEL

Dr. Brian S. Schepart Laboratory Director

Dr. Schepart received his B.A. in Biology from Clark University in 1977, and his Ph.D. in Experimental Pathology from the State University of New York at Buffalo in February of 1983, and his B.S. Pharmacy from the State University of New York at Buffalo in 1994. He was a Damon Runyon - Walter Winchell Fellow at the University of North Carolina at Chapel Hill and an Instructor of Microbiology at Duke University. Since 1986, Dr. Schepart has been an Assistant Professor of Microbiology and Immunology at Allegheny University of the Health Sciences, where he presently retains an adjunct position. While at Allegheny, he directed and managed a team of seven researchers whose work was supported by extramural funds. To his credit, Dr. Schepart has authored over thirty peer-reviewed publications and has received numerous awards and grants, from both public and private agencies. He is the Chairman of ASTM F20.24, a subcommittee within Spill Response F20 since 1991. He joined Waste Stream Technology in 1989.

Daniel W. Vollmer QA/QC Officer

Mr. Vollmer graduated from the State University of New York at Buffalo with a B.A. in Biology. Since his graduation, he has gained extensive experience in analytical chemistry as a laboratory technician, a GC, GC/MS, and HPLC analyst, and a laboratory supervisor. Since 1989, in conjunction with Dr. Schepart, he has been responsible for setting up WST's analytical laboratory and establishing the current laboratory protocol. In doing so, he has obtained extensive experience in US EPA methodologies, including the requirements necessary for maintaining good Quality Assurance and Quality Control.

Paul Morrow Assistant Laboratory Director

Mr. Morrow has a B.A. in Biochemistry from Canisius College, as well as an M.B.A., where he received the Edna Galvin Zeeman Award. Mr. Morrow has more than 10 years experience in GC and GC/MS methodologies for the generation of data according to NYSDEC and USEPA CLP protocols. His experience as an Accounts Manager and GC/MS Analyst reinforces his knowledge of the environmental testing laboratory.

Rebecca Dye Organics Analyst

Ms. Dye received her B.S. in Chemistry from Baldwin-Wallace College in 1993. She joined WST in 1996 after working for three years as an industrial chemist, responsible for formulation of precious metal anode coatings, product inspection, instrument maintenance and calibration, environmental wastewater monitoring, and technical support. She is currently the organic extraction

Anthony Portfilio Senior Metals Analyst and Metals Laboratory Supervisor

Mr. Portfilio received his B.S. in Recombinant DNA Technology at the State University of New York at Fredonia. He joined WST in 1993 with 4 years experience in operation and interpretation of metals analysis by Inductively Coupled Plasma Spectrophotometry, Flame Atomic Absorption Spectrophotometry and Graphite Furnace Atomic Absorption Spectrophotometry. In addition, he operates a Hydride Continuous Flow Analyzer for low level analysis of metals. He is also responsible for supervising the metals analysis laboratory.

Gregory Ignaszak Wet Chemistry Lab Supervisor

Mr. Ignaszak received his B.S. in Chemistry from Rosary Hill College in 1973. He joined WST in 1995 He has over 25 years of experience in analytical chemistry, over 13 of which is in the evironmental testing field. He is responsible for supervising the Wet Chemistry laboratory, as well as Sample Disposal. He supervises the Wet Chemistry laboratory in procedures according to USEPA, ASTM, and Standard Methodologies.

Sidney Tyrrell USACE Project Manager, QA/QC Officer and Organics Analyst

Mr. Tyrrell received his A.S. in Chemistry from Erie Community College in 1983. He joined WST after 10 years of experience as a GC and GC/MS Analyst. Since joining WST in February, 1994, he has established analyses for drinking water and continues to provide expertise in GC and GC/MS volatile organics and semi-volatile organics. He is currently responsible for data review and co-ordination of advanced data deliverables.

Thomas Franks Organics Analyst

Mr. Franks received his B.A. in Chemistry from Buffalo State College in 1993. He then joined WST first as an extraction chemist then as a GC Analyst. He is responsible for the analysis of environmental samples for the determination of PCBs/Pesticides and Herbicides using standard and innovative techniques.

Oliver Levi QA/QC Officer

Mr. Levi graduated from the State University of New York College at Buffalo with a B.A. in Chemistry. Since his graduation in 2001, he joined Waste Stream Technology where he has obtained extensive experience in US EPA methodologies, including the requirements necessary for maintaining good Quality Assurance and Quality Control.

Maria Bradley Radiochemistry Laboratory Manager

Ms. Bradley graduated from Canisius College with a B.S. in Environmental Science. She joined Waste Stream Technology as an intern, and has been an employee since her graduation in 1999. Her expertise include the operation of alpha, beta, and gamma radiological testing equipment, radiological and chemical data interpretation and validation, technical preparation of environmental monitoring reports, and radiological health and safety.

Joe Giacomazza Sample Custodian

Mr. Giacomazza received his B.S. in Earth Science from the Buffalo State College. He interned at Waste Stream in 1997, and was subsequently hired as a Data Manager, responsible for accurate and timely delivery of analytic data. He has since become Sample Custodian.

APPENDICES

SAFETY

Safety requires an open attitude and a knowledgeable awareness of potential hazards. Safety is a collective effort and requires the full cooperation of management, supervisors, and employees. This cooperation means that everyone should adhere to the established procedures of the company which are incorporated into the laboratory's "Chemical Hygiene Plan," "Hazard Communication Standard," and the "Waste Stream Technology Safety Manual@, and ""Waste Stream Radiation Control Standard Operating Procedure (SOP).@

Briefly, these manuals include guidelines, procedures, and suggestions for the following areas:

1. Personal protective equipment
2. Training
3. Emergency action
4. Chemical and Radiation hazards
5. Chemical storage
6. Fume hood monitoring program
7. Accident reporting
8. Established work rules

Personal Protective Equipment

Eye protection is required at all times in the laboratory and where chemicals are stored and handled. Appropriate clothing must be worn, including a protective lab coat. Open-toed shoes or sandals are not permitted. Gloves of the proper material should be selected to provide sufficient protection to minimize the chance of skin contact. Respirators should be worn as needed.

Training

Adequate training will be provided by management and the Health and Safety Department. Employees are expected to adhere to all safety rules as well as to seek advice and guidance whenever they have doubts about safety procedures or potential hazards. The training incorporates chemical and radiation hazards, evacuation, use of fire extinguishers, and use of the eye wash and other protective equipment. The employees are also instructed on signs and symptoms of over-exposure, OSHA permissible exposure limits (PEL's), location of Material Safety Data Sheets (MSDS), and how to read MSDS and reagent labeling. Employees are also instructed in proper respirator selection and use including fit testing.

Emergency Action

Employees are instructed on emergency action procedures which include spills/release, evacuation, and reporting. Routine drills are conducted throughout the entire company. An emergency action plan is provided and used in the training of all laboratory personnel. Escape routes are mapped out throughout the building. Fire alarms, fire extinguishers, and a sprinkler system are in place and inspected every other month. The Buffalo Fire Department is located approximately 300 feet from the facility at the intersection of Grote Street, Great Arrow Drive, and Elmwood Avenue.

Chemical and Radiological Hazards

All employees who may be exposed to chemicals and radioisotopes which may present a hazard, are fully informed of potential hazards and proper handling that is required to avoid exposure. This is accomplished through reagent labeling and MSDS's. Each employee is instructed on how to decipher a MSDS Sheet, providing the employee with special instructions on personal protective equipment, storage requirements, and associated health hazards. Special precautions and labeling are required for toxic, carcinogenic, or mutagenic compounds.When there has been a spill of radioactive material which may have produced contamination of the person or clothing, both the person and the clothing shall be monitored. Personnel contamination shall be removed as soon as possible.

Personnel External Exposure Monitoring Program

Personnel monitoring devices shall be provided for individuals in accordance the following criteria:

1) Personnel who handle millicurie quantities of photon or energetic beta emitting radionuclides on a regular basis* shall be supplies with a film or TLD finger monitor.
2) Personnel who handle millicuries quantities of energetic photon emitting radioactive materials on a regular basis* shall be supplied with film or TLD whole body monitors.
3) Personnel who are occupationally exposed to radiation on an occasional basis, need not be monitored if the requirements of 38.24 do not apply.

*This refers to personnel such as laboratory workers who handle millicurie quantities either routinely or as stock quantities.

Storage

Chemicals are arranged so only compatible chemical families are stored together. Flammable liquids are stored in minimum quantities within the laboratory,

stored in a containment area and a locked safe in the containment area, respectively, accessible to Radiological Laboratory personnel only.

Medical Surveillance

Employees have the option to receive medical attention whenever any of the following occur:

1. Employees develop signs or symptoms associated with hazardous chemicals.
2. Exposure levels routinely exceed the action levels.
3. There is a spill, leak, or release into the working environment.

Reporting of Injury or Illness

Employees must report all work-related injuries or illnesses. This will ensure that the appropriate medical treatment or follow-up is obtained. This will also alert management to unsafe work practices or conditions so corrective actions can be taken.

Established Work Rules

The following is a list of established safety rules which everyone must abide by:

1. Consumption, preparation, and storage of food and beverages, and application of cosmetics, are prohibited in the laboratory.
2. Laboratory glassware will not be used to contain food or beverages.
3. Smoking is prohibited in the laboratory and in the facility.
4. Safety glasses or goggles are required in the laboratory.
5. All visitors to the laboratory must follow the safety regulations.
6. Chemicals are not allowed in offices.
7. Horseplay and other acts of mischief are prohibited.
8. Unauthorized experiments are prohibited.
9. Work surfaces and personnel should be monitored after working with radioactive materials, and decontaminated if necessary.
10. Pipetting of radioactive solutions by mouth is prohibited.
11. Do not store food, drink, or personal effects with radioactive material.
12. Always transport radioactive materials in appropriately shielded containers, and other laboratory reagents in appropriate containers.

WASTE DISPOSAL

Procedures for the disposal of waste and virgin chemicals are outlined in the Waste Disposal SOP. Workers should follow this program with care to avoid any safety hazards or damage to the environment.

In general, WST has incorporated four routes of disposal into the Waste Disposal SOP. They are:

1. If possible, samples received for laboratory analyses are returned to the client or site upon completion.

2. Solvents are recovered/recycled through distillation.

3. Certain highly diluted, water soluble chemicals may be disposed of in small quantities in the sanitary sewer system.

4. The remaining waste will be separated and drummed for incineration or landfill by an appropriately licensed vendor.

Waste is segregated based upon its chemical properties. Liquids are packaged separately from solids. Reactive waste is isolated from non-reactive waste. Radioactive waste is isolated form non-radioactive waste. In general, the Waste Coordinator will assist in the segregation of waste.

Laboratory wastes will be stored in 5 gallon poly-buckets in the laboratory until full when they will be dumped into appropriate drums. Samples containing PCB material will be held separately. Samples that are sent back to the client are recorded on a type

All waste is stored in the posted waste storage area until disposal. Lab pack Disposal drums require DOT approved containers. All inside lab pack containers must be compatible for that waste. The maximum internal lab pack size is one gallon for metal, plastic, and glass containers. The chemical name and type/size of container should be recorded onto the side of the drum/written sheet and relinquished to a transporter or directly to a client. These completed forms are maintained by Sample Control and are filed in a three ring bound notebook. The forms are maintained for seven years after disposal.

The small containers that are packed in drums are separated based upon DOT hazard classes. In decreasing hazard order, they are:

- Radioactive
- Poison A
- Flammable gas
- Non-flammable gas
- Flammable liquid
- Oxidizer
- Flammable solid
- Corrosive (liquid)
- Poison B
- Corrosive (solid)
- Irritating agent
- ORM-B
- ORM-A
- Combustible liquid
- ORM-E

The Waste Coordinator prepares the waste manifest, shipping inventory and drum labels. The drums are labeled according to DOT requirements. Records of the disposal are maintained and filed with the Waste Coordinator for seven years.

RADIOACTIVE WASTE DISPOSAL

Currently material that enters the Radiochemistry lab are of relatively low specific activity. However, the lab operates in the same manner as if the material was of a higher activity. All wastes produced in Radiochemistry lab operations are to be handled in the proper manner. All wastes generated in the Rad Lab, until verified otherwise, are to be considered potentially radioactively contaminated. Care is used to ensure that the production of waste is kept to as minimum an amount as practical. Wastes shall be disposed of in the proper receptacles. Separate receptacles will be in-place for contaminated wastes. Unused samples and potentially contaminated wastes are to be collected and stored in assigned containers and locations. Waste material should be surveyed to verify activity levels. Material that is determined as non-radioactive is disposed of as Anormal@ trash. Acid wastes are documented as to the quantity generated and then neutralized prior to being disposed.

All radioactive wastes are returned as negotiated to the client along with unused sample material. Radioactive solid wastes and samples are documented as to their Specific Activities prior to return. All samples returned are accompanied by appropriate shipping papers and survey results. Under NO circumstance shall the requirements of Waste Stream Technology, Inc=s. Radioactive Material License OR the regulations of 12NYCRR38, 10CFR, or 40CFR be violated in the discharge of wastes to the environment.

SECURITY

There are three main areas to be considered when dealing with security. They are:

1. Laboratories
2. Offices
3. Sample storage areas

Security for the facility is provided by restricted admission through a main entrance during standard working hours. Key personnel are allowed access to the facility during non-standard hours using a computer-linked individualized numeric access code.

The integrity of the facility is monitored at key points using motion and audio sensors in addition to strategically placed door switches. Twenty-four hour monitoring of the system includes:

1. Computer link-up
2. Audio monitoring
3. 911 and hold-up protection
4. Perimeter security
5. Secure check-in/check-out
6. Monthly reports on check-in/check-out

In addition to the electronic security system, the samples are stored in a secured area. All cabinets and refrigerators are kept locked at all times. The Sample Custodian is in charge of access and all samples removed or returned must be logged out.

ANNUAL EXECUTIVE SUMMARY REPORT

The laboratory management will prepare an annual executive summary report. The report will be a review of the laboratory's quality system and its testing and calibration activities to ensure its continuing suitability and effectiveness and to introduce any necessary changes or improvements in the quality system and laboratory operations. The summary shall take into account reports from managerial and supervisory personnel, the outcome of recent internal audits, assessments by external bodies, the results of interlaboratory comparisons or proficiency tests, any changes in the volume of work undertaken, feedback from clients, corrective actions and other relevant factors.

The annual summary report will be reviewed by the Laboratory Director and Quality Control/Quality Assurance Officer who will also sign and date the cover of the report. Copies of the report will be distributed to the laboratory managerial and supervisory staff while the original report will then be placed into the QA/QC Officer's files.

Laboratory Certifications

1. New York State Department of Health
2. New Jersey Department of Environmental Protection and Energy
3. U.S. Army Corps of Engineers
4. Florida Department of Health

New York State Department of Health

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner

Expires 12:01 AM April 01, 2003
Issued July 05, 2002

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

DR. BRIAN S. SCHEPART
WASTE STREAM TECHNOLOGY
302 GROTE STREET
BUFFALO NY 14207 USA

NY Lab Id No: 11179
EPA Lab Code: NY00068

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards for the category ENVIRONMENTAL ANALYSES POTABLE WATER All approved analytes are listed below:

Drinking Water Metals I	
Arsenic, Total	EPA 200.7
	EPA 200.9
Barium, Total	EPA 200.7
C mium, Total	EPA 200.7
	EPA 200.9
Ch m, Total	EPA 200.7
Copper, Total	EPA 200.7
Iron, Total	EPA 200.7
Lead, Total	EPA 200.9
Manganese, Total	EPA 200.7
Selenium, Total	EPA 200.9
Silver, Total	EPA 200.7
	EPA 200.9
Sodium, Total	EPA 200.7
Zinc, Total	EPA 200.7
Drinking Water Metals II	
Antimony, Total	EPA 200.9
Beryllium, Total	EPA 200.7
Nickel, Total	EPA 200.7
Thallium, Total	EPA 200.9
Drinking Water Non-Metals	
Cyanide	SM18 4500-CN-E

Radiological Analytes	
Gross Alpha	Method Not Specified
Gross Beta	Method Not Specified
Radium-226	EPA 1984 Ra-03
Radium-228	EPA 1984 Ra-05
Volatile Aromatics	
1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
2-Chlorotoluene	EPA 524.2
4-Chlorotoluene	EPA 524.2
Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2
m-Xylene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2

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DOH-3317 (3/97)

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latile Aromatics	
-Xylene	EPA 524.2
-Isopropyltoluene (P-Cymene	EPA 524.2
-Xylene	EPA 524.2
ec-Butylbenzene	EPA 524.2
tyrene	EPA 524.2
ylbenzene	EPA 524.2
oluene	EPA 524.2
latile Halocarbons	
,1,1,2-Tetrachloroethane	EPA 524.2
,1,1-Trichloroethane	EPA 524.2
,1,2,2-Tetrachloroethane	EPA 524.2
,1,2-Trichloroethane	EPA 524.2
,1-Dichloroethane	EPA 524.2
,1-Dichloroethene	EPA 524.2
,1-Dichloropropene	EPA 524.2
,2,3-Trichloropropane	EPA 524.2
,2-Dichloroethane	EPA 524.2
,2-Dichloropropane	EPA 524.2
,3-Dichloropropane	EPA 524.2
,2-Dichloropropane	EPA 524.2
romochloromethane	EPA 524.2
romomethane	EPA 524.2
arbon tetrachloride	EPA 524.2

Volatile Halocarbons	
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2
cis-1,2-Dichloroethene	EPA 524.2
cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2
Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,2-Dichloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

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Benzidines	
3,3 -dichlorobenzidine	EPA 625
Benzidine	EPA 625
Chlorinated Hydrocarbon Pesticides	
DDT	EPA 608
Al	EPA 608
beta-BHC	EPA 608
Chlordane Total	EPA 608
Endrin	EPA 608
Heptachlor	EPA 608
Chlorinated Hydrocarbons	
1,2,4-Trichlorobenzene	EPA 625
2-Chloronaphthalene	EPA 625
Hexachlorobenzene	EPA 625
Hexachlorobutadiene	EPA 625
Hexachlorocyclopentadiene	EPA 625
Hexachloroethane	EPA 625
Chlorophenoxy Acid Pesticides	
2,4,5-T	EPA 1978, p.115
2,4,5-TP (Silvex)	EPA 1978, p.115
2,4-D	EPA 1978, p.115
Dicamba	EPA 1978, p.115

Demand	
Biochemical Oxygen Demand	EPA 405.1
	SM18 5210 B
Chemical Oxygen Demand	EPA 410.4
	SM18 5220D
Haloethers	
4-Bromophenylphenyl ether	EPA 625
4-Chlorophenylphenyl ether	EPA 1625
	EPA 625
Bis (2-chloroisopropyl) ether	EPA 625
Bis(2-chloroethoxy)methane	EPA 625
Bis(2-chloroethyl)ether	EPA 625
Mineral	
Alkalinity	EPA 310.1
Chloride	ASTM D512-89A
	EPA 300.0
	EPA 325.3
	SM18 4500Cl-B
Fluoride, Total	ASTM D-1179-88B
	EPA 300.0
	EPA 340.2
Hardness, Total	EPA 130.2
Sulfate (as SO4)	EPA 300.0
	EPA 375.4

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·oaromatics and Isophorone	
4-Dinitrotoluene	EPA 625
6-Dinitrotoluene	EPA 625
ophorone	EPA 625
itrobenzene	EPA 625
mines	
-Nitrosodimethylamine	EPA 625
-Nitrosodi-n-propylamine	EPA 625
-Nitrosodiphenylamine	EPA 625
rient	
nmonia (as N)	EPA 350.3
trate (as N)	EPA 300.0
	EPA 353.2
thophosphate (as P)	EPA 300.0
	EPA 365.3
iosphorus, Total	EPA 365.2
halate Esters	
enzyl butyl phthalate	EPA 625
s(2-ethylhexyl) phthalate	EPA 625
ethyl phthalate	EPA 625
methyl phthalate	EPA 625
-n-butyl phthalate	EPA 625
-n-octyl phthalate	EPA 625

Polychlorinated Biphenyls	
PCB-1232	EPA 608
PCB-1260	EPA 608
Polynuclear Aromatics	
Acenaphthene	EPA 625
Anthracene	EPA 625
Benzo(a)anthracene	EPA 625
Benzo(a)pyrene	EPA 625
Benzo(b)fluoranthene	EPA 625
Fluoranthene	EPA 625
Indeno(1,2,3-cd)pyrene	EPA 625
Pyrene	EPA 625
Priority Pollutant Phenols	
2,4,6-Trichlorophenol	EPA 625
2,4-Dichlorophenol	EPA 625
2,4-Dimethylphenol	EPA 625
2,4-Dinitrophenol	EPA 625
2-Chlorophenol	EPA 625
2-Methyl-4,6-dinitrophenol	EPA 625
2-Nitrophenol	EPA 625
4-Chloro-3-methylphenol	EPA 625
4-Nitrophenol	EPA 625
Pentachlorophenol	EPA 625
Phenol	EPA 625

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Purgeable Aromatics	
1,3-Dichlorobenzene	EPA 602
	EPA 624
	EPA 625
zene	EPA 602
	EPA 624
C benzene	EPA 602
	EPA 624
Ethyl benzene	EPA 602
	EPA 624
Toluene	EPA 602
	EPA 624
Total Xylenes	EPA 602
	EPA 624
Purgeable Halocarbons	
1,1,1-Trichloroethane	EPA 624
1,1,2,2-Tetrachloroethane	EPA 624
1,1-Dichloroethene	EPA 624
1,2-Dichloroethane	EPA 624
Bromomethane	EPA 624
Carbon tetrachloride	EPA 624
Chloroethane	EPA 624
Chloroform	EPA 624
Dibromochloromethane	EPA 624

Purgeable Halocarbons	
Methylene chloride	EPA 624
Trichloroethene	EPA 624
Vinyl chloride	EPA 624
Residue	
Solids, Total	EPA 160.1
	EPA 160.3
	SM18 2540B
Solids, Total Dissolved	EPA 160.1
	SM18 2540C
Solids, Total Suspended	EPA 160.2
	SM18 2540D
Wastewater Metals I	
Barium, Total	EPA 200.7
	MICROWAVE P/DIGEST
Cadmium, Total	EPA 200.7
	EPA 200.9
	EPA 213.2
	MICROWAVE P/DIGEST
Calcium, Total	EPA 200.7
Chromium, Total	EPA 200.7
	MICROWAVE P/DIGEST
Copper, Total	EPA 200.7
	MICROWAVE P/DIGEST

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stewater Metals I	
ın, Total	EPA 200.7
	MICROWAVE P/DIGEST
ad, Total	EPA 200.7
	EPA 200.9
	EPA 239.2
	MICROWAVE P/DIGEST
agnesium, Total	EPA 200.7
anganese, Total	EPA 200.7
	MICROWAVE P/DIGEST
ckel, Total	EPA 200.7
	EPA 249.2
	MICROWAVE P/DIGEST
tassium, Total	EPA 200.7
ver, Total	EPA 200.7
	EPA 200.9
	EPA 272.2
dium, Total	EPA 200.7
tewater Metals II	
uminum, Total	EPA 200.7
	MICROWAVE P/DIGEST
timony, Total	EPA 200.7
	EPA 200.9
	EPA 204.2

Wastewater Metals II	
Antimony, Total	MICROWAVE P/DIGEST
Arsenic, Total	EPA 200.7
	EPA 200.9
Beryllium, Total	EPA 200.7
Mercury, Total	EPA 245.1
Selenium, Total	EPA 200.7
	EPA 270.2
	MICROWAVE P/DIGEST
Vanadium, Total	EPA 200.7
Zinc, Total	EPA 200.7
	MICROWAVE P/DIGEST
Wastewater Metals III	
Cobalt, Total	EPA 200.7
	EPA 200.9
	EPA 219.2
Gold, Total	AES 0029
Molybdenum, Total	EPA 200.7
	EPA 246.2
Palladium, Total	AES 0029
Platinum, Total	AES 0029
Thallium, Total	EPA 200.7
	EPA 200.9
	EPA 279.2

l No.: 16484

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ed by calling (518) 485-5570.

l-3317 (3/97)

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner

Expires 12:01 AM April 01, 2003
Issued April 22, 2002
Revised July 05, 2002

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

DR. BRIAN S. SCHEPART
WASTE STREAM TECHNOLOGY
302 GROTE STREET
BUFFALO NY 14207 USA

NY Lab Id No: 11179
EPA Lab Code: NY00068

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER All approved analytes are listed below:

Wastewater Miscellaneous

Cyanide, Total	EPA 335.2
Hydrogen Ion (pH)	EPA 150.1
Oil & Grease Total Recoverabl	EPA 1664-A
	EPA 413.1
nic Carbon, Total	EPA 415.1
Su as S)	EPA 376.1
Surfactant (MBAS)	SM18 5540C

Se ' No.: 16484

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DOH-3317 (3/97)

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ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved subcategories and/or analytes are listed below:

lorinated Hydrocarbon Pesticides	
,4-DDD	EPA 608
lpha-BHC	EPA 608
aptan	Method Not Specified
ichloran	Method Not Specified
icofol	Method Not Specified
[illegible]	EPA 608
ndosulfan I	EPA 608
ndosulfan sulfate	EPA 608
ndrin aldehyde	EPA 608
eptachlor epoxide	EPA 608
odrin	Method Not Specified
ndane	EPA 608
ethoxychlor	Method Not Specified
irex	Method Not Specified
CNB	Method Not Specified
erthane	Method Not Specified
trobane	Method Not Specified
oxaphene	EPA 608
ifluralin	Method Not Specified
ychlorinated Biphenyls	
CB-1016	EPA 608
CB-1221	EPA 608
CB-1242	EPA 608
Polychlorinated Biphenyls	
PCB-1248	EPA 608
PCB-1254	EPA 608
Polynuclear Aromatics	
Acenaphthylene	EPA 625
Benzo(ghi)perylene	EPA 625
Benzo(k)fluoranthene	EPA 625
Chrysene	EPA 625
Dibenzo(a,h)anthracene	EPA 625
Fluorene	EPA 625
Naphthalene	EPA 625
Phenanthrene	EPA 625
Priority Pollutant Phenols	
2,4,5-Trichlorophenol	Method Not Specified
Purgeable Aromatics	
1,2-Dichlorobenzene	EPA 602
	EPA 624
	EPA 625
1,4-Dichlorobenzene	EPA 602
	EPA 624
	EPA 625
Purgeable Halocarbons	
1,1,2-Trichloroethane	EPA 624

[illegible]al No.: 16485

[illegible]y of the New York State Department of Health. Valid only at the address shown.
st be conspicuously posted. Valid certificates have a raised seal and may be
fied by calling (518) 485-5570.

H-3317 (3/97)

NEW YORK STATE DEPARTMENT OF HEALTH
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ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved subcategories and/or analytes are listed below:

Purgeable Halocarbons	
1,1-Dichloroethane	EPA 624
1,2-Dichloroethene (total)	EPA 624
1,2-Dichloropropane	EPA 624
2-Chloroethylvinyl ether	Method Not Specified
Bromodichloromethane	EPA 624
Bromoform	EPA 624
Chloromethane	EPA 624
cis-1,3-Dichloropropene	EPA 624
Dichlorodifluoromethane	Method Not Specified
Tetrachloroethene	EPA 624
trans-1,3-Dichloropropene	EPA 624
Trichlorofluoromethane	Method Not Specified
TCLP Additional Compounds	
Cresol	SW-846 8270C
Methylethyl ketone (2-butanon	SW-846 8260B
Pyridine	SW-846 8270C
Wastewater Metals II	
Chromium VI	SM 18 3500-CrD
Wastewater Miscellaneous	
Phenols	Method Not Specified

Serial No.: 16485

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All approved analytes are listed below:

ıracteristic Testing

P. Toxicity	SW846 1310
nitability	SW846 1010
	SW846 1020
eactivity	SW846 Ch7, Sec. 7.3
CLP	FED REG 1311

o..nated Hydrocarbon Pesticides

4-DDD	SW-846 8081A
ɔha-BHC	SW-846 8081A
ılordane Total	SW-846 8081A
eldrin	SW-846 8081A
ıdosulfan I	SW-846 8081A
ıdosulfan sulfate	SW-846 8081A
ıdrin aldehyde	SW-846 8081A
ptachlor epoxide	SW-846 8081A
ıdane	SW-846 8081A

ɔrinated Hydrocarbons

,4-Trichlorobenzene	SW-846 8270C
Chloronaphthalene	SW-846 8270C
xachlorobenzene	SW-846 8270C
xachlorobutadiene	SW-846 8270C
xachlorocyclopentadiene	SW-846 8270C
xachloroethane	SW-846 8270C

Chlorophenoxy Acid Pesticides

2,4,5-T	SW846 8151-A
2,4,5-TP (Silvex)	SW846 8151-A
2,4-D	SW846 8151-A
Dicamba	SW846 8151-A

Haloethers

Bis (2-chloroisopropyl) ether	SW-846 8270C
Bis(2-chloroethoxy)methane	SW-846 8270C

Metals I

Barium, Total	SW-846 6010B
Cadmium, Total	SW-846 6010B
Chromium, Total	SW-846 6010B
Lead, Total	SW-846 6010B
Nickel, Total	SW-846 6010B
Silver, Total	SW-846 6010B

Metals II

Antimony, Total	SW-846 6010B
Arsenic, Total	SW-846 6010B
Selenium, Total	SW-846 6010B

Miscellaneous

Hydrogen Ion (pH)	SW-846 9040B
	SW-846 9045C
Lead in Dust Wipes	APP. 14.2, HUD JUNE 1995

l No.: 16486

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All approved analytes are listed below:

Miscellaneous	
Sulfide (as S)	SW-846 9030B
	SW-846 9034
Nitroaromatics and Isophorone	
[illegible]initrotoluene	SW-846 8270C
2,[illegible]itrotoluene	SW-846 8270C
Isop[illegible]rone	SW-846 8270C
Nitrobenzene	SW-846 8270C
Phthalate Esters	
Benzyl butyl phthalate	SW-846 8270C
Bis(2-ethylhexyl) phthalate	SW-846 8270C
Diethyl phthalate	SW-846 8270C
Dimethyl phthalate	SW-846 8270C
Di-n-butyl phthalate	SW-846 8270C
Di-n-octyl phthalate	SW-846 8270C
Polychlorinated Biphenyls	
PCB-1016	SW-846 8082
PCB-1221	SW-846 8082
PCB-1232	SW-846 8082
PCB-1242	SW-846 8082
PCB-1248	SW-846 8082
PCB-1254	SW-846 8082
PCB-1260	SW-846 8082

Polynuclear Aromatic Hydrocarbons	
Acenaphthylene	SW-846 8270C
Benzo(b)fluoranthene	SW-846 8270C
Benzo(ghi)perylene	SW-846 8270C
Chrysene	SW-846 8270C
Dibenzo(a,h)anthracene	SW-846 8270C
Fluorene	SW-846 8270C
Naphthalene	SW-846 8270C
Phenanthrene	SW-846 8270C
Priority Pollutant Phenols	
2,4,6-Trichlorophenol	SW-846 8270C
2,4-Dichlorophenol	SW-846 8270C
2,4-Dimethylphenol	SW-846 8270C
2,4-Dinitrophenol	SW-846 8270C
2-Chlorophenol	SW-846 8270C
2-Methyl-4,6-dinitrophenol	SW-846 8270C
2-Nitrophenol	SW-846 8270C
4-Chloro-3-methylphenol	SW-846 8270C
4-Nitrophenol	SW-846 8270C
Pentachlorophenol	SW-846 8270C
Phenol	SW-846 8270C

S[illegible]l No.: 16486

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DOH-3317 (3/97)

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ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
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orinated Hydrocarbon Pesticides	
4 -DDE	SW-846 8081A
4 -DDT	SW-846 8081A
drin	SW-846 8081A
ta-BHC	SW-846 8081A
lta-BHC	SW-846 8081A
lfan II	SW-846 8081A
drin	SW-846 8081A
eptachlor	SW-846 8081A
ethoxychlor	SW-846 8081A
oxaphene	SW-846 8081A
als II	
romium VI	SW-846 7196A
ercury, Total	SW846 7471A
cellaneous	
anide, Total	SW-846 9014
	SW-846 9010B
ad in Paint	Method Not Specified
nuclear Aromatic Hydrocarbons	
enaphthene	SW-846 8270C
thracene	SW-846 8270C
nzo(a)anthracene	SW-846 8270C
nzo(a)pyrene	SW-846 8270C
oranthene	SW-846 8270C

Polynuclear Aromatic Hydrocarbons	
Indeno(1,2,3-cd)pyrene	SW-846 8270C
Pyrene	SW-846 8270C
Purgeable Aromatics	
1,2-Dichlorobenzene	SW-846 8021B
	SW-846 8260B
1,3-Dichlorobenzene	SW-846 8021B
	SW-846 8260B
1,4-Dichlorobenzene	SW-846 8021B
	SW-846 8260B
Benzene	SW-846 8021B
	SW-846 8260B
Chlorobenzene	SW-846 8021B
	SW-846 8260B
Ethyl benzene	SW-846 8021B
	SW-846 8260B
Toluene	SW-846 8021B
	SW-846 8260B
Total Xylenes	SW-846 8021B
	SW-846 8260B
Purgeable Halocarbons	
1,1,1-Trichloroethane	SW-846 8260B
1,1,2,2-Tetrachloroethane	SW-846 8260B
1,1,2-Trichloroethane	SW-846 8260B

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Purgeable Halocarbons	
1,1-Dichloroethane	SW-846 8260B
1,1-Dichloroethene	SW-846 8260B
1,2-Dichloroethane	SW-846 8260B
Dichloropropane	SW-846 8260B
Chloroethylvinyl ether	SW-846 8260B
Dichloromethane	SW-846 8260B
Bromoform	SW-846 8260B
Bromomethane	SW-846 8260B
Carbon tetrachloride	SW-846 8260B
Chloroethane	SW-846 8260B
Chloroform	SW-846 8260B
Chloromethane	SW-846 8260B
cis-1,3-Dichloropropene	Method Not Specified
Dibromochloromethane	SW-846 8260B
Dichlorodifluoromethane	SW-846 8260B
Methylene chloride	SW-846 8260B
Tetrachloroethene	SW-846 8260B
trans-1,3-Dichloropropene	Method Not Specified
Trichloroethene	SW-846 8260B
Trichlorofluoromethane	SW-846 8260B
Vinyl chloride	SW-846 8260B

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DOH-3317 (3/97)

STATE OF NEW YORK
DEPARTMENT OF HEALTH

Wadsworth Center The Governor Nelson A. Rockefeller Empire State Plaza P.O. Box 509 Albany, New York 12201-0509

Antonia C. Novello, M.D., M.P.H., Dr.P.H.
Commissioner

Dennis P. Whalen
Executive Deputy Commissioner

JUL 05 2002

Dear Laboratory Director:

Enclosed are the ELAP and/or NELAP Certificate(s) of Approval for permit year 2002-2003, issued to your environmental laboratory. The Certificate(s) supersede any previously issued and are in effect through March 31, 2003. Please carefully examine the Certificate(s) to insure that the category(ies), subcategory(ies), analyte(s) and method(s) for which your laboratory is approved are listed correctly, as well as verifying your laboratory's name, address, director and identification number.

Please note that pursuant to Section 55-2.5(a) NYCRR, any misrepresentation of the analytes or subcategories for which your laboratory is approved may result in suspension, limitation or termination of said certification.

The National Environmental Laboratory Accreditation Conference (NELAC) further defines and limits the use of NELAP accreditation and the NELAP logo.

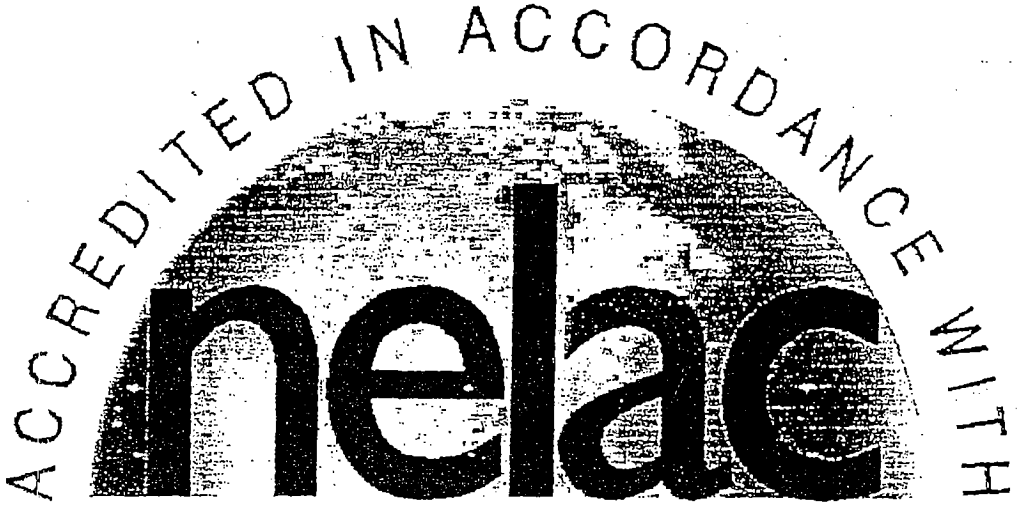
Please notify this office of any corrections required. We may be reached at (518) 485-5570.

Sincerely,

Linda L. Madlin

Linda L. Madlin
Administrative Assistant
Environmental Laboratory
Approval Program

LLM:mes
Encs.


ACCREDITED IN ACCORDANCE WITH
nelac


ACCREDITED IN ACCORDANCE WITH
nelac


ACCREDITED IN ACCORDANCE WITH
nelac

New Jersey Department of Environmental Protection and Energy

State of New Jersey
Department of Environmental Protection
Certifies That

WASTE STREAM TECHNOLOGY, INC.

LABORATORY CERTIFICATION ID # NY977

having duly met the requirements of the
Regulations Governing The Certification Of
Laboratories And Environmental Measurements N.J.A.C. 7:18 et. seq.
and
having been found compliant with the standards approved by the
National Environmental Laboratory Accreditation Conference
is hereby approved as a
State Certified Environmental Laboratory
to perform the analyses as indicated on the Annual Certified Parameter List
which must accompany this certificate to be valid

Expiration Date June 30, 2003

NJDEP is a NELAP Recognized Accrediting Authority

Joseph F. Aiello, Chief
Office of Quality Assurance

THIS CERTIFICATE IS TO BE CONSPICUOUSLY DISPLAYED AT THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST IN A LOCATION ON THE PREMISES VISIBLE TO THE PUBLIC

National Environmental Laboratory Accreditation Program

Annual Certified Parameter List and Current Status

WASTE STREAM TECHNOLOGY INC
302 GROTE STREET
BUFFALO, NY 14207
Lab ID NY977

Effective Date: 07/01/2002 Expiration Date: 06/30/2003

Status	Code	Parameter	EPA	ASTM	SM18	USGS	SW846	Other	Primary Accrediting Authority
D	SDW02.02000	NITRATE	353.2						NY
C	SDW02.04000	NITRATE	300.0						NY
C	SDW02.14000	FLUORIDE	300.0						NY
C	SDW02.15000	CYANIDE			4500 CN-G				NY
C	SDW02.15100	CYANIDE			4500CN-E				NY
C	SDW04.06000	ANTIMONY	200.9						NY
C	SDW04.10000	ARSENIC	200.9						NY
C	SDW04.11000	ARSENIC	200.7						NY
C	SDW04.16000	BARIUM	200.7						NY
C	SDW04.20000	BERYLLIUM	200.7						NY
C	SDW04.23000	CADMIUM	200.9						NY
C	SDW04.24000	CADMIUM	200.7						NY
C	SDW04.28000	CHROMIUM	200.7						NY
C	SDW04.33000	COPPER	200.7						NY
C	SDW04.37000	IRON	200.7						NY
D	SDW04.38000	LEAD		D3559-95D	3113 B				NY
C	SDW04.39000	LEAD	200.9						NY
C	SDW04.44000	MANGANESE	200.7						NY
C	SDW04.46000	MERCURY	245.1						NY
D	SDW04.47000	MERCURY	245.2						NY
D	SDW04.51000	NICKEL	200.9						NY
C	SDW04.52000	NICKEL	200.7						NY
C	SDW04.56000	SELENIUM	200.9						NY
C	SDW04.61000	SILVER	200.9						NY

For

Joseph F. Aiello, Chief

New Jersey Department of Environmental Protection
National Environmental Laboratory Accreditation Program
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Status	Code	Parameter	EPA	ASTM	SM18	USGS	SW846	Other	Primary Accrediting Authority
C	SDW04.62000	SILVER	200.7						NY
C	SDW04.64000	THALLIUM	200.9						NY
C	SDW04.67000	ZINC	200.7						NY
D	SDW06.01010	BROMOFORM	524.2						NY
D	SDW06.01020	CHLOROFORM	524.2						NY
D	SDW06.01030	DIBROMOCHLOROMETHANE	524.2						NY
D	SDW06.01040	DICHLOROBROMOMETHANE	524.2						NY
C	SDW06.02010	BENZENE	524.2						NY
C	SDW06.02020	CARBON TETRACHLORIDE	524.2						NY
C	SDW06.02030	CHLOROBENZENE	524.2						NY
C	SDW06.02040	1,2-DICHLOROBENZENE	524.2						NY
C	SDW06.02050	1,3-DICHLOROBENZENE	524.2						NY
C	SDW06.02060	1,4-DICHLOROBENZENE	524.2						NY
C	SDW06.02070	1,1-DICHLOROETHANE	524.2						NY
C	SDW06.02080	1,2-DICHLOROETHANE	524.2						NY
C	SDW06.02090	cis-1,2-DICHLOROETHENE	524.2						NY
C	SDW06.02100	trans-1,2-DICHLOROETHENE	524.2						NY
C	SDW06.02110	DICHLOROMETHANE (methylene chloride)	524.2						NY
C	SDW06.02120	1,2-DICHLOROPROPANE	524.2						NY
C	SDW06.02130	ETHYLBENZENE	524.2						NY
D	SDW06.02140	METHYL-TERT-BUTYL-ETHER	524.2						NY
D	SDW06.02150	NAPHTHALENE	524.2						NY
C	SDW06.02160	STYRENE	524.2						NY

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Status	Code	Parameter	EPA	ASTM	SM18	USGS	SW846	Other	Primary Accrediting Authority
C	SDW06.02170	1,1,2,2-TETRACHLOROETHANE	524.2						NY
C	SDW06.02180	TETRACHLOROETHENE	524.2						NY
C	SDW06.02190	1,1,1-TRICHLOROETHANE	524.2						NY
C	SDW06.02200	TRICHLOROETHENE	524.2						NY
C	SDW06.02210	TOLUENE	524.2						NY
C	SDW06.02220	1,2,4-TRICHLOROBENZENE	524.2						NY
C	SDW06.02230	1,1-DICHLOROETHENE	524.2						NY
C	SDW06.02240	1,1,2-TRICHLOROETHANE	524.2						NY
C	SDW06.02250	VINYL CHLORIDE	524.2						NY
C	SDW06.02260	XYLENES (TOTAL)	524.2						NY
C	SDW06.03010	BROMOBENZENE	524.2						NY
C	SDW06.03020	BROMOCHLOROMETHANE	524.2						NY
C	SDW06.03030	BROMOMETHANE	524.2						NY
C	SDW06.03040	n-BUTYLBENZENE	524.2						NY
C	SDW06.03050	sec-BUTYLBENZENE	524.2						NY
C	SDW06.03060	tert-BUTYLBENZENE	524.2						NY
C	SDW06.03070	CHLOROETHANE	524.2						NY
C	SDW06.03080	CHLOROMETHANE	524.2						NY
C	SDW06.03090	o-CHLOROTOLUENE	524.2						NY
C	SDW06.03100	p-CHLOROTOLUENE	524.2						NY
D	SDW06.03110	1,2-DIBROMO-3-CHLOROPROPANE	524.2						NY
D	SDW06.03120	1,2-DIBROMOETHANE	524.2						NY
C	SDW06.03130	DIBROMOMETHANE	524.2						NY
C	SDW06.03140	DICHLORODIFLUOROMETHANE	524.2						NY

New Jersey Department of Environmental Protection
National Environmental Laboratory Accreditation Program
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C	SDW06.03150	1,3-DICHLOROPROPANE	524.2						NY
C	SDW06.03160	2,2-DICHLOROPROPANE	524.2						NY
C	SDW06.03170	1,1-DICHLOROPROPENE	524.2						NY
C	SDW06.03180	cis-1,3-DICHLOROPROPENE	524.2						NY
C	SDW06.03190	trans-1,3-DICHLOROPROPENE	524.2						NY
C	SDW06.03200	HEXACHLOROBUTADIENE	524.2						NY
C	SDW06.03210	ISOPROPYLBENZENE	524.2						NY
C	SDW06.03220	p-ISOPROPYLTOLUENE	524.2						NY
C	SDW06.03230	n-PROPYLBENZENE	524.2						NY
C	SDW06.03240	1,1,1,2-TETRACHLOROETHANE	524.2						NY
C	SDW06.03250	1,2,3-TRICHLOROBENZENE	524.2						NY
C	SDW06.03260	TRICHLOROFLUOROMETHANE	524.2						NY
C	SDW06.03270	1,2,3-TRICHLOROPROPANE	524.2						NY
C	SDW06.03280	1,2,4-TRIMETHYLBENZENE	524.2						NY
C	SDW06.03300	1,3,5-TRIMETHYLBENZENE	524.2						NY
D	SDW06.03310	NITROBENZENE	524.2						NY
D	SDW06.03410	ACETONE	524.2						NY
D	SDW06.03420	ACRYLONITRILE	524.2						NY
D	SDW06.03430	ALLYL CHLORIDE	524.2						NY
D	SDW06.03440	2-BUTANONE	524.2						NY
D	SDW06.03450	CARBON DISULFIDE	524.2						NY
D	SDW06.03460	CHLOROACETONITRILE	524.2						NY
D	SDW06.03470	1-CHLOROBUTANE	524.2						NY
D	SDW06.03480	trans-1,4-DICHLORO-2-BUTENE	524.2						NY

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D	SDW06.03490	1,1-DICHLOROPROPANONE	524.2						NY
D	SDW06.03500	DIETHYL ETHER	524.2						NY
D	SDW06.03510	ETHYL METHACRYLATE	524.2						NY
D	SDW06.03520	HEXACHLOROETHANE	524.2						NY
D	SDW06.03530	2-HEXANONE	524.2						NY
D	SDW06.03540	METHACRYLONITRILE	524.2						NY
D	SDW06.03550	METHYLACRYLATE	524.2						NY
D	SDW06.03560	METHYL IODIDE	524.2						NY
D	SDW06.03570	METHYLMETHACRYLATE	524.2						NY
D	SDW06.03580	4-METHYL-2-PENTANONE	524.2						NY
D	SDW06.03590	2-NITROPROPANE	524.2						NY
D	SDW06.03600	PENTACHLOROETHANE	524.2						NY
D	SDW06.03610	PROPIONITRILE	524.2						NY
D	SDW06.03620	TETRAHYDROFURAN	524.2						NY
C	SDW07.01000	GROSS ALPHA-BETA	900.0		7110B				NY
C	SDW07.03900	RADIUM-226			7500-Ra B				NY
D	SDW07.04000	RADIUM-226	903.1		7500-Ra C				NY
C	SDW07.04100	RADIUM-228	904.0		7500-Ra D				NY
C	SDW07.05000	RADIUM,TOTAL			7500-Ra B				NY
A	SDW07.06000	STRONTIUM-89,90	905.0		7500-Sr B				NJ
A	SDW07.06010	STRONTIUM-90	905.0		7500-Sr B				NJ
D	SDW07.08000	URANIUM	908.1	D2907-97	7500-U C SM17th				NY
A	SDW07.08100	URANIUM						OTHER7500-UB SM17TH ED;EPA908.	NJ

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C	SHW02.01000	IGNITABILITY					1010 REV 0, 9/86		NY
C	SHW02.02000	IGNITABILITY					1020A, REV 1, 7/92		NY
C	SHW02.03000	CORROSIVITY, pH WASTE, >20% WATER					9040B, REV 2, 1/95		NY
C	SHW02.04000	CORROSIVITY TOWARD STEEL					1110, REV 0, 9/86		NY
C	SHW02.05000	REACTIVITY					7.3.3.2, REV 3, 12/96		NY
C	SHW02.06000	REACTIVITY					7.3.4.2, REV 3, 12/96		NY
C	SHW02.06900	VOLATILE ORGANICS					1311, REV 0, 7/92		NY
C	SHW02.07000	METALS/SEMI VOLATILE ORGANICS					1311, REV 0, 7/92		NJ
C	SHW02.07100	METALS/ORGANICS					1310A, REV 1, 7/92		NY
C	SHW02.08000	METALS/ORGANICS					1312, REV 0, 9/94		NY
C	SHW02.09000	METALS/ORGANICS					1320, REV 0, 9/86		NJ
C	SHW03.01000	pH, HYDROGEN ION					9040B, REV 2, 1/95		NY
C	SHW04.01000	METALS, TOTAL REC. + DISSOLVED					3005A, REV 1, 7/92		NY
C	SHW04.01500	METALS, TOTAL					3010A, REV 1, 7/92		NY
C	SHW04.02000	METALS					3020A, REV 1, 7/92		NY
C	SHW04.02100	METALS					3015, REV 0, 9/94,		NY
C	SHW04.02500	METALS					3040A, REV 1, 12/96		NY
C	SHW04.03000	METALS					3050B, REV 2, 12/96		NJ
C	SHW04.06500	ANTIMONY					6010B, REV 2, 12/96		NY
D	SHW04.08000	ANTIMONY					7041, REV 0, 9/86		NY
C	SHW04.09000	ARSENIC					6010B, REV 2, 12/96		NY
C	SHW04.11000	ARSENIC					7062, REV 0, 9/94		NY
D	SHW04.11100	ARSENIC					7060A, REV 0, 9/94		NY

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C	SHW04.11500	BARIUM					6010B, REV 2, 12/96		NY
C	SHW04.13500	BERYLLIUM					6010B, REV 2, 12/96		NJ
C	SHW04.15500	CADMIUM					6010B, REV 2, 12/96		NY
C	SHW04.17000	CADMIUM					7131A, REV 1, 9/94		NY
C	SHW04.17500	CALCIUM					6010B, REV 2, 12/96		NJ
C	SHW04.18500	CHROMIUM					6010B, REV 2, 12/96		NY
C	SHW04.21000	CHROMIUM (VI)					7196A, REV 1, 7/92		NY
A	SHW04.22500	COBALT					6010B, REV 2, 12/96		NJ
D	SHW04.24000	COBALT					7201, REV 0, 9/86		NY
A	SHW04.24500	COPPER					6010B, REV 2, 12/96		NJ
A	SHW04.26000	IRON					6010B, REV 2, 12/96		NJ
C	SHW04.27500	LEAD					6010B, REV 2, 12/96		NY
D	SHW04.29000	LEAD					7421, REV 0, 9/86		NY
A	SHW04.30500	MAGNESIUM					6010B, REV 2, 12/96		NY
A	SHW04.31500	MANGANESE					6010B, REV 2, 12/96		NJ
A	SHW04.33000	MERCURY, LIQUID WASTE					7470A, REV 1, 9/94		NJ
C	SHW04.33500	MERCURY, SOLID WASTE					7471A, REV 1, 9/94		NY
A	SHW04.34000	MOLYBDENUM					6010B, REV 2, 12/96		NJ
D	SHW04.35000	MOLYBDENUM					7481, REV 0, 9/86		NY
C	SHW04.35500	NICKEL					6010B, REV 2, 12/96		NY
A	SHW04.38000	POTASSIUM					6010B, REV 2, 12/96		NJ
C	SHW04.39000	SELENIUM					6010B, REV 2, 12/96		NY
D	SHW04.39500	SELENIUM					7740, REV 0, 9/86		NY
C	SHW04.41000	SILVER					6010B, REV 2, 12/96		NY

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D	SHW04.42500	SILVER					7761, REV 0, 7/92		NY
A	SHW04.43000	SODIUM					6010B, REV 2, 12/96		NJ
A	SHW04.45000	THALLIUM					6010B, REV 2, 12/96		NJ
D	SHW04.46500	THALLIUM					7841, REV 0, 9/86		NY
A	SHW04.47500	VANADIUM					6010B, REV 2, 12/96		NJ
A	SHW04.49000	ZINC					6010B, REV 2, 12/96		NJ
C	SHW05.00000	ORGANIC EXTRACTION					3500B, REV 2, 12/96		NY
C	SHW05.01000	SEMIVOLATILE ORGANICS					3510C, REV 3, 12/96		NY
C	SHW05.02000	SEMIVOLATILE ORGANICS					3520C, REV 3, 12/96		NY
C	SHW05.03000	SEMIVOLATILE ORGANICS					3540C, REV 3, 12/96		NY
C	SHW05.04000	SEMIVOLATILE ORGANICS					3541, REV 0, 9/94		NJ
C	SHW05.05000	SEMIVOLATILE ORGANICS					3550B, REV 2, 12/96		NY
C	SHW05.06000	ORGANICS					3580A, REV 1, 7/92		NY
C	SHW05.07000	VOLATILE ORGANICS					5030B, REV 2, 12/96		NY
C	SHW05.12000	SEMIVOLATILE ORGANICS					3620B, REV 2, 12/96		NY
C	SHW05.13000	SEMIVOLATILE ORGANICS					3630C, REV 3, 12/96		NY
C	SHW05.14000	SEMIVOLATILE ORGANICS					3640A, REV 1, 9/94		NY
C	SHW05.16000	SEMIVOLATILE ORGANICS					3660, REV 2, 12/96		NY
C	SHW05.17000	SEMIVOLATILE ORGANICS					3665A, REV 1, 12/96		NY
C	SHW06.05010	BENZENE					8021B, REV 2, 12/96		NY
C	SHW06.05020	CHLOROBENZENE					8021B, REV 2, 12/96		NY
C	SHW06.05030	1,2-DICHLOROBENZENE					8021B, REV 2, 12/96		NY
C	SHW06.05040	1,3-DICHLOROBENZENE					8021B, REV 2, 12/96		NY
C	SHW06.05050	1,4-DICHLOROBENZENE					8021B, REV 2, 12/96		NY

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C	SHW06.05060	ETHYLBENZENE					8021B, REV 2, 12/96		NY
C	SHW06.05070	TOLUENE					8021B, REV 2, 12/96		NY
C	SHW06.05080	O-XYLENE					8021B, REV 2, 12/96		NY
C	SHW06.05090	M-XYLENE					8021B, REV 2, 12/96		NY
C	SHW06.05100	P-XYLENE					8021B, REV 2, 12/96		NY
A	SHW06.05360	METHYL-TERT-BUTYL ETHER					8021B, REV 2, 12/96		NJ
C	SHW06.12010	ALDRIN					8081A, REV 1, 12/96		NY
C	SHW06.12020	ALPHA-BHC					8081A, REV 1, 12/96		NY
C	SHW06.12030	BETA-BHC					8081A, REV 1, 12/96		NY
C	SHW06.12040	DELTA-BHC					8081A, REV 1, 12/96		NY
C	SHW06.12050	GAMMA-BHC (LINDANE)					8081A, REV 1, 12/96		NY
C	SHW06.12060	CHLORDANE (TECHNICAL)					8081A, REV 1, 12/96		NY
C	SHW06.12090	4,4'-DDD					8081A, REV 1, 12/96		NY
C	SHW06.12100	4,4'-DDE					8081A, REV 1, 12/96		NY
C	SHW06.12110	4,4'-DDT					8081A, REV 1, 12/96		NY
C	SHW06.12120	DIELDRIN					8081A, REV 1, 12/96		NY
C	SHW06.12130	ENDOSULFAN I					8081A, REV 1, 12/96		NY
C	SHW06.12140	ENDOSULFAN II					8081A, REV 1, 12/96		NY
C	SHW06.12150	ENDOSULFAN SULFATE					8081A, REV 1, 12/96		NY
C	SHW06.12160	ENDRIN					8081A, REV 1, 12/96		NY
C	SHW06.12170	ENDRIN ALDEHYDE					8081A, REV 1, 12/96		NY
C	SHW06.12180	ENDRIN KETONE					8081A, REV 1, 12/96		NY
C	SHW06.12190	HEPTACHLOR					8081A, REV 1, 12/96		NY
C	SHW06.12200	HEPTACHLOR EPOXIDE					8081A, REV 1, 12/96		NY

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C	SHW06.12210	METHOXYCHLOR					8081A, REV 1, 12/96		NY
C	SHW06.12220	TOXAPHENE					8081A, REV 1, 12/96		NY
C	SHW06.13110	PCB-1016					8082, REV 0, 12/96		NY
C	SHW06.13120	PCB-1221					8082, REV 0, 12/96		NY
C	SHW06.13130	PCB-1232					8082, REV 0, 12/96		NY
C	SHW06.13140	PCB-1242					8082, REV 0, 12/96		NY
C	SHW06.13150	PCB-1248					8082, REV 0, 12/96		NY
C	SHW06.13160	PCB-1254					8082, REV 0, 12/96		NY
C	SHW06.13170	PCB-1260					8082, REV 0, 12/96		NY
A	SHW06.23010	DALAPON					8151A, REV 1, 9/96		NJ
C	SHW06.23020	DICAMBA					8151A, REV 1, 9/96		NY
A	SHW06.23030	DINOSEB					8151A, REV 1, 9/96		NJ
C	SHW06.23040	2,4-D					8151A, REV 1, 9/96		NY
C	SHW06.23050	2,4,5-T					8151A, REV 1, 9/96		NY
C	SHW06.23060	2,4,5-TP					8151A, REV 1, 9/96		NY
C	SHW07.04010	BENZENE					8260B, REV 2, 12/96		NY
C	SHW07.04020	CHLOROBENZENE					8260B, REV 2, 12/96		NY
C	SHW07.04030	1,2-DICHLOROBENZENE					8260B, REV 2, 12/96		NY
C	SHW07.04040	1,3-DICHLOROBENZENE					8260B, REV 2, 12/96		NY
C	SHW07.04050	1,4-DICHLOROBENZENE					8260B, REV 2, 12/96		NY
C	SHW07.04060	ETHYLBENZENE					8260B, REV 2, 12/96		NY
C	SHW07.04070	TOLUENE					8260B, REV 2, 12/96		NY
C	SHW07.04080	TOTAL XYLENES					8260B, REV 2, 12/96		NY
C	SHW07.04090	BROMODICHLOROMETHANE					8260B, REV 2, 12/96		NY

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C	SHW07.04100	BROMOFORM					8260B, REV 2, 12/96		NY
C	SHW07.04110	BROMOMETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04120	CARBON TETRACHLORIDE					8260B, REV 2, 12/96		NY
C	SHW07.04130	CHLOROETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04140	2-CHLOROETHYL VINYL ETHER					8260B, REV 2, 12/96		NY
C	SHW07.04150	CHLOROFORM					8260B, REV 2, 12/96		NY
C	SHW07.04160	CHLOROMETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04170	TRANS, 1,3-DICHLOROPROPENE					8260B, REV 2, 12/96		NY
C	SHW07.04180	DIBROMOCHLOROMETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04190	DICHLORODIFLUOROMETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04200	1,1-DICHLOROETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04210	1,2-DICHLOROETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04220	1,1-DICHLOROETHENE					8260B, REV 2, 12/96		NY
D	SHW07.04230	TRANS 1,2-DICHLOROETHENE					8260B, REV 2, 12/96		NY
C	SHW07.04240	1,2-DICHLOROPROPANE					8260B, REV 2, 12/96		NY
C	SHW07.04250	CIS 1,3-DICHLOROPROPENE					8260B, REV 2, 12/96		NY
C	SHW07.04260	METHYLENE CHLORIDE					8260B, REV 2, 12/96		NY
C	SHW07.04270	1,1,2,2-TETRACHLOROETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04280	TETRACHLOROETHENE					8260B, REV 2, 12/96		NY
C	SHW07.04290	1,1,1-TRICHLOROETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04300	1,1,2-TRICHLOROETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04310	TRICHLOROETHENE					8260B, REV 2, 12/96		NY
C	SHW07.04320	TRICHLOROFLUOROMETHANE					8260B, REV 2, 12/96		NY
C	SHW07.04330	VINYL CHLORIDE					8260B, REV 2, 12/96		NY

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A	SHW07.04340	ACETONE					8260B, REV 2, 12/96		NJ
A	SHW07.04350	CARBON DISULFIDE					8260B, REV 2, 12/96		NJ
A	SHW07.04360	2-BUTANONE					8260B, REV 2, 12/96		NJ
A	SHW07.04370	2-HEXANONE					8260B, REV 2, 12/96		NJ
A	SHW07.04380	4-METHYL-2-PENTANONE					8260B, REV 2, 12/96		NJ
A	SHW07.04390	METHYL-TERT-BUTYL ETHER					8260B, REV 2, 12/96		NJ
A	SHW07.04400	ACROLEIN					8260B, REV 2, 12/96		NJ
A	SHW07.04410	ACRYLONITRILE					8260B, REV 2, 12/96		NJ
A	SHW07.04500	HEXACHLOROBUTADIENE					8260B, REV 2, 12/96		NJ
A	SHW07.04530	HEXACHLOROETHANE					8260B, REV 2, 12/96		NJ
A	SHW07.04540	NAPTHALENE					8260B, REV 2, 12/96		NJ
A	SHW07.04550	STYRENE					8260B, REV 2, 12/96		NJ
A	SHW07.04560	1,1,1,2-TETRACHLOROETHANE					8260B, REV 2, 12/96		NJ
A	SHW07.04570	1,2,4-TRICHLOROBENZENE					8260B, REV 2, 12/96		NJ
A	SHW07.04580	NITROBENZENE					8260B, REV 2, 12/96		NJ
D	SHW07.05000	SEMIVOLATILE ORGANICS					8270C, REV 3, 12/96		NY
D	SHW07.05010	N-NITROSODIPHENYLAMINE					8270C, REV 3, 12/96		NY
A	SHW07.05030	CARBAZOLE							NJ
A	SHW07.05040	3,3'-DICHLOROBENZIDINE					8270C, REV 3, 12/96		NJ
D	SHW07.05050	4-CHLORANILINE					8270C, REV 3, 12/96		NY
D	SHW07.05060	2-NITROANILINE					8270C, REV 3, 12/96		NY
C	SHW07.05070	2-CHLORONAPHTHALENE					8270C, REV 3, 12/96		NY
C	SHW07.05080	HEXACHLOROBENZENE					8270C, REV 3, 12/96		NY
C	SHW07.05090	HEXACHLOROBUTADIENE					8270C, REV 3, 12/96		NY

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C	SHW07.05100	HEXACHLOROCYCLOPENTADIENE					8270C, REV 3, 12/96		NY
C	SHW07.05110	HEXACHLOROETHANE					8270C, REV 3, 12/96		NY
C	SHW07.05120	1,2,4-TRICHLOROBENZENE					8270C, REV 3, 12/96		NY
A	SHW07.05130	BIS (2-CHLOROETHOXY) METHANE					8270C, REV 3, 12/96		NY
D	SHW07.05140	BIS (2-CHLOROISOPROPYL) ETHER					8270C, REV 3, 12/96		NY
A	SHW07.05150	4-CHLOROPHENYL-PHENYLETHER					8270C, REV 3, 12/96		NJ
A	SHW07.05160	4-BROMOPHENYL-PHENYLETHER					8270C, REV 3, 12/96		NJ
C	SHW07.05170	2,4-DINITROTOLUENE					8270C, REV 3, 12/96		NY
C	SHW07.05180	2,6-DINITROTOLUENE					8270C, REV 3, 12/96		NY
C	SHW07.05190	ISOPHORONE					8270C, REV 3, 12/96		NY
C	SHW07.05200	NITROBENZENE					8270C, REV 3, 12/96		NY
C	SHW07.05210	BUTYL BENZYL PHTHALATE					8270C, REV 3, 12/96		NY
C	SHW07.05220	BIS (2-ETHYLHEXYL) PHTHALATE					8270C, REV 3, 12/96		NY
C	SHW07.05230	DIETHYL PHTHALATE					8270C, REV 3, 12/96		NY
C	SHW07.05240	DIMETHYL PHTHALATE					8270C, REV 3, 12/96		NY
C	SHW07.05250	DI-N-BUTYL PHTHALATE					8270C, REV 3, 12/96		NY
C	SHW07.05260	DI-N-OCTYL PHTHALATE					8270C, REV 3, 12/96		NY
C	SHW07.05270	ACENAPHTHENE					8270C, REV 3, 12/96		NY
C	SHW07.05280	ANTHRACENE					8270C, REV 3, 12/96		NY
C	SHW07.05290	ACENAPHTHYLENE					8270C, REV 3, 12/96		NY
C	SHW07.05300	BENZO(A)ANTHRACENE					8270C, REV 3, 12/96		NY
C	SHW07.05310	BENZO(A)PYRENE					8270C, REV 3, 12/96		NY
C	SHW07.05320	BENZO(B)FLUORANTHENE					8270C, REV 3, 12/96		NY
C	SHW07.05330	BENZO(GHI)PERYLENE					8270C, REV 3, 12/96		NY

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A	SHW07.05340	BENZO(K)FLUORANTHENE					8270C, REV 3, 12/96		NJ
C	SHW07.05350	CHRYSENE					8270C, REV 3, 12/96		NY
C	SHW07.05360	DIBENZO(A,H)ANTHRACENE					8270C, REV 3, 12/96		NY
C	SHW07.05370	FLUORANTHENE					8270C, REV 3, 12/96		NY
C	SHW07.05380	FLUORENE					8270C, REV 3, 12/96		NY
C	SHW07.05390	INDENO(1,2,3-CD)PYRENE					8270C, REV 3, 12/96		NY
A	SHW07.05400	2-METHYLNAPHTHALENE					8270C, REV 3, 12/96		NJ
C	SHW07.05410	NAPHTHALENE					8270C, REV 3, 12/96		NY
C	SHW07.05420	PHENANTHRENE					8270C, REV 3, 12/96		NY
C	SHW07.05430	PYRENE					8270C, REV 3, 12/96		NY
C	SHW07.05440	4-CHLORO-3-METHYL-PHENOL					8270C, REV 3, 12/96		NY
C	SHW07.05450	2-CHLOROPHENOL					8270C, REV 3, 12/96		NY
C	SHW07.05460	2,4-DICHLOROPHENOL					8270C, REV 3, 12/96		NY
C	SHW07.05470	2,4-DIMETHYLPHENOL					8270C, REV 3, 12/96		NY
C	SHW07.05480	2,4-DINITROPHENOL					8270C, REV 3, 12/96		NY
C	SHW07.05490	2-METHYL-4,6-DINITROPHENOL					8270C, REV 3, 12/96		NY
D	SHW07.05500	2-METHYLPHENOL					8270C, REV 3, 12/96		NJ
D	SHW07.05510	4-METHYLPHENOL					8270C, REV 3, 12/96		NJ
C	SHW07.05520	2-NITROPHENOL					8270C, REV 3, 12/96		NY
C	SHW07.05530	4-NITROPHENOL					8270C, REV 3, 12/96		NY
C	SHW07.05540	PENTACHLOROPHENOL					8270C, REV 3, 12/96		NY
C	SHW07.05550	PHENOL					8270C, REV 3, 12/96		NY
A	SHW07.05560	2,4,5-TRICHLOROPHENOL					8270C, REV 3, 12/96		NJ
C	SHW07.05570	2,4,6-TRICHLOROPHENOL					8270C, REV 3, 12/96		NY

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A	SHW07.05590	3-METHYLPHENOL					8270C, REV 3, 12/96		NJ
A	SHW07.05600	DIBENZOFURAN					8270C, REV 3, 12/96		NJ
A	SHW07.05700	1,4-DICHLOROBENZENE					8270C, REV 3, 12/96		NJ
A	SHW07.05750	PYRIDINE					8270C, REV 3 12/96		NJ
D	SHW09.01000	TOTAL REC. PETROL. HYDROCARBONS					8440, REV 0, 12/96		NY
C	SHW09.02000	CYANIDE TOTAL					9010B, REV 2, 12/96		NY
C	SHW09.03000	CYANIDE TOTAL, AMENABLE TO CI2					9010B, REV 2, 12/96		NY
C	SHW09.04100	CYANIDE TOTAL					9014, REV 0, 12/96		NY
C	SHW09.09000	SULFIDES, ACID SOL. & INSOLUBLES					9030B, REV 2, 12/96		NY
C	SHW09.10100	SULFIDES, ACID SOL. & INSOL.					9034, REV 0, 12/96		NY
C	SHW09.14000	pH, HYDROGEN ION, WASTE, >20% WATER					9040B, REV 2, 1/95		NY
C	SHW09.16000	pH, SOIL AND WASTE					9045C, REV 3, 1/95		NY
C	SHW09.21000	PHENOLS					9065, REV 0, 9/86		NY
C	SHW09.24100	OIL & GREASE-HEM					1664A		NY
A	SHW09.25000	OIL & GREASE, SLUDGE-HEM					9071B, REV 2, 5/99		NJ
C	SHW09.29000	FREE LIQUID					9095, REV 0, 9/86		NY
A	SHW09.34000	CHLORIDE					9253, REV 0, 9/94		NJ
A	SHW09.60000	GROSS ALPHA-BETA					9310, REV 0, 9/86		NJ
A	SHW09.60100	ALPHA EMITTING RADIUM ISOTOPES					9315, REV 0, 9/86		NJ
A	SHW09.60110	RADIUM-228					9320, REV 0, 9/86		NJ
A	SHW09.60120	CESIUM-134/137						DoE 4.5.2.3	NJ
A	SHW09.60130	COBALT-60						DoE 4.5.2.3	NJ

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A	SHW09.60140	ZINC-65						DoE 4.5.2.3	NJ
A	SHW09.60150	BARIUM-133						DoE 4.5.2.3	NJ
A	SHW09.60200	STRONTIUM-89/90						DoE 1990 Sr-01, 02	NJ
A	SHW09.60300	URANIUM						DoE 1990 U-02	NJ
A	SHW09.60400	THORIUM						DoE 4.5.5	NJ
C	WPP02.01000	ACIDITY as CaCO3	305.1						NY
C	WPP02.01500	ALKALINITY as CaCO3	310.1						NY
C	WPP02.03500	AMMONIA	350.2+ .3						NY
C	WPP02.05000	BIOCHEMICAL OXYGEN DEMAND	405.1						NY
C	WPP02.08000	CALCIUM	200.7						NY
C	WPP02.10000	CHEMICAL OXYGEN DEMAND (COD)	410.1 OR .2 OR .3		5220 C				NY
C	WPP02.10500	CHEMICAL OXYGEN DEMAND	410.4						NY
C	WPP02.11000	CHLORIDE			4500-Cl B				NY
C	WPP02.11500	CHLORIDE	325.3		4500-Cl C				NY
C	WPP02.12600	CHLORIDE	300.0						NY
C	WPP02.15000	CYANIDE	335.2						NY
D	WPP02.16000	CYANIDE AMENABLE TO Cl2	335.1						NY
D	WPP02.16500	FLUORIDE	340.2						NY
C	WPP02.18100	FLUORIDE	300.0						NY
C	WPP02.19000	HARDNESS-TOTAL as CaCO3	130.2						NY
C	WPP02.24000	MAGNESIUM	200.7						NY
C	WPP02.26100	NITRATE	300.0						NY

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A	WPP02.26500	NITRATE-NITRITE	353.3						NY
C	WPP02.29000	OIL & GREASE--TOTAL RECOV	413.1						NY
C	WPP02.29100	OIL & GREASE-HEM-LL	1664A						NY
C	WPP02.31500	ORTHOPHOSPHATE	365.2						NY
C	WPP02.32000	ORTHOPHOSPHATE	365.3						NY
C	WPP02.32100	ORTHOPHOSPHATE	300.0						NY
C	WPP02.32500	PHENOLS	420.1						NY
C	WPP02.34000	PHOSPHORUS(TOTAL)	365.2						NY
			+ .3						
C	WPP02.36500	POTASSIUM	200.7						NY
C	WPP02.38000	RESIDUE-TOTAL	160.3						NY
C	WPP02.38500	RESIDUE-FILTERABLE(TDS)	160.1						NY
C	WPP02.39000	RESIDUE-NONFILTERABLE(TSS)	160.2						NY
A	WPP02.39500	RESIDUE-SETTLEABLE	160.5						NJ
A	WPP02.40000	RESIDUE-VOLATILE	160.4						NJ
D	WPP02.42500	SILICA-DISSOLVED	200.7						NY
C	WPP02.44000	SODIUM	200.7						NY
C	WPP02.46500	SULFATE	375.4						NY
C	WPP02.47100	SULFATE	300.0						NY
C	WPP02.47500	SULFIDE-S	376.1						NY
C	WPP02.48500	SURFACTANTS	425.1		5540 C				NY
C	WPP03.09000	pH HYDROGEN ION	150.1		4500-H B				NY
C	WPP04.02000	ALUMINUM	200.7						NY
C	WPP04.04000	ANTIMONY	204.2						NY

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C	WPP04.04100	ANTIMONY	200.9						NY
C	WPP04.04500	ANTIMONY	200.7						NY
D	WPP04.05000	ARSENIC	206.5 + .2						NY
C	WPP04.05100	ARSENIC	200.9						NY
C	WPP04.05600	ARSENIC	200.7						NY
C	WPP04.08000	BARIUM	200.7						NY
C	WPP04.11000	BERYLLIUM	200.7						NY
C	WPP04.12000	CADMIUM	213.2						NY
C	WPP04.12100	CADMIUM	200.9						NY
C	WPP04.13500	CADMIUM	200.7						NY
C	WPP04.14500	CHROMIUM (VI)	218.4		3111 C				NY
A	WPP04.15000	CHROMIUM (VI)							NJ
C	WPP04.18000	CHROMIUM	200.7						NY
C	WPP04.19000	COBALT	219.2						NY
C	WPP04.19100	COBALT	200.9						NY
C	WPP04.19500	COBALT							NY
C	WPP04.21500	COPPER	200.7						NY
D	WPP04.23600	GOLD							
C	WPP04.26500	IRON	200.7						NY
A	WPP04.27500	LEAD	239.2						NY
C	WPP04.27600	LEAD	200.9						NY
C	WPP04.28000	LEAD	200.7						NY
C	WPP04.31000	MANGANESE	200.7						NY

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C	WPP04.33000	MERCURY	245.1						NY
D	WPP04.33500	MERCURY	245.2						NY
C	WPP04.34500	MOLYBDENUM	246.2						NY
C	WPP04.35000	MOLYBDENUM	200.7						NY
C	WPP04.37000	NICKEL	249.2						NY
C	WPP04.37500	NICKEL	200.7						NY
D	WPP04.40600	PALLADIUM							
D	WPP04.42100	PLATINUM							
C	WPP04.45000	SELENIUM	270.2						NY
C	WPP04.45500	SELENIUM	200.7						NY
C	WPP04.47000	SILVER	272.2						NY
C	WPP04.48000	SILVER	200.7						NY
C	WPP04.49500	THALLIUM	279.2						NY
C	WPP04.49600	THALLIUM	200.9						NY
C	WPP04.50000	THALLIUM	200.7						NY
C	WPP04.54000	VANADIUM	200.7						NY
D	WPP04.56000	ZINC	289.2						NY
C	WPP04.56500	ZINC	200.7						NY
C	WPP05.02010	BENZENE	602						NY
C	WPP05.02020	CHLOROBENZENE	602						NY
C	WPP05.02030	1,2-DICHLOROBENZENE	602						NY
C	WPP05.02040	1,3-DICHLOROBENZENE	602						NY
C	WPP05.02050	1,4-DICHLOROBENZENE	602						NY
C	WPP05.02060	ETHYLBENZENE	602						NY

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C	WPP05.02070	TOLUENE	602						NY
C	WPP05.02080	TOTAL XYLENES	602						NY
C	WPP05.09010	ALDRIN	608						NY
C	WPP05.09020	ALPHA-BHC	608						NY
C	WPP05.09030	BETA-BHC	608						NY
C	WPP05.09040	DELTA-BHC	608						NY
C	WPP05.09050	GAMMA-BHC	608						NY
C	WPP05.09060	CHLORDANE	608						NY
C	WPP05.09070	4,4'-DDD	608						NY
C	WPP05.09080	4,4'-DDE	608						NY
C	WPP05.09090	4,4'-DDT	608						NY
C	WPP05.09100	DIELDRIN	608						NY
C	WPP05.09110	ENDOSULFAN I	608						NY
C	WPP05.09120	ENDOSULFAN II	608						NY
C	WPP05.09130	ENDOSULFAN SULFATE	608						NY
C	WPP05.09140	ENDRIN	608						NY
C	WPP05.09150	ENDRIN ALDEHYDE	608						NY
A	WPP05.09160	ENDRIN KETONE	608						NJ
C	WPP05.09170	HEPTACHLOR	608						NY
C	WPP05.09180	HEPTACHLOR EPOXIDE	608						NY
C	WPP05.09190	METHOXYCHLOR	608						NY
C	WPP05.09200	TOXAPHENE	608						NY
C	WPP05.11010	PCB-1016	608						NY
C	WPP05.11020	PCB-1221	608						NY

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A	WPP05.11030	PCB-1232	608						NY
C	WPP05.11040	PCB-1242	608						NY
C	WPP05.11050	PCB-1248	608						NY
C	WPP05.11060	PCB-1254	608						NY
A	WPP05.11070	PCB-1260	608						NY
C	WPP06.02010	BENZENE	624						NY
C	WPP06.02020	BROMODICHLOROMETHANE	624						NY
C	WPP06.02030	BROMOFORM	624						NY
C	WPP06.02040	BROMOMETHANE	624						NY
A	WPP06.02050	CARBON TETRACHLORIDE	624						NY
C	WPP06.02060	CHLOROBENZENE	624						NY
C	WPP06.02070	CHLOROETHANE	624						NY
C	WPP06.02080	2-CHLOROETHYL VINYL ETHER	624						NY
C	WPP06.02090	CHLOROFORM	624						NY
C	WPP06.02100	CHLOROMETHANE	624						NY
C	WPP06.02110	DIBROMOCHLOROMETHANE.	624						NY
C	WPP06.02120	1,2-DICHLOROBENZENE	624						NY
C	WPP06.02130	1,3-DICHLOROBENZENE	624						NY
C	WPP06.02140	1,4-DICHLOROBENZENE	624						NY
C	WPP06.02150	1,1-DICHLOROETHANE	624						NY
C	WPP06.02160	1,2-DICHLOROETHANE	624						NY
C	WPP06.02170	1,1-DICHLOROETHENE	624						NY
C	WPP06.02180	TRANS-1,2-DICHLOROETHENE	624						NY
C	WPP06.02190	1,2-DICHLOROPROPANE	624						NY

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C	WPP06.02200	CIS-1,3-DICHLOROPROPENE	624						NY
C	WPP06.02210	TRANS-1,3-DICHLOROPROPENE	624						NY
C	WPP06.02220	ETHYLBENZENE	624						NY
C	WPP06.02230	METHYLENE CHLORIDE	624						NY
A	WPP06.02232	METHYL TERT-BUTYL ETHER	624						NJ
A	WPP06.02234	TERT-BUTYL ALCOHOL	624						NJ
A	WPP06.02238	STYRENE	624		6210 B				NJ
C	WPP06.02240	1,1,2,2-TETRACHLOROETHANE	624						NY
C	WPP06.02250	TETRACHLOROETHENE	624						NY
C	WPP06.02260	TOLUENE	624						NY
C	WPP06.02270	1,1,1-TRICHLOROETHANE	624						NY
C	WPP06.02280	1,1,2-TRICHLOROETHANE	624						NY
C	WPP06.02290	TRICHLOROETHENE	624						NY
C	WPP06.02300	TRICHLOROFLUOROMETHANE	624						NY
C	WPP06.02310	VINYL CHLORIDE	624						NY
C	WPP06.02312	TOTAL XYLENES	624						NY
C	WPP06.03010	ACENAPHTHENE	625						NY
C	WPP06.03020	ACENAPHTHYLENE	625						NY
C	WPP06.03030	ANTHRACENE	625						NY
C	WPP06.03040	BENZO(A)ANTHRACENE	625						NY
C	WPP06.03050	BENZO(B)FLUORANTHENE	625						NY
C	WPP06.03060	BENZO(K)FLUORANTHENE	625						NY
C	WPP06.03070	BENZO(A)PYRENE	625						NY
C	WPP06.03080	BENZO(GHI)PERYLENE	625						NY

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C	WPP06.03090	BUTYL BENZYL PHTHALATE	625						NY
C	WPP06.03100	BIS (2-CHLOROETHYL) ETHER	625						NY
C	WPP06.03110	BIS (2-CHLOROETHOXY)METHANE	625						NY
C	WPP06.03120	BIS (2-ETHYLHEXYL) PHTHALATE	625						NY
C	WPP06.03130	BIS (2-CHLOROISOPROPYL) ETHER	625						NY
C	WPP06.03140	4-BROMOPHENYL-PHENYL ETHER	625						NY
C	WPP06.03150	2-CHLORONAPHTHALENE	625						NY
C	WPP06.03160	4-CHLOROPHENYL-PHENYL ETHER	625						NY
C	WPP06.03170	CHRYSENE	625						NY
C	WPP06.03180	DIBENZO(A,H)ANTHRACENE	625						NY
C	WPP06.03190	DI-N-BUTYL PHTHALATE	625						NY
C	WPP06.03200	1,3-DICHLOROBENZENE	625						NY
C	WPP06.03210	1,2-DICHLOROBENZENE	625						NY
C	WPP06.03220	1,4-DICHLOROBENZENE	625						NY
C	WPP06.03230	3,3'-DICHLOROBENZIDINE	625						NY
C	WPP06.03240	DIETHYL PHTHALATE	625						NY
C	WPP06.03250	DIMETHYL PHTHALATE	625						NY
C	WPP06.03260	2,4-DINITROTOLUENE	625						NY
C	WPP06.03270	2,6-DINITROTOLUENE	625						NY
C	WPP06.03280	DI-N-OCTYL PHTHALATE	625						NY
C	WPP06.03290	FLUORANTHENE	625						NY
C	WPP06.03300	FLUORENE	625						NY
C	WPP06.03310	HEXACHLOROBENZENE	625						NY
C	WPP06.03320	HEXACHLOROBUTADIENE	625						NY

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C	WPP06.03330	HEXACHLOROETHANE	625						NY
C	WPP06.03340	INDENO(1,2,3-CD)PYRENE	625						NY
C	WPP06.03350	ISOPHORONE	625						NY
A	WPP06.03358	METHYLNAPTHALENE	625						NJ
C	WPP06.03360	NAPHTHALENE	625						NY
A	WPP06.03366	4-CHLOROANALINE	625						NJ
A	WPP06.03367	2-NITROANILINE	625						NJ
A	WPP06.03368	3-NITROANILINE	625						NJ
A	WPP06.03369	4-NITROANILINE	625						NJ
C	WPP06.03370	NITROBENZENE	625						NY
C	WPP06.03380	N-NITROSODI-N-PROPYLAMINE	625						NY
C	WPP06.03390	PHENANTHRENE	625						NY
C	WPP06.03400	PYRENE	625						NY
C	WPP06.03410	1,2,4-TRICHLOROBENZENE	625						NY
A	WPP06.03417	2-METHYLPHENOL	625						NJ
A	WPP06.03418	4-METHYLPHENOL	625						NJ
C	WPP06.03420	4-CHLORO-3-METHYLPHENOL	625						NY
C	WPP06.03430	2-CHLOROPHENOL	625						NY
C	WPP06.03440	2,4-DICHLOROPHENOL	625						NY
C	WPP06.03450	2,4-DIMETHYLPHENOL	625						NY
C	WPP06.03460	2,4-DINITROPHENOL	625						NY
C	WPP06.03470	2-METHYL-4,6-DINITROPHENOL	625						NY
C	WPP06.03480	2-NITROPHENOL	625						NY
C	WPP06.03490	4-NITROPHENOL	625						NY

WASTE STREAM TECHNOLOGY INC
302 GROTE STREET
BUFFALO, NY 14207
Lab ID NY977

Effective Date: 07/01/2002 Expiration Date: 06/30/2003

Status	Code	Parameter	EPA	ASTM	SM18	USGS	SW846	Other	Primary Accrediting Authority
C	WPP06.03500	PENTACHLOROPHENOL	625						NY
C	WPP06.03510	PHENOL	625						NY
C	WPP06.03520	2,4,6-TRICHLOROPHENOL	625						NY
A	WPP06.03530	BENZOIC ACID	625						NJ
C	WPP06.03540	p-CRESOL	625						NY
D	WPP06.03550	ACETOPHENONE	625						NY
D	WPP06.03560	ALPHA-TERPINEOL	625						NY
A	WPP06.03570	ANILINE	625						NJ
C	WPP06.03580	BENZIDINE	625						NY
A	WPP06.03590	CARBAZOLE	625						NJ
D	WPP06.03600	2,3-DICHLOROANILINE	625						NY
D	WPP06.03610	O-CRESOL	625						NY
D	WPP06.03620	N-DECANE	625						NY
D	WPP06.03630	N-DOCOSANE	625						NY
D	WPP06.03640	N-DODECANE	625						NY
D	WPP06.03650	N-EICOSANE	625						NY
C	WPP06.03660	HEXACHLOROCYCLOPENTADIENE	625						NY
D	WPP06.03670	N-HEXADECANE	625						NY
C	WPP06.03680	N-NITROSODIMETHYLAMINE	625						NY
C	WPP06.03690	N-NITROSODIPHENYLAMINE	625						NY
D	WPP06.03700	N-OCTADECANE	625						NY
D	WPP06.03710	N-TETRADECANE	625						NY
A	WPP06.03720	PYRIDINE	625						NJ
D	WPP06.03730	1-METHYLPHENANTHRENE	625						NY

New Jersey Department of Environmental Protection
National Environmental Laboratory Accreditation Program
Annual Certified Parameter List and Current Status

WASTE STREAM TECHNOLOGY INC
302 GROTE STREET
BUFFALO, NY 14207
Lab ID NY977

Effective Date: 07/01/2002 Expiration Date: 06/30/2003

Status	Code	Parameter	EPA	ASTM	SM18	USGS	SW846	Other	Primary Accrediting Authority
C	WPP09.01000	GROSS-ALPHA			7110B				NY
C	WPP09.03000	GROSS-BETA			7110B				NY
C	WPP09.05000	RADIUM-TOTAL			7500Ra B				NY
C	WPP09.06000	RADIUM-226			7500Ra C				NY

Key: A Applied, C Accredited, D Dropped by Lab, S Suspended, T Temporary Certification

U.S. Army Corps of Engineers

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
HTRW CENTER OF EXPERTISE
12565 WEST CENTER ROAD
OMAHA, NEBRASKA 68144-3869

REPLY TO
ATTENTION OF:

October 31, 2001

Hazardous, Toxic and Radioactive Waste
Center of Expertise

Waste Stream Technology, Inc.
ATTN: Dan Vollmer
302 Grote Street
Buffalo, NY 14207-2442

Gentlemen:

This correspondence addresses the ongoing validation status of Waste Stream Technology Inc. of Buffalo, NY by the U.S. Army Corps of Engineers (USACE) for chemical and radiological analysis in support of the USACE Hazardous, Toxic and Radioactive Waste Program.

Your laboratory is now validated for the parameters listed below:

METHOD	PARAMETERS	MATRIX[1]
300 series	Anions[4]	Water[2]
9010B/9012A	Cyanide	Water[2]
9013/9012A	Cyanide	Solids
8151A	Herbicides	Water[2]
8151A	Herbicides	Solids
8081A	Organochlorine Pesticides	Water[2]
8081A	Organochlorine Pesticides	Solids
8082	Polychlorinated Biphenyls	Water[2]
8082	Polychlorinated Biphenyls	Solids[2]
8270C	Semivolatile Organics	Water[2]
8270C	Semivolatile Organics	Solids[2]
6010B/7000A	TAL Metals[3]	Water[2]
6010B/7000A	TAL Metals[3]	Solids[2]
9060	Total Organic Carbon	Water[2]
Mod 8015	TPH - DRO/GRO[5]	Water
Mod 8015	TPH - DRO/GRO[5]	Solids

8260B	Volatile Organics	Water[2]
8260B	Volatile Organics	Solids
M-UTEVA-01-XX	SOP for measuring Uranium or Thorium with EICHROM UTEVA columns	na[5]
M-TEVA-01-XX	SOP for measuring Thorium with EICHROM TEVA columns	na[5]
M-RA228-02-XX	SOP for measuring Radium 228 by Beta decay of Actinium 228	na[5]
M-RA226-03-XX	SOP for measuring Radium 226 by Alpha spectrometry	na[5]
M-GAMMA-01-XX	SOP gamma spectrometry using EG&G ORTEC DSPEC	na[5]
M-ALPHANYLST-01-XX	SOP for operating the alpha spectroscopy counting system	na[5]
M-GASPRO-01-XX	SOP gas proportional Alpha-Beta counter	na[5]
M-RADSMPLPREP-00-XX	SOP for radioactive analysis sample preparation	Water[5]
M-RADSMPLPREP-00-XX	SOP for radioactive analysis sample preparation	Solids[5]

Remarks:

1) 'Solids' includes soils, sediments, and solid waste.

2) The laboratory has successfully analyzed a performance evaluation sample for this method/matrix.

3) TAL Metals: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

4) Anions: Chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate.

5) Approval for this parameter is based on review of SOPs only.

Based on the successful review of standard operating procedures (SOPs) for radiological parameters your laboratory will continue to be validated for sample analysis by the methods listed above. The period of validation for all parameters has been previously established and expires on October 12, 2003.

The USACE reserves the right to conduct additional laboratory inspections or to suspend validation status for any or all of the listed parameters if deemed necessary. It should be noted that your laboratory may not subcontract USACE analytical work to any other laboratory location without the approval of this office. This laboratory validation does not guarantee the delivery of any analytical samples from a USACE Contracting Officer Representative.

Any questions or comments can be directed to Dr. Jan W. Dunker at (402) 697-2566. General questions regarding laboratory validation may be directed to the Laboratory Validation Coordinator at (402) 697-2574.

Sincerely,

Marcia C. Davies

Marcia C. Davies, Ph.D.
Director, USACE Hazardous,
Toxic and Radioactive Waste
Center of Expertise

Enclosure

Florida Department of Health

FLORIDA DEPARTMENT OF HEALTH

State of Florida
Department of Health, Bureau of Laboratories

This is to certify that

E87662
Waste Stream Technology, Inc.
302 Grote Street
Buffalo, NY 14207

has complied with Florida Administrative Code 64E-1, for the examination of Environmental samples in the following categories:

SDWA - Group II Unregulated Contaminants,Other Regulated Contaminants,Primary Inorganic Contaminants,Secondary Inorganic Contaminants
CWA - Extractable Organics,General Chemistry,Metals,Pesticides-Herbicides-PCB's,Volatile Organics
RCRA/CERCLA - Extractable Organics,Metals,Pesticides-Herbicides-PCB's,Volatile Organics

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are on file at the Bureau of Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

EFFECTIVE JULY 1, 2002 THROUGH JUNE 30, 2003

Ming S. Chan, Ph.D.
Bureau Chief, Bureau of Laboratories
Florida Department of Health
DH Form 1697, 3/98

NON-TRANSFERABLE N6100E87662

Jeb Bush
Governor

FLORIDA DEPARTMENT OF HEALTH

John O. Agwunobi, M.D., M.B.A.
Secretary

Laboratory Scope of Accreditation

THIS LISTING OF ACCREDITED ANALYTES SHOULD BE USED ONLY WHEN ASSOCIATED WITH A VALID CERTIFICATE

State Laboratory ID: E87662 EPA Lab Code: NY00068 (716) 876-5290

E87662
Waste Stream Technology, Inc.
302 Grote Street
Buffalo, NY 14207

Program SDWA

Analyte	Method	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,1,1-Trichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
1,1,2,2-Tetrachloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,1,2-Trichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
1,1-Dichloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,1-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
1,1-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,2,3-Trichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,2,3-Trichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,2,4-Trichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
1,2,4-Trimethylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
·Dichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
1,2-Dichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
1,2-Dichloropropane	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
1,3,5-Trimethylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,3-Dichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,3-Dichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
1,4-Dichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
1,4-Isopropyltoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
2,2-Dichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
2,4,6-Trichlorophenol	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
2-Chlorophenol	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
2-Chlorotoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
2-Methyl-4,6-dinitrophenol	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
4-Chlorotoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Antimony	EPA 200.9	Primary Inorganic Contaminants	NELAP	5/16/2001
Arsenic	EPA 200.7	Primary Inorganic Contaminants	NELAP	5/16/2001
Arsenic	EPA 200.9	Primary Inorganic Contaminants	NELAP	5/16/2001
Barium	EPA 200.7	Primary Inorganic Contaminants	NELAP	5/16/2001
Benzene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
·yllium	EPA 200.7	Primary Inorganic Contaminants	NELAP	5/16/2001
·mobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001

Laboratory Scope of Accreditation

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State Laboratory ID: E87662 EPA Lab Code: NY00068 (716) 876-5290

E87662
Waste Stream Technology, Inc.
302 Grote Street
Buffalo, NY 14207

Program SDWA

Analyte	Method	Category	Certification Type	Effective Date
Bromochloromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Butyl benzyl phthalate	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
Cadmium	EPA 200.7	Primary Inorganic Contaminants	NELAP	5/16/2001
Cadmium	EPA 200.9	Primary Inorganic Contaminants	NELAP	5/16/2001
Carbon tetrachloride	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
Chlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
Chloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Chromium	EPA 200.7	Primary Inorganic Contaminants	NELAP	5/16/2001
cis-1,2-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
cis-1,3-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Copper	EPA 200.7	Secondary Inorganic Contaminants,Primary Inorganic Contaminants	NELAP	5/16/2001
Dibromomethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Dichlorodifluoromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Dichloromethane (DCM, Methylene chloride)	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
Diethyl phthalate	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
Dimethyl phthalate	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
Di-n-butyl phthalate	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
Di-n-octyl phthalate	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
Ethylbenzene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
Fluoride	EPA 300.0	Primary Inorganic Contaminants	NELAP	5/16/2001
Hexachlorobutadiene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Iron	EPA 200.7	Secondary Inorganic Contaminants	NELAP	5/16/2001
Isophorone	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
Isopropylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Lead	EPA 200.9	Primary Inorganic Contaminants	NELAP	5/16/2001
Manganese	EPA 200.7	Secondary Inorganic Contaminants	NELAP	5/16/2001
Mercury	EPA 245.1	Primary Inorganic Contaminants	NELAP	5/16/2001
Methyl bromide (Bromomethane)	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Methyl chloride (Chloromethane)	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Methyl tert-butyl ether (MTBE)	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Naphthalene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
n-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Nickel	EPA 200.7	Primary Inorganic Contaminants	NELAP	5/16/2001

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E87662
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302 Grote Street
Buffalo, NY 14207

Program SDWA

Analyte	Method	Category	Certification Type	Effective Date
Nitrobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
n-Propylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Phenol	EPA 625	Group II Unregulated Contaminants	NELAP	5/16/2001
sec-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Selenium	EPA 200.9	Primary Inorganic Contaminants	NELAP	5/16/2001
Silver	EPA 200.7	Secondary Inorganic Contaminants	NELAP	5/16/2001
Sodium	EPA 200.7	Primary Inorganic Contaminants	NELAP	5/16/2001
Styrene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
tert-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Tetrachloroethylene (Perchloroethylene)	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
Thallium	EPA 200.9	Primary Inorganic Contaminants	NELAP	5/16/2001
ıene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
Total dissolved solids	EPA 160.1	Secondary Inorganic Contaminants	NELAP	5/16/2001
trans-1,2-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
trans-1,3-Dichloropropylene	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Trichloroethene (Trichloroethylene)	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
Trichlorofluoromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	5/16/2001
Xylene (total)	EPA 524.2	Other Regulated Contaminants	NELAP	5/16/2001
Zinc	EPA 200.7	Secondary Inorganic Contaminants	NELAP	5/16/2001

Laboratory Scope of Accreditation

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State Laboratory ID: E87662 EPA Lab Code: NY00068 (716) 876-5290

E87662
Waste Stream Technology, Inc.
302 Grote Street
Buffalo, NY 14207

Program CWA

Analyte	Method	Category	Certification Type	Effective Date
1,1,1-Trichloroethane	EPA 624	Volatile Organics	NELAP	5/16/2001
1,1,2,2-Tetrachloroethane	EPA 624	Volatile Organics	NELAP	5/16/2001
1,1,2-Trichloroethane	EPA 624	Volatile Organics	NELAP	5/16/2001
1,1-Dichloroethane	EPA 624	Volatile Organics	NELAP	5/16/2001
1,1-Dichloroethylene	EPA 624	Volatile Organics	NELAP	5/16/2001
1,2,4-Trichlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2001
1,2-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	5/16/2001
1,2-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2001
1,2-Dichloroethane	EPA 624	Volatile Organics	NELAP	5/16/2001
1,2-Dichloropropane	EPA 624	Volatile Organics	NELAP	5/16/2001
1,3-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	5/16/2001
-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2001
1,4-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	5/16/2001
1,4-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2001
2,4,6-Trichlorophenol	EPA 625	Extractable Organics	NELAP	5/16/2001
2,4-Dichlorophenol	EPA 625	Extractable Organics	NELAP	5/16/2001
2,4-Dimethylphenol	EPA 625	Extractable Organics	NELAP	5/16/2001
2,4-Dinitrophenol	EPA 625	Extractable Organics	NELAP	5/16/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	Extractable Organics	NELAP	5/16/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	Extractable Organics	NELAP	5/16/2001
2-Chloroethyl vinyl ether	EPA 624	Volatile Organics	NELAP	5/16/2001
2-Chloronaphthalene	EPA 625	Extractable Organics	NELAP	5/16/2001
2-Chlorophenol	EPA 625	Extractable Organics	NELAP	5/16/2001
2-Methyl-4,6-dinitrophenol	EPA 625	Extractable Organics	NELAP	5/16/2001
2-Nitrophenol	EPA 625	Extractable Organics	NELAP	5/16/2001
3,3'-Dichlorobenzidine	EPA 625	Extractable Organics	NELAP	5/16/2001
4,4'-DDD	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
4,4'-DDE	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
4,4'-DDT	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
4-Bromophenyl phenyl ether	EPA 625	Extractable Organics	NELAP	5/16/2001
4-Chloro-3-methylphenol	EPA 625	Extractable Organics	NELAP	5/16/2001
-Chlorophenyl phenylether	EPA 625	Extractable Organics	NELAP	5/16/2001
Nitrophenol	EPA 625	Extractable Organics	NELAP	5/16/2001
naphthene	EPA 625	Extractable Organics	NELAP	5/16/2001

Laboratory Scope of Accreditation

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State Laboratory ID: E87662 EPA Lab Code: NY00068 (716) 876-5290

E87662
Waste Stream Technology, Inc.
302 Grote Street
Buffalo, NY 14207

Program CWA

Analyte	Method	Category	Certification Type	Effective Date
Acenaphthylene	EPA 625	Extractable Organics	NELAP	5/16/2001
Aldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aluminum	EPA 200.7	Metals	NELAP	5/16/2001
Anthracene	EPA 625	Extractable Organics	NELAP	5/16/2001
Antimony	EPA 200.7	Metals	NELAP	5/16/2001
Aroclor-1016 (PCB-1016)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1221 (PCB-1221)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1232 (PCB-1232)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1242 (PCB-1242)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1248 (PCB-1248)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
clor-1254 (PCB-1254)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1260 (PCB-1260)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Arsenic	EPA 200.7	Metals	NELAP	5/16/2001
Arsenic	EPA 6010	Metals	NELAP	5/16/2001
Barium	EPA 200.7	Metals	NELAP	5/16/2001
Benzene	EPA 624	Volatile Organics	NELAP	5/16/2001
Benzidine	EPA 625	Extractable Organics	NELAP	5/16/2001
Benzo(a)anthracene	EPA 625	Extractable Organics	NELAP	5/16/2001
Benzo(a)pyrene	EPA 625	Extractable Organics	NELAP	5/16/2001
Benzo(b)fluoranthene	EPA 625	Extractable Organics	NELAP	5/16/2001
Benzo(g,h,i)perylene	EPA 625	Extractable Organics	NELAP	5/16/2001
Benzo(k)fluoranthene	EPA 625	Extractable Organics	NELAP	5/16/2001
Beryllium	EPA 200.7	Metals	NELAP	5/16/2001
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
bis(2-Chloroethoxy)methane	EPA 625	Extractable Organics	NELAP	5/16/2001
bis(2-Chloroethyl) ether	EPA 625	Extractable Organics	NELAP	5/16/2001
bis(2-Chloroisopropyl) ether	EPA 625	Extractable Organics	NELAP	5/16/2001
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	Extractable Organics	NELAP	5/16/2001
Bromodichloromethane	EPA 624	Volatile Organics	NELAP	5/16/2001
Bromoform	EPA 624	Volatile Organics	NELAP	5/16/2001
Butyl benzyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2001
dmium	EPA 200.7	Metals	NELAP	5/16/2001
mium	EPA 6010	Metals	NELAP	5/16/2001

Laboratory Scope of Accreditation

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State Laboratory ID: E87662 EPA Lab Code: NY00068 (716) 876-5290

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Waste Stream Technology, Inc.
302 Grote Street
Buffalo, NY 14207

Program CWA

Analyte	Method	Category	Certification Type	Effective Date
Calcium	EPA 200.7	Metals	NELAP	5/16/2001
Chlordane (tech.)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Chlorobenzene	EPA 624	Volatile Organics	NELAP	5/16/2001
Chloroethane	EPA 624	Volatile Organics	NELAP	5/16/2001
Chloroform	EPA 624	Volatile Organics	NELAP	5/16/2001
Chromium	EPA 200.7	Metals	NELAP	5/16/2001
Chromium	EPA 6010	Metals	NELAP	5/16/2001
Chromium VI	EPA 218.4	Metals	NELAP	5/16/2001
Chrysene	EPA 625	Extractable Organics	NELAP	5/16/2001
cis-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	5/16/2001
Cobalt	EPA 200.7	Metals	NELAP	5/16/2001
Copper	EPA 200.7	Metals	NELAP	5/16/2001
Copper	EPA 6010	Metals	NELAP	5/16/2001
delta-BHC	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Dibenz(a,h) anthracene	EPA 625	Extractable Organics	NELAP	5/16/2001
Dibromochloromethane	EPA 624	Volatile Organics	NELAP	5/16/2001
Dieldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Diethyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2001
Dimethyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2001
Di-n-butyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2001
Di-n-octyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2001
Endosulfan I	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endosulfan II	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endosulfan sulfate	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endrin aldehyde	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Ethylbenzene	EPA 624	Volatile Organics	NELAP	5/16/2001
Fluoranthene	EPA 625	Extractable Organics	NELAP	5/16/2001
Fluorene	EPA 625	Extractable Organics	NELAP	5/16/2001
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Heptachlor	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Heptachlor epoxide	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Hexachlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2001
Hexachlorobutadiene	EPA 625	Extractable Organics	NELAP	5/16/2001

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Analyte	Method	Category	Certification Type	Effective Date
Hexachlorocyclopentadiene	EPA 625	Extractable Organics	NELAP	5/16/2001
Hexachloroethane	EPA 625	Extractable Organics	NELAP	5/16/2001
Indeno(1,2,3-cd)pyrene	EPA 625	Extractable Organics	NELAP	5/16/2001
Iron	EPA 200.7	Metals	NELAP	5/16/2001
Isophorone	EPA 625	Extractable Organics	NELAP	5/16/2001
Lead	EPA 200.7	Metals	NELAP	5/16/2001
Lead	EPA 6010	Metals	NELAP	5/16/2001
Magnesium	EPA 200.7	Metals	NELAP	5/16/2001
Manganese	EPA 200.7	Metals	NELAP	5/16/2001
Mercury	EPA 245.1	Metals	NELAP	5/16/2001
Mercury	EPA 7470	Metals	NELAP	5/16/2001
hyl bromide (Bromomethane)	EPA 624	Volatile Organics	NELAP	5/16/2001
Methyl chloride (Chloromethane)	EPA 624	Volatile Organics	NELAP	5/16/2001
Methylene chloride	EPA 624	Volatile Organics	NELAP	5/16/2001
Molybdenum	EPA 200.7	Metals	NELAP	5/16/2001
Molybdenum	EPA 6010	Metals	NELAP	5/16/2001
Naphthalene	EPA 625	Extractable Organics	NELAP	5/16/2001
Nickel	EPA 200.7	Metals	NELAP	5/16/2001
Nickel	EPA 6010	Metals	NELAP	5/16/2001
Nitrobenzene	EPA 625	Extractable Organics	NELAP	5/16/2001
n-Nitrosodimethylamine	EPA 625	Extractable Organics	NELAP	5/16/2001
n-Nitrosodi-n-propylamine	EPA 625	Extractable Organics	NELAP	5/16/2001
n-Nitrosodiphenylamine	EPA 625	Extractable Organics	NELAP	5/16/2001
Oil & Grease	EPA 1664	General Chemistry	NELAP	5/16/2001
Pentachlorophenol	EPA 625	Extractable Organics	NELAP	5/16/2001
Phenanthrene	EPA 625	Extractable Organics	NELAP	5/16/2001
Phenol	EPA 625	Extractable Organics	NELAP	5/16/2001
Potassium	EPA 200.7	Metals	NELAP	5/16/2001
Pyrene	EPA 625	Extractable Organics	NELAP	5/16/2001
Residue-filterable (TDS)	EPA 160.1	General Chemistry	NELAP	5/16/2001
Residue-nonfilterable (TSS)	EPA 160.2	General Chemistry	NELAP	5/16/2001
Residue-settleable	EPA 160.5	General Chemistry	NELAP	5/16/2001
Residue-total	EPA 160.3	General Chemistry	NELAP	5/16/2001
due-volatile	EPA 160.4	General Chemistry	NELAP	5/16/2001

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Analyte	Method	Category	Certification Type	Effective Date
Selenium	EPA 200.7	Metals	NELAP	5/16/2001
Selenium	EPA 6010	Metals	NELAP	5/16/2001
Silver	EPA 200.7	Metals	NELAP	5/16/2001
Sodium	EPA 200.7	Metals	NELAP	5/16/2001
Tetrachloroethylene (Perchloroethylene)	EPA 624	Volatile Organics	NELAP	5/16/2001
Thallium	EPA 200.7	Metals	NELAP	5/16/2001
Toluene	EPA 624	Volatile Organics	NELAP	5/16/2001
Toxaphene (Chlorinated camphene)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
trans-1,2-Dichloroethylene	EPA 624	Volatile Organics	NELAP	5/16/2001
trans-1,3-Dichloropropylene	EPA 624	Volatile Organics	NELAP	5/16/2001
Trichloroethene (Trichloroethylene)	EPA 624	Volatile Organics	NELAP	5/16/2001
Trichlorofluoromethane	EPA 624	Volatile Organics	NELAP	5/16/2001
Vanadium	EPA 200.7	Metals	NELAP	5/16/2001
Vinyl chloride	EPA 624	Volatile Organics	NELAP	5/16/2001
Zinc	EPA 200.7	Metals	NELAP	5/16/2001
Zinc	EPA 6010	Metals	NELAP	5/16/2001

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Program RCRA/CERCLA

Analyte	Method	Category	Certification Type	Effective Date
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2001
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2001
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	5/16/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	5/16/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	5/16/2001
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	5/16/2001
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2001
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	5/16/2001
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	5/16/2001
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	5/16/2001
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	5/16/2001
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	5/16/2001
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	5/16/2001
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	5/16/2001
Acenaphthene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Acetone	EPA 8260	Volatile Organics	NELAP	5/16/2001
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Anthracene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2001

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Analyte	Method	Category	Certification Type	Effective Date
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Arsenic	EPA 6010	Metals	NELAP	5/16/2001
Barium	EPA 6010	Metals	NELAP	5/16/2001
Benzene	EPA 8260	Volatile Organics	NELAP	5/16/2001
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	5/16/2001
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	5/16/2001
bis(2-Chloroisopropyl) ether	EPA 8270	Extractable Organics	NELAP	5/16/2001
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	5/16/2001
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
Bromoform	EPA 8260	Volatile Organics	NELAP	5/16/2001
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2001
Cadmium	EPA 6010	Metals	NELAP	5/16/2001
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	5/16/2001
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	5/16/2001
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2001
Chloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
Chloroform	EPA 8260	Volatile Organics	NELAP	5/16/2001
Chromium	EPA 6010	Metals	NELAP	5/16/2001
Chrysene	EPA 8270	Extractable Organics	NELAP	5/16/2001
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	5/16/2001
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Dibenz(a,h) anthracene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	5/16/2001

"STATE" indicates certification for the analyte by the method specified. "NELAP" further indicates certification compliant with the NELAC Standards.

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Analyte	Method	Category	Certification Type	Effective Date
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2001
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2001
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2001
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2001
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
rin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2001
Fluoranthene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Fluorene	EPA 8270	Extractable Organics	NELAP	5/16/2001
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	5/16/2001
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Lead	EPA 6010	Metals	NELAP	5/16/2001
Mercury	EPA 7470	Metals	NELAP	5/16/2001
Mercury	EPA 7471	Metals	NELAP	5/16/2001
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	5/16/2001
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	5/16/2001
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	5/16/2001
ıylene chloride	EPA 8260	Volatile Organics	NELAP	5/16/2001
Naphthalene	EPA 8270	Extractable Organics	NELAP	5/16/2001

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Analyte	Method	Category	Certification Type	Effective Date
Nickel	EPA 6010	Metals	NELAP	5/16/2001
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2001
Phenanthrene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Phenol	EPA 8270	Extractable Organics	NELAP	5/16/2001
Pyrene	EPA 8270	Extractable Organics	NELAP	5/16/2001
Pyridine	EPA 8270	Extractable Organics	NELAP	5/16/2001
Selenium	EPA 6010	Metals	NELAP	5/16/2001
Silver	EPA 6010	Metals	NELAP	5/16/2001
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Styrene	EPA 8260	Volatile Organics	NELAP	5/16/2001
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	5/16/2001
Toluene	EPA 8260	Volatile Organics	NELAP	5/16/2001
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2001
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	5/16/2001
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	5/16/2001
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	5/16/2001
Xylene (total)	EPA 8260	Volatile Organics	NELAP	5/16/2001

Quality Control Sample Acceptance Criteria

METHOD 6010B, 7000 SERIES COMPOUND LISTS AND LABORATORY CONTROL SAMPLE (LCS) OBJECTIVES	
Constituent	LCS Objectives (% Recovery)
Aluminum	85-115
Antimony	85-115
Antimony (SW-846 7041)	80-120
Arsenic	85-115
Barium	85-115
Beryllium	85-115
Cadmium	85-115
Calcium	85-115
Chromium	85-115
Cobalt	85-115
Copper	85-115
Iron	85-115
Lead	85-115
Lead (SW-846 7421)	80-120
Magnesium	85-115
Manganese	85-115
Mercury (SW-846 7470A)	80-120
Nickel	85-115
Potassium	85-115
Selenium	85-115
Silver	85-115
Sodium	85-115
Thallium	85-115
Vanadium	85-115
Zinc	85-115

Waste Stream Technology Inc.

QC Acceptance Criteria for Metals

Analyte	Reference Sample QC Limits		RPD QC Limits	Matrix Spike QC Limits	
	Soil	Water		Soil	Water
Zinc	85 - 115	85 - 115	25	75 - 125	75 - 125
Lead	85 - 115	85 - 115	25	75 - 125	75 - 125
Cadmium	85 - 115	85 - 115	25	75 - 125	75 - 125
Cobalt	85 - 115	85 - 115	25	75 - 125	75 - 125
Nickel	85 - 115	85 - 115	25	75 - 125	75 - 125
Barium	85 - 115	85 - 115	25	75 - 125	75 - 125
Manganese	85 - 115	85 - 115	25	75 - 125	75 - 125
Iron	85 - 115	85 - 115	25	75 - 125	75 - 125
Chromium	85 - 115	85 - 115	25	75 - 125	75 - 125
Magnesium	85 - 115	85 - 115	25	75 - 125	75 - 125
Vanadium	85 - 115	85 - 115	25	75 - 125	75 - 125
Aluminum	85 - 115	85 - 115	25	75 - 125	75 - 125
Beryllium	85 - 115	85 - 115	25	75 - 125	75 - 125
Calcium	85 - 115	85 - 115	25	75 - 125	75 - 125
Copper	85 - 115	85 - 115	25	75 - 125	75 - 125
Silver	85 - 115	85 - 115	25	75 - 125	75 - 125
Potassium	85 - 115	85 - 115	25	75 - 125	75 - 125
Sodium	85 - 115	85 - 115	25	75 - 125	75 - 125
Arsenic	85 - 115	85 - 115	25	75 - 125	75 - 125
Antimony	85 - 115	85 - 115	25	75 - 125	75 - 125
Selenium	85 - 115	85 - 115	25	75 - 125	75 - 125
Thallium	85 - 115	85 - 115	25	75 - 125	75 - 125
Mercury	80 - 120	80 - 120	25	75 - 125	75 - 125

METHOD 1632 ARSENIC SPECIATION LIST AND LABORATORY CONTROL SAMPLE OBJECTIVES	
Constituent	**LCS Objectives (% Recovery)**
As(III)	75-125
AsH_3	75-125
MMA	75-125
DMA	75-125

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample QC Limits for Volatile Organics by GC/MS Methods 624 and 8260B

Compound	Laboratory Control Sample QC Limits (%)		
	Water	Soil	TCLP
dichlorodifluoromethane	76 - 168	79 - 124	NA
chloromethane	56 - 210	55 - 159	NA
vinyl chloride	66 - 147	76 - 129	74 - 134
bromomethane	10 - 237	29 - 162	NA
chloroethane	44 - 158	42 - 159	NA
trichlorofluoromethane	64 - 141	77 - 123	NA
1,1-dichloroethene	77 - 121	74 - 124	74 - 121
acetone	50 - 181	48 - 146	NA
carbon disulfide	65 - 121	51 - 132	NA
methylene chloride	42 - 169	26 - 166	NA
methyl-t-butyl ether	84 - 120	76 - 127	NA
trans-1,2-dichloroethene	79 - 132	82 - 128	NA
1,1-dichloroethane	83 - 131	85 - 127	NA
vinyl acetate	34 - 166	36 - 162	NA
2-butanone	68 - 133	64 - 147	60 - 158
2-dichloropropane	66 - 125	76 - 123	NA
cis-1,2-dichloroethene	85 - 127	78 - 123	NA
chloroform	72 - 124	72 - 127	75 - 131
bromochloromethane	85 - 132	75 - 129	NA
1,1,1-trichloroethane	77 - 127	75 - 117	NA
carbon tetrachloride	79 - 128	74 - 129	79 - 130
1,1-dichloropropene	77 - 123	75 - 120	NA
benzene	81 - 124	76 - 119	86 - 116
1,2-dichloroethane	79 - 127	80 - 113	84 - 123
trichloroethene	79 - 123	77 - 114	87 - 113
1,2-dichloropropane	78 - 120	78 - 114	NA
bromodichloromethane	83 - 125	82 - 120	NA
2-chloroethylvinyl ether	11 - 184	NA	NA
4-methyl-2-pentanone	69 - 130	66 - 131	NA
cis-1,3-dichloropropene	82 - 123	77 - 118	NA
toluene	80 - 118	78 - 114	NA
trans-1,3-dichloropropene	81 - 131	78 - 119	NA
1,1,2-trichloroethane	83 - 118	79 - 113	NA
2-hexanone	64 - 133	71 - 126	NA
tetrachloroethene	82 - 122	75 - 120	82 - 115
1,3-dichloropropane	79 - 120	82 - 110	NA
dibromochloromethane	83 - 120	79 - 117	NA
2-dibromoethane	81 - 121	76 - 114	NA
chlorobenzene	86 - 116	77 - 117	86 - 116

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample
for Volatile Organics by GC/MS
Methods 624 and 8260B

Compound	Laboratory Control Sample QC Limits (%)		
	Water	Soil	TCLP
1,1,1,2-tetrachloroethane	79 - 121	78 - 113	NA
ethylbenzene	84 - 118	79 - 118	NA
m,p-xylene	82 - 115	76 - 113	NA
o-xylene	85 - 114	76 - 119	NA
styrene	80 - 119	76 - 118	NA
bromoform	84 - 117	59 - 181	NA
isopropylbenzene	80 - 109	74 - 114	NA
1,1,2,2-tetrachloroethane	75 - 123	74 - 118	NA
bromobenzene	80 - 129	77 - 118	NA
1,2,3-trichloropropane	64 - 151	74 - 123	NA
n-propylbenzene	79 - 118	76 - 118	NA
2-chlorotoluene	83 - 120	78 - 118	NA
1,3,5-trimethylbenzene	82 - 120	76 - 118	NA
4-chlorotoluene	80 - 117	76 - 119	NA
ert-butylbenzene	72 - 131	77 - 117	NA
,4-trimethylbenzene	82 - 119	75 - 122	NA
sec-butylbenzene	81 - 122	78 - 122	NA
p-isopropyltoluene	80 - 120	76 - 120	NA
1,3-dichlorobenzene	84 - 118	73 - 122	NA
1,4-dichlorobenzene	83 - 115	73 - 122	84 - 118
n-butylbenzene	76 - 121	75 - 123	NA
1,2-dichlorobenzene	85 - 113	73 - 121	NA
1,2-dibromo-3-chloropropane	77 - 127	63 - 129	NA
1,2,4-trichlorobenzene	59 - 126	69 - 129	NA
hexachlorobutadiene	72 - 132	70 - 130	NA
naphthalene	52 - 130	62 - 140	NA
1,2,3-trichlorobenzene	66 - 132	65 - 136	NA
n-amyl acetate	70 - 130	NA	NA
ethyl acetate	70 - 130	NA	NA
isopropyl acetate	70 - 130	NA	NA
tertiary butyl alcohol	70 - 130	NA	NA
acrylonitrile	70 - 130	70 - 130	NA
acrolein	60 - 140	NA	NA
Dibromofluoromethane (%)	82 - 116	75 - 125	NA
1,2 Dichloroethane-d4 (%)	76 - 114	76 - 118	77 - 118
Toluene-d8 (%)	84 - 118	73 - 117	84 - 112
romofluorobenzene (%)	82 - 117	76 - 115	79 - 125

WASTE STREAM TECHNOLOGY INC.

2002 Matrix Spike Sample QC Limits and MS/MSD RPD Limits for Volatile Organics by GC/MS Methods 624 and 8260B

Compound	Matrix Spike Sample QC Limits (%)			MS/MSD RPD Limits (%)	
	Water	Soil	TCLP	Water	Soil
chlorodifluoromethane	62 - 157	47 - 142	NA	20	25
loromethane	46 - 193	30 - 208	NA	20	25
yl chloride	59 - 137	58 - 155	68 - 140	20	25
omomethane	10 - 188	10 - 187	NA	20	25
loroethane	81 - 125	62 - 152	NA	20	25
chlorofluoromethane	68 - 129	57 - 134	NA	20	25
1-dichloroethene	72 - 115	38 - 148	76 - 116	20	25
etone	10 - 289	10 - 270	NA	20	25
rbon disulfide	59 - 112	39 - 150	NA	20	25
ethylene chloride	41 - 153	35 - 183	NA	20	25
ethyl-t-butyl ether	84 - 119	58 - 167	NA	20	25
ans-1,2-dichloroethene	79 - 122	68 - 138	NA	20	25
1-dichloroethane	87 - 124	49 - 157	NA	20	25
yl acetate	10 - 181	10 - 183	NA	20	25
butanone	18 - 204	38 - 208	49 - 175	20	25
chloropropane	49 - 154	71 - 127	NA	20	25
s-1,2-dichloroethene	82 - 125	72 - 135	NA	20	25
loroform	75 - 119	78 - 126	76 - 125	20	25
omochloromethane	75 - 133	73 - 131	NA	20	25
1,1-trichloroethane	82 - 122	68 - 132	NA	20	25
rbon tetrachloride	77 - 130	64 - 137	69 - 134	20	25
1-dichloropropene	81 - 117	65 - 125	NA	20	25
nzene	81 - 123	73 - 120	83 - 118	20	25
2-dichloroethane	82 - 123	68 - 132	76 - 126	20	25
chloroethene	78 - 125	50 - 151	87 - 110	20	25
2-dichloropropane	82 - 118	76 - 119	NA	20	25
omodichloromethane	82 - 123	83 - 121	NA	20	25
chloroethylvinyl ether	NA	NA	NA	20	25
methyl-2-pentanone	70 - 129	52 - 168	NA	20	25
s-1,3-dichloropropene	87 - 118	58 - 126	NA	20	25
uene	62 - 134	73 - 131	NA	20	25
ans-1,3-dichloropropene	89 - 124	63 - 129	NA	20	25
1,2-trichloroethane	87 - 114	59 - 154	NA	20	25
nexanone	56 - 155	42 - 185	NA	20	25
rachloroethene	79 - 121	76 - 115	75 - 120	20	25
3-dichloropropane	89 - 112	78 - 124	NA	20	25
romochloromethane	80 - 118	78 - 124	NA	20	25
bromoethane	87 - 111	69 - 128	NA	20	25
lorobenzene	89 - 117	55 - 140	86 - 115	20	25

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample
for Volatile Organics by GC/MS
Methods 624 and 8260B

Compound	Matrix Spike Sample QC Limits (%)			MS/MSD RPD Limits (%)	
	Water	Soil	TCLP	Water	Soil
1,1,1,2-tetrachloroethane	80 - 117	53 - 152	NA	20	25
ethylbenzene	83 - 126	74 - 127	NA	20	25
m,p-xylene	87 - 118	57 - 134	NA	20	25
o-xylene	90 - 120	78 - 125	NA	20	25
styrene	68 - 127	51 - 129	NA	20	25
bromoform	74 - 119	30 - 157	NA	20	25
isopropylbenzene	81 - 116	73 - 116	NA	20	25
1,1,2,2-tetrachloroethane	86 - 116	58 - 142	NA	20	25
bromobenzene	90 - 120	55 - 149	NA	20	25
1,2,3-trichloropropane	82 - 139	69 - 167	NA	20	25
n-propylbenzene	83 - 124	67 - 145	NA	20	25
2-chlorotoluene	85 - 126	69 - 148	NA	20	25
1,3,5-trimethylbenzene	85 - 125	45 - 175	NA	20	25
4-chlorotoluene	85 - 121	56 - 148	NA	20	25
tert-butylbenzene	83 - 125	76 - 140	NA	20	25
1,2,4-trimethylbenzene	87 - 121	61 - 162	NA	20	25
sec-butylbenzene	83 - 133	84 - 126	NA	20	25
p-isopropyltoluene	79 - 129	63 - 140	NA	20	25
1,3-dichlorobenzene	90 - 114	49 - 148	NA	20	25
1,4-dichlorobenzene	87 - 116	44 - 150	82 - 115	20	25
n-butylbenzene	78 - 131	62 - 131	NA	20	25
1,2-dichlorobenzene	86 - 117	52 - 144	NA	20	25
1,2-dibromo-3-chloropropane	53 - 157	57 - 164	NA	20	25
1,2,4-trichlorobenzene	60 - 131	22 - 147	NA	20	25
hexachlorobutadiene	60 - 139	34 - 138	NA	20	25
naphthalene	56 - 153	21 - 161	NA	20	25
1,2,3-trichlorobenzene	60 - 141	17 - 154	NA	20	25
n-amyl acetate	60 - 140	NA	NA	20	NA
ethyl acetate	60 - 140	NA	NA	20	NA
isopropyl acetate	60 - 140	NA	NA	20	NA
tertiary butyl alcohol	60 - 140	NA	NA	20	NA
acrylonitrile	60 - 140	60 - 140	NA	20	25
acrolein	50 - 150	NA	NA	30	NA

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample and Surrogate QC Limits for Semivolatile Organics by GC/MS Methods 625 and 8270C

Compound	Laboratory Control Sample QC Limits (%)		
	Water	Solid	TCLP
yridine	NA	NA	10 - 67
-nitrosodimethylamine	22 - 66	50 - 109	NA
henol	21 - 47	56 - 122	NA
is(2-chloroethyl)ether	39 - 110	54 - 112	NA
-chlorophenol	41 - 98	54 - 109	NA
,3-dichlorobenzene	39 - 103	52 - 109	NA
,4-dichlorobenzene	39 - 104	52 - 110	53 - 100
enzyl alcohol	44 - 82	56 - 111	NA
,2-dichlorobenzene	42 - 105	53 - 111	NA
-methylphenol	40 - 96	51 - 132	44 - 88
is(2-chloroisopropyl)ether	43 - 112	54 - 120	NA
& 4-methylphenol	38 - 90	51 - 131	44 - 88
-nitroso-di-n-propylamine	52 - 103	56 - 112	NA
exachloroethane	36 - 104	51 - 110	49 - 104
itrobenzene	37 - 122	57 - 111	56 - 106
ophorone	65 - 119	61 - 131	NA
ophenol	51 - 113	58 - 120	NA
,4-dimethylphenol	51 - 116	56 - 128	NA
is(2-chloroethoxy)methane	59 - 111	61 - 118	NA
enzoic acid	20 - 100	52 - 122	NA
4-dichlorophenol	56 - 111	61 - 117	NA
2,4-trichlorobenzene	48 - 106	57 - 112	NA
aphthalene	50 - 109	57 - 112	NA
-chloroaniline	56 - 103	52 - 122	NA
exachlorobutadiene	44 - 119	58 - 122	44 - 119
-chloro-3-methylphenol	59 - 110	66 - 116	NA
-methylnaphthalene	60 - 116	63 - 120	NA
exachlorocyclopentadiene	26 - 140	31 - 152	NA
4,6-trichlorophenol	58 - 118	61 - 120	65 - 109
4,5-trichlorophenol	57 - 131	54 - 134	63 - 115
-chloronaphthalene	57 - 115	57 - 118	NA
-nitroaniline	60 - 116	60 - 121	NA
methylphthalate	64 - 121	64 - 122	NA
enaphthylene	62 - 126	55 - 131	NA
nitroaniline	64 - 113	55 - 128	NA
6-dinitrotoluene	62 - 127	60 - 132	NA
enaphthene	65 - 123	59 - 130	NA
4-dinitrophenol	34 - 137	29 - 162	NA
ophenol	18 - 39	53 - 117	NA
benzofuran	64 - 118	60 - 121	NA

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample and Surrogate QC Limits for Semivolatile Organics by GC/MS Methods 625 and 8270C

Compound	Laboratory Control Sample QC Limits (%)		
	Water	Solid	TCLP
2,4-dinitrotoluene	61 - 130	59 - 134	66 - 121
diethylphthalate	67 - 123	63 - 127	NA
fluorene	65 - 124	60 - 126	NA
4-nitroaniline	67 - 116	55 - 132	NA
4-chlorophenyl-phenylether	56 - 124	58 - 123	NA
4,6-dinitro-2-methylphenol	55 - 147	55 - 164	NA
n-nitrosodiphenylamine	61 - 125	56 - 129	NA
azobenzene	60 - 140	60 - 140	NA
4-bromophenyl-phenylether	50 - 111	54 - 106	NA
hexachlorobenzene	56 - 126	62 - 119	68 - 111
pentachlorophenol	56 - 128	61 - 133	66 - 126
phenanthrene	68 - 130	64 - 128	NA
anthracene	66 - 124	63 - 126	NA
carbazole	60 - 140	55 - 123	NA
n-butylphthalate	72 - 121	65 - 123	NA
fluoranthene	65 - 125	63 - 123	NA
benzidine	10 - 50	10 - 72	NA
pyrene	66 - 126	63 - 136	NA
butylbenzylphthalate	70 - 124	65 - 133	NA
3,3'-dichlorobenzidine	58 - 120	53 - 130	NA
benzo(a)anthracene	66 - 125	63 - 129	NA
chrysene	71 - 128	66 - 134	NA
bis(2-ethylhexyl)phthalate	75 - 127	65 - 130	NA
di-n-octylphthalate	62 - 117	57 - 138	NA
benzo(b)fluoranthene	53 - 124	57 - 134	NA
benzo(k)fluoranthene	69 - 120	58 - 133	NA
benzo(a)pyrene	65 - 121	55 - 134	NA
indeno(1,2,3-cd)pyrene	53 - 153	38 - 163	NA
dibenzo(a,h)anthracene	54 - 150	34 - 161	NA
benzo(g,h,i)perylene	49 - 154	27 - 169	NA
2-fluorophenol (%)	23 - 58	49 - 106	20 - 69
phenol-d6 (%)	16 - 41	53 - 115	13 - 48
nitrobenzene-d5 (%)	43 - 106	55 - 117	42 - 126
2-fluorobiphenyl (%)	50 - 112	55 - 124	44 - 133
2,4,6-tribromophenol (%)	60 - 124	39 - 149	49 - 144
p-terphenyl-d14 (%)	57 - 122	60 - 137	43 - 149

WASTE STREAM TECHNOLOGY INC.

2002 Matrix Spike Sample QC Limits and MS/MSD RPD Limits for Semivolatile Organics by GC/MS Methods 625 and 8270C

Compound	Matrix Spike Sample QC Limits (%)			MS/MSD RPD Limits (%)	
	Water	Soil	TCLP	Water	Soil
ridine	NA	NA	5 - 74	NA	NA
nitrosodimethylamine	18 - 79	45 - 116	NA	30	35
enol	18 - 41	56 - 116	NA	30	35
s(2-chloroethyl)ether	49 - 98	52 - 113	NA	30	35
chlorophenol	39 - 94	54 - 103	NA	30	35
3-dichlorobenzene	46 - 94	55 - 102	NA	30	35
4-dichlorobenzene	47 - 95	55 - 102	44 - 113	30	35
nzyl alcohol	34 - 90	53 - 114	NA	30	35
2-dichlorobenzene	45 - 98	56 - 104	NA	30	35
methylphenol	37 - 92	55 - 122	13 - 126	30	35
s(2-chloroisopropyl)ether	40 - 103	46 - 122	NA	30	35
& 4-methylphenol	31 - 88	53 - 123	13 - 126	30	35
nitroso-di-n-propylamine	49 - 104	52 - 122	NA	30	35
xachloroethane	40 - 98	46 - 106	37 - 119	30	35
robenzene	47 - 112	41 - 127	47 - 118	30	35
phorone	64 - 112	64 - 126	NA	30	35
phenol	47 - 105	46 - 116	NA	30	35
4-dimethylphenol	40 - 114	61 - 123	NA	30	35
s(2-chloroethoxy)methane	58 - 106	59 - 118	NA	30	35
nzoic acid	5 - 46	10 - 117	NA	30	35
4-dichlorophenol	48 - 108	52 - 115	NA	30	35
2,4-trichlorobenzene	50 - 99	55 - 107	NA	30	35
phthalene	50 - 102	58 - 108	NA	30	35
chloroaniline	28 - 123	41 - 129	NA	30	35
xachlorobutadiene	43 - 116	54 - 123	57 - 112	30	35
chloro-3-methylphenol	52 - 110	61 - 120	NA	30	35
methylnaphthalene	57 - 110	48 - 139	NA	30	35
xachlorocyclopentadiene	16 - 123	10 - 148	NA	30	35
4,6-trichlorophenol	52 - 113	30 - 141	56 - 115	30	35
4,5-trichlorophenol	49 - 125	33 - 144	50 - 127	30	35
chloronaphthalene	55 - 106	59 - 116	NA	30	35
itroaniline	26 - 139	60 - 126	NA	30	35
nethylphthalate	70 - 110	65 - 120	NA	30	35
enaphthylene	58 - 116	62 - 124	NA	30	35
itroaniline	28 - 139	52 - 130	NA	30	35
6-dinitrotoluene	68 - 115	58 - 128	NA	30	35
enaphthene	58 - 119	56 - 130	NA	30	35
4-dinitrophenol	10 - 160	10 - 161	NA	30	35
phenol	11 - 54	10 - 177	NA	30	35
enzofuran	60 - 113	56 - 124	NA	30	35

WASTE STREAM TECHNOLOGY INC.

2002 Matrix Spike Sample QC Limits and MS/MSD RPD Limits for Semivolatile Organics by GC/MS Methods 625 and 8270C

Compound	Matrix Spike Sample QC Limits (%)			MS/MSD RPD Limits (%)	
	Water	Soil	TCLP	Water	Soil
2,4-dinitrotoluene	66 - 119	55 - 131	58 - 123	30	35
diethylphthalate	66 - 118	65 - 126	NA	30	35
fluorene	58 - 120	43 - 141	NA	30	35
4-nitroaniline	59 - 117	49 - 132	NA	30	35
4-chlorophenyl-phenylether	55 - 116	63 - 119	NA	30	35
4,6-dinitro-2-methylphenol	16 - 173	10 - 190	NA	30	35
n-nitrosodiphenylamine	57 - 126	56 - 142	NA	30	35
azobenzene	48 - 86	63 - 124	NA	30	35
4-bromophenyl-phenylether	45 - 110	55 - 106	NA	30	35
hexachlorobenzene	47 - 125	57 - 126	54 - 120	30	35
pentachlorophenol	41 - 127	32 - 129	32 - 153	30	35
phenanthrene	57 - 122	67 - 121	NA	30	35
anthracene	54 - 122	67 - 122	NA	30	35
carbazole	65 - 114	42 - 136	NA	30	35
di-n-butylphthalate	57 - 124	68 - 123	NA	30	35
fluoranthene	56 - 121	58 - 126	NA	30	35
benzidine	10 - 37	10 - 41	NA	30	35
pyrene	54 - 127	63 - 132	NA	30	35
butylbenzylphthalate	55 - 55	72 - 134	NA	30	35
3,3'-dichlorobenzidine	19 - 141	2 - 153	NA	30	35
benzo(a)anthracene	52 - 126	65 - 122	NA	30	35
chrysene	53 - 133	64 - 128	NA	30	35
bis(2-ethylhexyl)phthalate	47 - 140	64 - 150	NA	30	35
di-n-octylphthalate	36 - 152	34 - 190	NA	30	35
benzo(b)fluoranthene	45 - 128	56 - 133	NA	30	35
benzo(k)fluoranthene	49 - 140	58 - 156	NA	30	35
benzo(a)pyrene	48 - 127	61 - 127	NA	30	35
indeno(1,2,3-cd)pyrene	34 - 141	25 - 146	NA	30	35
dibenzo(a,h)anthracene	37 - 137	29 - 141	NA	30	35
benzo(g,h,i)perylene	32 - 138	16 - 147	NA	30	35

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample and Surrogate QC Limits for Pesticide and PCBs by GC/ECD Methods 608, 8081A and 8082

Compound	Laboratory Control Sample QC Limits (%)		
	Water	Solid	TCLP
alpha-BHC	61 - 126	86 - 126	NA
beta-BHC	65 - 124	81 - 127	NA
gamma-BHC (Lindane)	62 - 124	87 - 122	74 - 114
delta-BHC	68 - 134	93 - 129	NA
Heptachlor	50 - 150	81 - 137	73 - 122
Aldrin	55 - 146	89 - 125	NA
Heptachlor Epoxide	57 - 124	82 - 119	73 - 105
Endosulfan I	57 - 134	87 - 124	NA
4,4'-DDE	56 - 131	82 - 129	NA
Dieldrin	51 - 142	86 - 123	NA
Endrin	54 - 166	88 - 155	76 - 139
Endosulfan II	57 - 130	83 - 127	NA
4,4' - DDD	51 - 157	72 - 162	NA
Endrin Aldehyde	39 - 143	54 - 117	NA
Endosulfan Sulfate	65 - 133	92 - 130	NA
4,4' - DDT	55 - 163	64 - 172	NA
Endrin Ketone	57 - 151	94 - 136	NA
Methoxychlor	58 - 157	70 - 160	67 - 145
Toxaphene	60 - 150	60 - 150	60 - 150
Chlordane	60 - 150	60 - 150	60 - 150
Aroclor 1016	61 - 129	79 - 132	NA
Aroclor 1221	60 - 140	60 - 140	NA
Aroclor 1232	60 - 140	60 - 140	NA
Aroclor 1242	60 - 140	60 - 140	NA
Aroclor 1248	60 - 140	60 - 140	NA
Aroclor 1254	60 - 140	60 - 140	NA
Aroclor 1260	52 - 140	78 - 153	NA
Tetrachloro-m-xylene (%)	58 - 124	80 - 127	72 - 117
Decachlorobiphenyl (%)	62 - 127	76 - 133	71 - 123

Compound	Laboratory Control Sample QC Limits (%)	
	Wipes	Oil
Aroclor 1016	65 - 139	52 - 129
Aroclor 1221	60 - 140	60 - 140
Aroclor 1232	60 - 140	60 - 140
Aroclor 1242	60 - 140	60 - 140
Aroclor 1248	60 - 140	60 - 140
Aroclor 1254	60 - 140	60 - 140
Aroclor 1260	62 - 146	62 - 143
Tetrachloro-m-xylene (%)	73 - 140	52 - 123
Decachlorobiphenyl (%)	58 - 141	42 - 150

WASTE STREAM TECHNOLOGY INC.

2002 Matrix Spike Sample QC Limits and MS/MSD RPD Limits for Pesticides and PCBs Methods 608, 8081A and 8082

Compound	Matrix Spike Sample QC Limits (%)			MS/MSD RPD Limits (%)	
	Water	Soil	TCLP	Water	Soil
alpha-BHC	69 - 115	70 - 136	NA	25	30
beta-BHC	74 - 109	44 - 158	NA	25	30
gamma-BHC (Lindane)	72 - 110	67 - 138	59 - 126	25	30
delta-BHC	62 - 134	58 - 169	NA	25	30
Heptachlor	52 - 137	44 - 160	57 - 142	25	30
Aldrin	54 - 116	52 - 145	NA	25	30
Heptachlor Epoxide	58 - 119	53 - 140	36 - 137	25	30
Endosulfan I	60 - 121	49 - 151	NA	25	30
4,4'-DDE	50 - 134	48 - 145	NA	25	30
Dieldrin	56 - 129	47 - 160	NA	25	30
Endrin	60 - 141	65 - 169	58 - 155	25	30
Endosulfan II	59 - 123	57 - 142	NA	25	30
4,4' - DDD	58 - 134	78 - 153	NA	25	30
Endrin Aldehyde	45 - 130	48 - 133	NA	25	30
Endosulfan Sulfate	58 - 134	65 - 145	NA	25	30
4,4' - DDT	62 - 136	32 - 176	NA	25	30
Endrin Ketone	53 - 139	45 - 167	NA	25	30
Methoxychlor	55 - 150	29 - 184	53 - 167	25	30
Toxaphene	50 - 160	50 - 160	50 - 160	25	30
Chlordane	50 - 160	50 - 160	50 - 160	25	30
Aroclor 1016	50 - 160	50 - 142	NA	25	30
Aroclor 1221	50 - 160	50 - 160	NA	25	30
Aroclor 1232	50 - 160	50 - 160	NA	25	30
Aroclor 1242	50 - 160	50 - 160	NA	25	30
Aroclor 1248	50 - 160	50 - 160	NA	25	30
Aroclor 1254	50 - 160	50 - 160	NA	25	30
Aroclor 1260	50 - 160	53 - 157	NA	25	30

Compound	Matrix Spike Sample QC Limits (%)	MS/MSD RPD Limits (%)
	Oil	Oil
Aroclor 1016	50 - 160	30
Aroclor 1221	50 - 160	30
Aroclor 1232	50 - 160	30
Aroclor 1242	50 - 160	30
Aroclor 1248	50 - 160	30
Aroclor 1254	50 - 160	30
Aroclor 1260	53 - 160	30

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample and Surrogate QC Limits for Herbicides by GC/ECD Methods 615 and 8151A

Compound	Laboratory Control Sample QC Limits (%)		
	Water	Solid	TCLP
Dalapon	40 - 130	40 - 130	NA
4-Nitrophenol	40 - 130	40 - 130	NA
Dicamba	40 - 130	40 - 130	NA
MCPP	40 - 130	40 - 130	NA
MCPA	40 - 130	40 - 130	NA
Dichloroprop	40 - 130	40 - 130	NA
2,4-D	40 - 130	40 - 130	68 - 167
Pentachlorophenol	40 - 130	40 - 130	NA
2,4,5-TP	40 - 130	40 - 130	81 - 143
2,4,5-T	40 - 130	40 - 130	NA
2,4-DB	40 - 130	40 - 130	NA
Dinoseb	40 - 130	40 - 130	NA
2,4-DCPAA (%)	27 - 151	22 - 140	24 - 146

WASTE STREAM TECHNOLOGY INC.

2002 Matrix Spike Sample QC Limits and MS/MSD RPD Limits for Herbicide Methods 615 and 8151A

Compound	Matrix Spike Sample QC Limits (%)			MS/MSD RPD Limits (%)	
	Water	Soil	TCLP	Water	Soil
Dalapon	30 - 140	30 - 140	NA	30	35
4-Nitrophenol	30 - 140	30 - 140	NA	30	35
Dicamba	30 - 140	30 - 140	NA	30	35
MCPP	30 - 140	30 - 140	NA	30	35
MCPA	30 - 140	30 - 140	NA	30	35
Dichloroprop	30 - 140	30 - 140	NA	30	35
2,4-D	30 - 140	30 - 140	41 - 171	30	35
Pentachlorophenol	30 - 140	30 - 140	NA	30	35
2,4,5-TP	30 - 140	30 - 140	78 - 146	30	35
2,4,5-T	30 - 140	30 - 140	NA	30	35
2,4-DB	30 - 140	30 - 140	NA	30	35
Dinoseb	30 - 140	30 - 140	NA	30	35

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample and Surrogate Compound QC Limits for Volatile Organics by GC/PID Methods 602 and 8021B*

	Recovery Limits (%)		
Compound	Water	Soil (a)	TCLP
tert-butylmethyl ether (MTBE)	50 - 120	51 - 139	63 - 147
benzene	66 - 98	66 - 106	60 - 130
toluene	68 - 109	70 - 110	64 - 139
ethylbenzene	70 - 104	74 - 106	70 - 120
m,p-xylene	67 - 122	77 - 109	64 - 126
o-xylene	74 - 106	77 - 112	71 - 126
isopropylbenzene	71 - 111	77 - 117	66 - 126
n-propylbenzene	68 - 119	79 - 125	73 - 116
1,3,5-trimethylbenzene	63 - 122	78 - 131	60 - 131
tert-butylbenzene	65 - 120	64 - 124	59 - 128
1,2,4-trimethylbenzene	57 - 122	76 - 128	59 - 125
sec-butylbenzene	62 - 118	73 - 126	62 - 130
p-isopropyltoluene	61 - 131	83 - 136	64 - 131
n-butylbenzene	63 - 126	78 - 131	60 - 131
napthalene	48 - 150	79 - 163	67 - 131

* NYSDEC Petroleum Contaminated Water/Soil Compound List.

Surrogate Recovery	% Recovery Limits		
Matrix	Water	Soil	TCLP
a,a,a-trifluorotoluene	72 - 124	73 - 130	74 - 132

WASTE STREAM TECHNOLOGY INC.

2002 Matrix Spike Sample QC Limits and MS/MSD RPD Limits for Volatile Organics by GC/PID Methods 602 and 8021B*

	MS and MSD Recovery Limits (%)			MS/MSD RPD Limits (%)	
Compound	Water	Soil	TCLP	Water	Soil
tert-butylmethyl ether (MTBE)	55 - 118	51 - 174	70 - 148	20	30
benzene	54 - 108	61 - 120	72 - 129	20	30
toluene	41 - 141	53 - 133	68 - 150	20	30
ethylbenzene	63 - 116	56 - 118	72 - 138	20	30
m,p-xylene	39 - 156	60 - 124	57 - 147	20	30
o-xylene	51 - 139	65 - 131	70 - 143	20	30
isopropylbenzene	70 - 114	66 - 116	67 - 131	20	30
n-propylbenzene	67 - 122	57 - 116	69 - 131	20	30
1,3,5-trimethylbenzene	57 - 135	56 - 133	74 - 137	20	30
t-butylbenzene	69 - 114	50 - 127	73 - 127	20	30
4-trimethylbenzene	37 - 154	44 - 133	49 - 148	20	30
sec-butylbenzene	63 - 118	56 - 115	63 - 137	20	30
p-isopropyltoluene	80 - 124	55 - 125	58 - 148	20	30
n-butylbenzene	69 - 124	32 - 126	66 - 144	20	30
napthalene	62 - 164	8 - 197	54 - 147	20	30

* NYSDEC Petroleum Contaminated Water/Soil Compound List.

WASTE STREAM TECHNOLOGY INC.

2002 Laboratory Control Sample
Surrogate Compound and MS/MSD QC Limits
for Volatile Organics by GC/ELCD
Method 601

	Recovery Limits (%)		MS/MSD
Compound	LCS	MS/MSD	RPD Limits (%)
chloromethane	80 - 120	70 - 130	25
chloroethane	80 - 120	70 - 130	25
1,1-dichloroethene	80 - 120	70 - 130	25
1,1-dichloroethane	80 - 120	70 - 130	25
1,1,1-trichloroethane	80 - 120	70 - 130	25
1,2-dichloroethane	80 - 120	70 - 130	25
trichloroethene	80 - 120	70 - 130	25
1,2-dichloropropane	80 - 120	70 - 130	25
1,4-dichlorobutane (%)	80 - 120	70 - 130	25

Radiochemistry Lab D a Quality Objectives

Effective 1/1/2001

Data Quality Control Objectives	Analysis							Acceptance Criteria	Flagging Requirement/Corrective Actions All flags applied to sample data are to be announced and explained in the Sample Group Case Narrative
	Gamma Spectrum	Gross Alpha	Gross Beta	Radium 226	Radium 228	Thorium Isotopic	Uranium Isotopic		
Holding Time		X	X		X			< 4 $t_{1/2}$ for most critical isotope	None B If criteria is met J B If criteria for holding times is not met R B If criteria for holding time is not met and the data is <MDA
Preservation								Bioassay, Drinking Water, or Ground Water samples to be preserved to a pH = 2.0 with Nitric Acid. Hydrochloric Acid is acceptable, if clearly identified by sampler. Unpreserved samples preserved at time of receipt by the Rad Lab , not to be analyzed within 24 hours of preservation.	None B If criteria is met J B If criteria for preservation is not met.
Energy Calibration Check	X	X	X					Daily prior to use of Gamma Spectroscopy system (geometry specific).	None B If criteria is met J- If criteria is exceeded >24 hrs. = 32 hrs. R B If criteria is exceeded by > 32 hrs.
								Per sample analyzed by Gamma Spectroscopy Check of Peak Centroid Energy of Analyte ∀ 0.5 keV from Calculated Peak Warning ∀2.0 = E > ∀ 0.5 Control E > ∀ 2.0 Unacceptable	None B If Warning criteria is met J B If Control criteria met R B If Control criteria exceeded Trend analysis of Recovery results
								50 = R = 100 % Warning 20 B 50% < R >100 B 150% Control 20% < R > 150% Unacceptable ∀ 26 deviation Warning limit between results	
Enrgy Pulser Check				X		X	X	Daily prior to use of Alpha Spectroscopy system Pass system check criteria	None B If criteria is met J- If criteria is exceeded >24 hrs. = 32 hrs. R B If criteria is exceeded by > 32 hrs.
Cal Check		X	X					Daily prior to use	None B If criteria is met J- If criteria is exceeded >24 hrs. = 32 hrs. R B If criteria is exceeded by > 32 hrs.
								50 = R = 100 % Warning 20 B 50% < R >100 B 150% Control 20% < R > 150% Unacceptable ∀ 26 deviation Warning limit between results	None B If Warning criteria is met J B If Control criteria met R B If Control criteria exceeded Trend analysis of Recovery results

Radiochemistry Lab Data Quality Objectives

Effective 1/1/2001

Data Quality Control Objectives	Analysis							Acceptance Criteria	Flagging Requirement/Corrective Actions All flags applied to sample data are to be announced and explained in the Sample Group Case Narrative
	Gamma Spectrum	Gross Alpha	Gross Beta	Radium 226	Radium 228	Thorium Isotopic	Uranium Isotopic		
Background Count Rate	X	X	X	X	X	X	X	Calculated monthly for each geometry and counting time used with each counting system. ∀ 3ó deviation Warning limit between results	None B If criteria is met in < 4 days* J B If criteria not met within +5 - 7 days R B If criteria not met within = 8 days
				X	X	X	X	Current Alpha Spectrum background file used	None B If criteria met Reanalyze with proper file B If criteria not met
		X	X					Checked Daily prior to use ∀ 3ó deviation Warning limit between results	None B If criteria is met in < 4 days* J B If criteria not met within +5 - 7 days R B If criteria f not met within = 8 days*
Method Blank		X	X	X	X	X	X	One per sample batch of the same matrix ∀ 3ó deviation Warning limit between results	None B If criteria is met R B If criteria not met
Method Blank Spike		X	X	X	X	X	X	One per sample batch of the same matrix ∀ 3ó deviation Warning limit between results	Trend analysis applied None B If Warning criteria met Corrective Actions B If Warning criteria exceeded
Method Blank Spike Recovery		X	X	X	X	X	X	One per sample batch of the same matrix **Not Applicable** to Air Filter matrix GA/GB 50 = R = 100 % Warning 20 B 50% < R >100 B 150% Control 20% < R > 150% Unacceptable ∀ 2ó deviation Warning limit between results ∀ 3ó deviation Control limit between results	None B If Warning criteria is met J B If Control criteria met R B If Control criteria exceeded
Method Blank/Sample Normalized Absolute Difference		X	X	X	X	X	X	One per sample batch of the same matrix determined against lowest sample activity measured, when blank activity is subtracted from sample activity. **Not Applicable** to Air Filter matrix due to inability to simulate a representative blank air at prescribed volumes of air through filter NAD as calculated > 2.58 Warning 1.96 = NAD = 2.58 Control NAD < 1.96 Unacceptable	None B If Warning criteria is met NJ B If Control criteria met NR B If Control criteria exceeded NAD examoined against background result trend. IF background within specifications and sample results near background, THEN Control criteria will be exceeded. In this instance NO flag is required. Explanation required in Case Narrative

Radiochemistry Lab D a Quality Objectives

Effective 1/1/2001

Data Quality Control Objectives	Analysis							Acceptance Criteria	Flagging Requirement/Corrective Actions All flags applied to sample data are to be announced and explained in the Sample Group Case Narrative
	Gamma Spectrum	Gross Alpha	Gross Beta	Radium 226	Radium 228	Thorium Isotopic	Uranium Isotopic		
Duplicate	X	X	X	X	X	X	X	One per sample batch of the same matrix **Not Applicable** to Air Filter matrix IF sample is being digested, AND ONLY personal breathing zone air filters comprise sample batch.	None – If criteria met R – If criteria not met
Sample/ Duplicate Normalized Absolute Difference	X	X	X	X	X	X	X	One per sample batch of the same matrix NAD as calculated > 3.92 Warning 1.96 = NAD = 3.92 Control NAD < 1.96	Calculate when performed None – If Warning criteria is met NJ – If Control criteria met NR – If Control criteria exceeded
Tracer Recovery		X	X	X	X	X	X	One per sample and method blank	± 3ó deviation Warning limit between results
								50 = R = 100 % Warning 20 – 50% < R >100 – 150% Control 20% < R > 150% Unacceptable ± 2ó deviation Warning limit between results	None – If Warning criteria is met J – If Control criteria met R – If Control criteria exceeded Trend analysis of Recovery results
LCS Recovery	X							One per sample batch of the same matrix	None – If criteria met R – If criteria not met
								Bioassay, Drinking Water, or Ground Water 80 = R = 120 % Warning 50 - 80% < R >120 – 150% Control 50% < R > 150% Unacceptable	None – If Warning criteria is met J – If Control criteria met R – If Control criteria exceeded
								Soil, Solid, Air Filter, Vegetation 70 = R = 130 % Warning 40 - 70% < R >130 – 160% Control 40% < R > 160% Unacceptable	

Radiochemistry Lab Data Quality Objectives

Effective 1/1/2001

Data Quality Control Objectives	Analysis							Acceptance Criteria	Flagging Requirement/Corrective Actions All flags applied to sample data are to be announced and explained in the Sample Group Case Narrative
	Gamma Spectrum	Gross Alpha	Gross Beta	Radium 226	Radium 228	Thorium Isotopic	Uranium Isotopic		
Matrix Spike Recovery		X	X	X	X	X	X	One per sample batch of the same matrix	± 3ó deviation Warning limit between results
								Bioassay, Drinking Water, or Ground Water 75 = R = 50-100 % Warning 20-50% < R >100-150% Control 20% < R > 150% Unacceptable	None – If Warning criteria is met J – If Control criteria met R – If Control criteria exceeded
								Soil, Solid, Air Filter, Vegetation **Not Applicable** to Air Filter matrix GA/GB 70 = R = 130 % Warning 30 - 70% < R >130 – 170% Control 30% < R > 170% Unacceptable	
Target Nuclide Identification	X			X	X	X	X	Per sample analyzed by Gamma Spectroscopy Check of Peak Centroid Energy of Analyte E = ± 0.5 keV Warning ± 0.5 > E = ± 2.0 Control E > ± 2.0 Unacceptable	None – If Warning criteria is met J – If Control criteria met R – If Control criteria exceeded
								Per sample analyzed by Alpha Spectroscopy Check of Peak Centroid Energy of Analyte E = ± 100 keV Warning ± 100 keV > E = ± 750 keV Control E > ± 750 keV Unacceptable	
FWHM	X	X	X	X	X	X	X	Review FWHM values for each peak of interest	None – If Warning criteria is met J – If Control criteria met R – If Control criteria exceeded
								Gamma Spectroscopy FWHM = 1.4 Warning FWHM = 1.4-2.8 Control FWHM > 2.8 Unacceptable	
								Alpha Spectroscopy FWHM = 150 Warning >80 FWHM = 150-350 Control < 350 Review for Acceptability	

Radiochemistry Lab Data Quality Objectives

Effective 1/1/2001

Data Quality Control Objectives	Analysis							Acceptance Criteria	Flagging Requirement/Corrective Actions All flags applied to sample data are to be announced and explained in the Sample Group Case Narrative
	Gamma Spectrum	Gross Alpha	Gross Beta	Radium 226	Radium 228	Thorium Isotopic	Uranium Isotopic		
Equilibrium	X			X	X	X	X	Each sample where the analyses performed provide sufficient data to relate secular equilibrium and transient equilibrium to the results	None B When criteria met J B If criteria not met
Isotope Distribution	X					X	X	Each sample where the analyses performed provide sufficient data to relate expected isotope distribution based on historical or calculated correlation data	None B When criteria met J B If criteria not met

Legend

A Sample Batch is equal to a maximum of 20 samples of the same matrix, AND if soil, from the same sample site.

The above stated Data Quality Objectives (DQOs) are those currently applied by The Radiochemistry Lab at Waste Stream Technology, Inc. The client may request changes to any of these parameters. Specification changes will be documented and approved by written agreement prior to performance of any analysis.

* - Deviation from prescribed Quality Criteria requires approval from the Radiochemistry Lab Manager

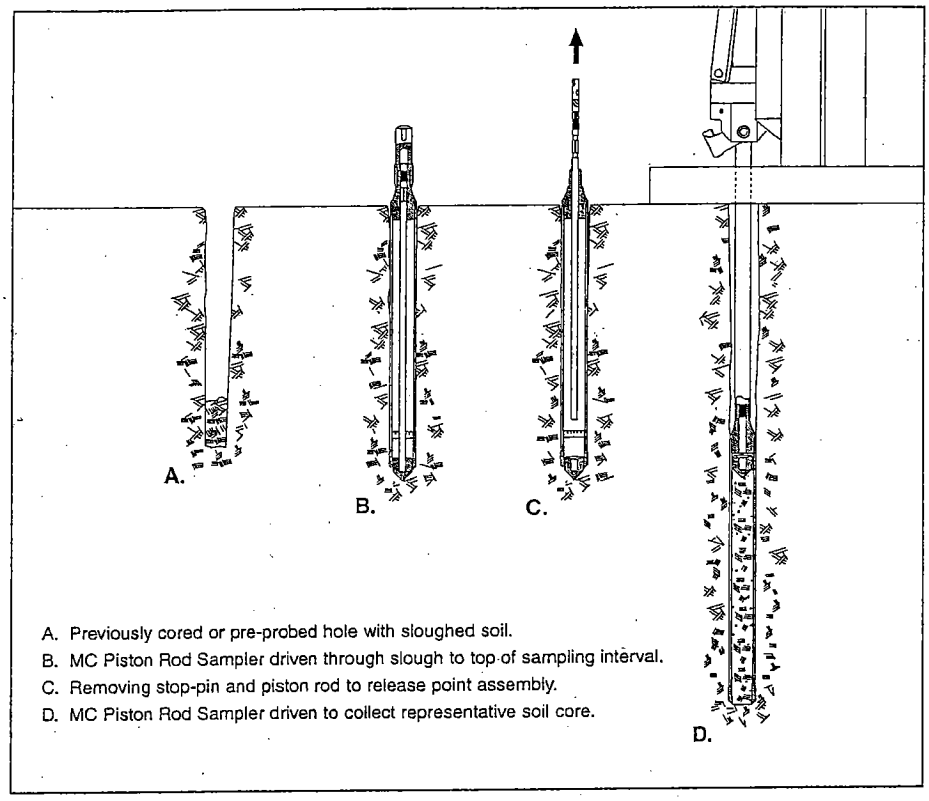
GEOPROBE MACRO-CORE® SOIL SAMPLER

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 95-8500

PREPARED: November, 1995

REVISED: September, 1998



OPERATION OF MACRO-CORE® PISTON ROD SOIL SAMPLING SYSTEM

Geoprobe® Systems

A DIVISION OF KEJR, INC.

Geoprobe® is a Registered Trademark of
Kejr, Inc., Salina, Kansas

Macro-Core® is a Registered Trademark of
Kejr, Inc., Salina, Kansas

Macro-Core® and Large Bore Soil Samplers
manufactured under US Patent 5,606,139.

Macro-Core® Closed-Piston Drive Point
manufactured under US Patent 5,542,481

1.0 OBJECTIVE

The objective of this procedure is to collect a representative soil sample at depth and recover it for visual inspection and/or chemical analysis.

2.0 BACKGROUND

2.1 Definitions

Geoprobe®*: A brand name of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface.
** Geoprobe® is a registered trademark of Kejr, Inc., Salina, Kansas*

Macro-Core® Soil Sampler*: A solid barrel, direct push device for collecting continuous core samples of unconsolidated materials at depth. Although other lengths are available, the standard Macro-Core® Sampler has an assembled length of approximately 52 inches (1321 mm) with an outside diameter (OD) of 2.2 inches (56 mm). Collected samples measure up to 1300 ml in volume in the form of a 1.5-inch x 45-inch (38 mm x 1143 mm) core contained inside a removable liner. The Macro-Core® Sampler may be used in an open-tube or closed-point configuration.
** Macro-Core® is a registered trademark of Kejr, Inc., Salina, Kansas*

Liner: A removable/replaceable, thin-walled tube inserted inside the Macro-Core® sample tube for the purpose of containing and storing soil samples. While other lengths are available, the standard Macro-Core® Liner is 1.75 inches OD x 46 inches long (44 mm x 1168 mm). Liner materials include stainless steel, Teflon®, PVC, and PETG.

2.2 Discussion

In this procedure, an assembled Macro-Core® Soil Sampler is driven one sampling interval into the subsurface and then retrieved using a Geoprobe soil probing machine. The collected soil core is removed from the sampler along with the used liner. After decon, the Macro-Core® sampler is reassembled using a new liner. The clean sampler is then advanced back down the same hole to collect the next soil core. The Macro-Core® Sampler may be used as an open-tube or closed-point sampler.

The Macro-Core® Soil Sampler is most commonly used as an open-tube sampler (Fig. 2.1A). In this configuration, coring starts at the ground surface with a sampler that is open at the leading end. The sampler is driven into the subsurface and then pulled from the ground to retrieve the first soil core. In stable soils, an open-tube sampler is advanced back down the same hole to collect the next core.

In unstable soils which tend to collapse into the core hole, the Macro-Core® Sampler can be equipped with a piston rod point assembly (Fig. 2.1B). The point fits firmly into the cutting shoe and is held in place by a piston rod and stop-pin. The MC Piston Rod System prevents collapsed soil from entering the sampler as it is advanced to the bottom of an existing hole, thus ensuring collection of a reprentative sample.

The Macro-Core® Piston Rod Sampler is not designed to be driven through undisturbed soil. A probe hole must be opened above the sampling interval either by removing continuous soil cores with an open-tube sampler, or by advancing a Macro-Core® Pre-Probe to depth.

Once a hole is opened to the appropriate depth, an assembled MC Piston Rod Sampler is advanced through any slough material to the top of the next sampling interval. Extension rods are inserted through the probe

rod string and threaded onto the MC Stop-Pin Assembly. When unthreaded, the stop-pin is removed from the tool string with the extension rods. (MC Piston rod is removed with stop-pin if MC Stop-Pin Coupler is utilized). With the point assembly now released, the tool string is driven into the subsurface to fill the sampler with soil. The point assembly is later retrieved from the sampler with the liner and soil core.

Loose soils may fall from the bottom of the sampler as it is retrieved from depth. The MC Core Catcher (Fig. 3.1) alleviates this problem. Excellent results are obtained when the core catcher is used with saturated sands and other non-cohesive soils. A core catcher should not be used with tight soils as it may actually inhibit sample recovery. Constructed of PVC, the core catcher is suitable for use with all Geoprobe liners.

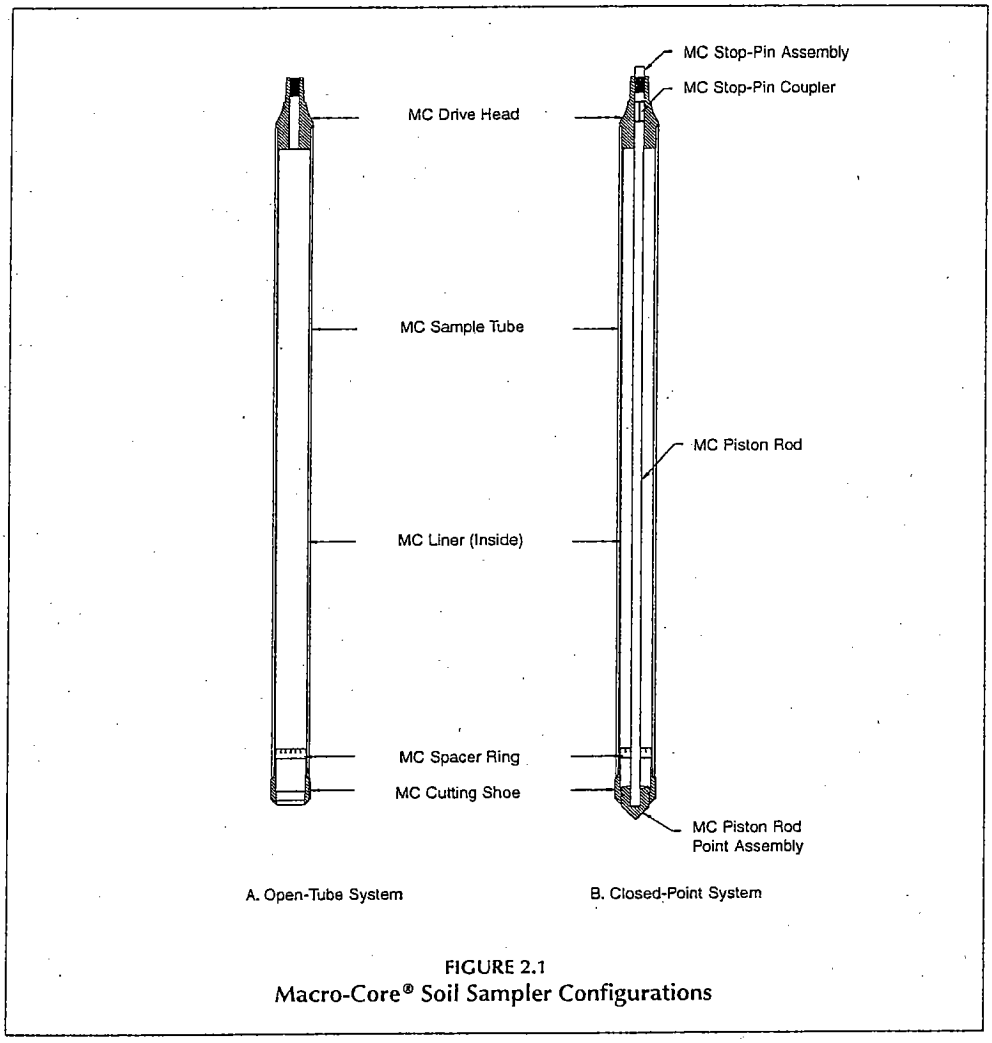


FIGURE 2.1
Macro-Core® Soil Sampler Configurations

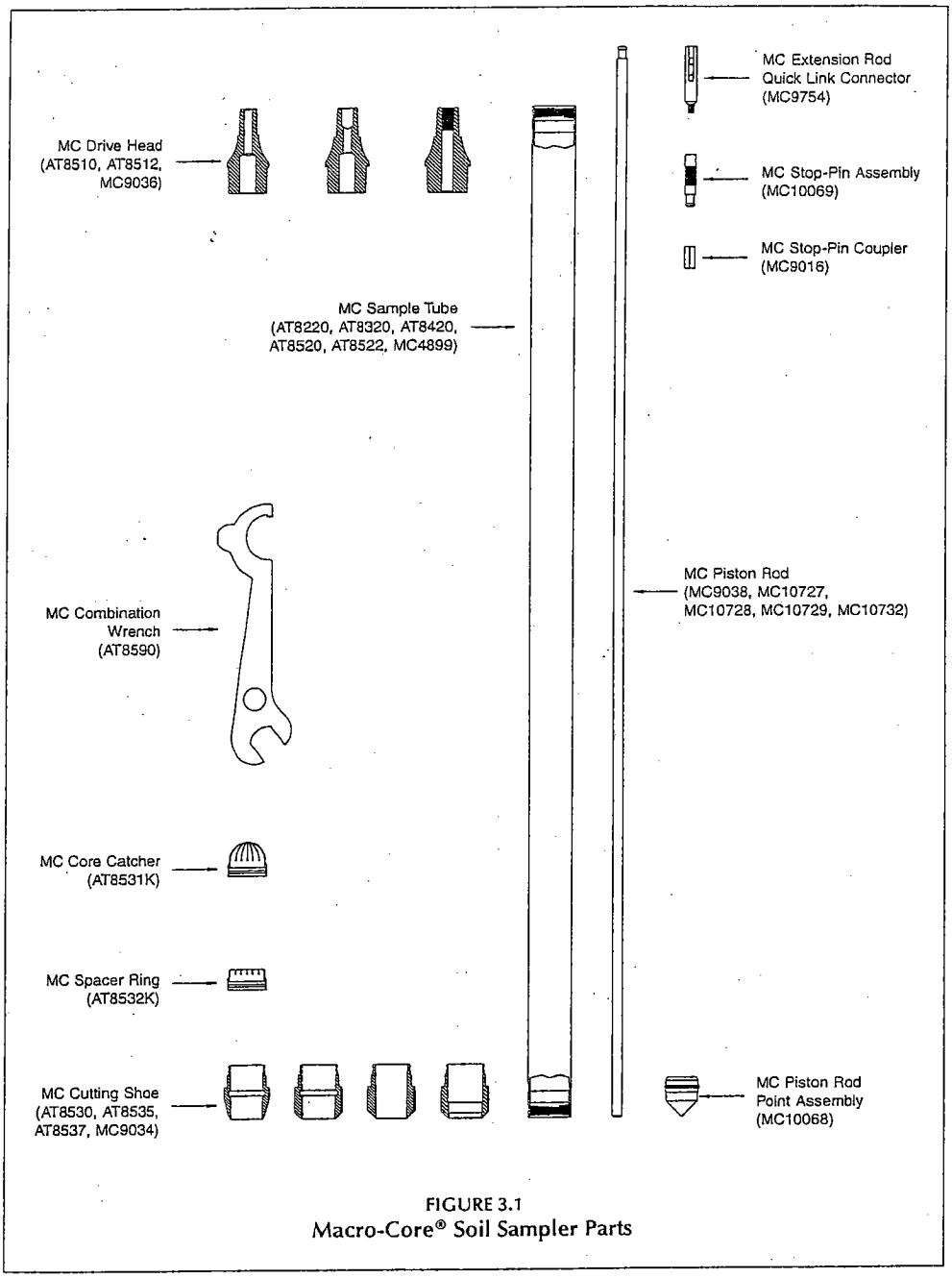


FIGURE 3.1
Macro-Core® Soil Sampler Parts

3.0 REQUIRED EQUIPMENT

The following equipment is used to recover samples using the Geoprobe Macro-Core® Soil Sampler and probing system. Although many options are available (sampler length, liner material, etc.), the basic sampler configuration does not change. Refer to Figure 3.1 (previous page) to view the major components of the Macro-Core® sampler.

MACRO-CORE® SAMPLER PARTS	PART NUMBER
MC Drive Head, for use with 1.0-inch probe rods	AT8510
MC Drive Head, for use with 1.25-inch probe rods	AT8512
MC Sample Tube, 24-inch, unplated	AT8220
MC Sample Tube, 36-inch, unplated	AT8320
MC Sample Tube, 1-meter, unplated	AT8420
MC Sample Tube, 48-inch, Ni-plated	AT8520
MC Sample Tube, 48-inch, unplated	AT8522
MC Sampler Tube, 60-inch, unplated	MC4889
MC Cutting Shoe, standard	AT8530
MC Cutting Shoe, heavy-duty	AT8535
MC Cutting Shoe, 0.125 inches undersized	AT8537
MC Combination Wrench	AT8590
Nylon Brush for MC Sample Tubes	BU700

MACRO-CORE® PISTON ROD SYSTEM PARTS	PART NUMBER
O-Rings for MC Stop-Pin (pkg. of 25)	AT6312R
O-Rings for MC Piston Rod Point (pkg. of 25)	DT4070R
MC Stop-Pin Coupler (pkg. of 5)	MC9016
MC Cutting Shoe, for use with piston rod point	MC9034
MC Drive Head, for use with 1.25-inch probe rods and stop-pin	MC9036
MC Piston Rod, 48-inch	MC9038
MC Extension Rod Quick Link Connector	MC9754
MC Piston Rod Point Assembly	MC10068
MC Stop-Pin Assembly	MC10069
MC Piston Rod/Stop-Pin Assembly, 48-inch	MC10070
MC Piston Rod, 60-inch	MC10727
MC Piston Rod, 36-inch	MC10728
MC Piston Rod, 24-inch	MC10729
MC Piston Rod, 1-meter	MC10732
MC Piston Rod/Stop-Pin Assembly, 60-inch	MC11881
MC Piston Rod/Stop-Pin Assembly, 36-inch	MC12028
MC Piston Rod/Stop-Pin Assembly, 24-inch	MC12029
MC Piston Rod/Stop-Pin Assembly, 1-meter	MC12030
MC Quick Link Kit	MC12131

MACRO-CORE® LINERS AND ACCESSORIES	PART NUMBER
MC Stainless Steel Liner Assembly, 48-inch	AT7235
MC Teflon® Liner Assembly, 48-inch	AT724
MC PETG Liner, thin-wall, 48-inch, (box of 66)	AT725K
MC Vinyl End Caps (66 pair)	AT726K
MC Heavy-Duty PETG Liner Assembly, 48-inch (box of 66)	AT825K
MC PVC Liner Assembly, clear, 24-inch (box of 66)	AT922K
MC PVC Liner Assembly, clear, 36-inch (box of 66)	AT923K
MC PVC Liner Assembly, clear, 1-meter (box of 66)	AT924K
MC PVC Liner Assembly, clear, 48-inch (box of 66)	AT925K
MC Liner Cutter Kit	AT8000K
MC Liner Cutting Tool*	AT8010
MC Liner Cutter Holder*	AT8020
MC Liner Cutter Blades (pkg. of 5)*	AT8030
MC Liner Circular Cutting Tool	AT8050
MC Core Catchers (pkg. of 25)	AT8531K
MC Spacer Rings (pkg. of 25)	AT8532K
MC PVC Liner Assembly, clear, 60-inch (box of 66)	11984

GEOPROBE TOOLS**	PART NUMBER
Drive Cap, for use with 1.25-inch probe rods	AT1200
Slotted Drive Cap, for use with 1.25-inch probe rods	AT1202
Pull Cap, for use with 1.25-inch probe rods	AT1204
Probe Rod, 1.25 inches x 36 inches	AT1236
Probe Rod, 1.25 inches x 1 meter	AT1239
Probe Rod, 1.25 inches x 48 inches	AT1248
Probe Rod, 1.25 inches x 60 inches	AT1260
MC Pre-Probe, 2-inch OD	AT1247
MC Pre-Probe, 2.5-inch OD	AT1242
MC Pre-Probe, 3-inch OD	AT1252
Extension Rod, 36-inch	AT67
Extension Rod, 48-inch	AT671
Extension Rod, 1-meter	AT675
Extension Rod Coupler	AT68
Extension Rod Handle	AT69
Extension Rod Quick Links	AT694K
Machine Vise	FA300

ADDITIONAL TOOLS

Combination Wrench, 1/2-inch (or) Adjustable Wrench
Pipe Wrenches (2)

*The items are included in the MC Liner Cutter Kit (AT8000K).
**Geoprobe tools and accessories are also available for use with 1.0-inch OD (outside diameter) probe rods.

4.0 OPERATION

Size and material options have resulted in an extensive list of Macro-Core® part numbers. To simplify the instructions presented in this document, part numbers are listed in the illustrations only. Refer to Pages 6 and 7 for a complete parts listing.

4.1 Decontamination

Before and after each use, thoroughly clean all parts of the soil sampling system according to project requirements. A new, clean liner is recommended for each sample if using PETG, PVC, or Teflon® liners.

Stainless Steel Liners from Geoprobe Systems are cleaned at the factory with an agitated detergent bath at a temperature of approximately 180 degrees F. After rinsing with 180-degree tap water, the liner is air dried, wrapped in PVC outer cladding, and capped with vinyl end caps.

Thoroughly clean the sampler before assembly, not only to remove contaminants but also to ensure correct operation. Dirty threads complicate assembly and may lead to sampler failure. Sand is particularly troublesome as it can bind liners in the sample tube resulting in wasted time and lost samples.

4.2 Field Blank

It is suggested that a field blank be taken on a representative sample liner prior to starting a project and at regular intervals during extended projects. Liners can become contaminated in storage. A field blank will prove that the liners do not carry contaminates which can be transferred to soil samples. The following information is offered as an example method which may be used to take a field blank. Make the appropriate modifications for the specific analytes of interest to the investigation.

Example Procedure:

REQUIRED EQUIPMENT

MC Liner	(1)
MC Vinyl End Caps	(2)
Distilled Water	(100 ml)
VOA Vial (or other appropriate sample container)	(1)

1. Place a vinyl end cap on one end of the liner.
2. Pour 100 milliliters of distilled water (or other suitable extracting fluid) into the liner.
3. Place a vinyl end cap on the open end of the liner.
4. From the vertical position, repeatedly invert the liner so that the distilled water contacts the entire inner surface. Repeat this step for one minute.
5. Remove one end cap from the liner, empty contents into an appropriate sample container, and cap the container.
6. Perform analysis on the extract water for the analytes of interest to the investigation.

4.3 Open-Tube Sampler Assembly

1a. (With MC Core Catcher) Place the open end of an MC Core Catcher over the threaded end of an MC Cutting Shoe as shown in Figure 4.1. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

NOTE: AT725K (thin-wall PETG) liners have a swedged end which is generally slipped directly over the groove in the cutting shoe (Fig. 4.2). To use a core catcher with these liners, cut approximately 0.25 inches (6 mm) of material from the swedged end of the liner and proceed to Step 2.

1b. (Without MC Core Catcher) Push the base of an MC Spacer Ring onto the threaded end of a cutting shoe until it snaps into place (Fig. 4.3).

NOTE: With the exception of AT-725K (thin-wall PETG) liners, all liners must utilize either a spacer ring or core catcher. PETG liners have a swedged end which slides directly over the end of the cutting shoe. Attach the liner to the cutting shoe (Fig. 4.2) before proceeding to Step 2.

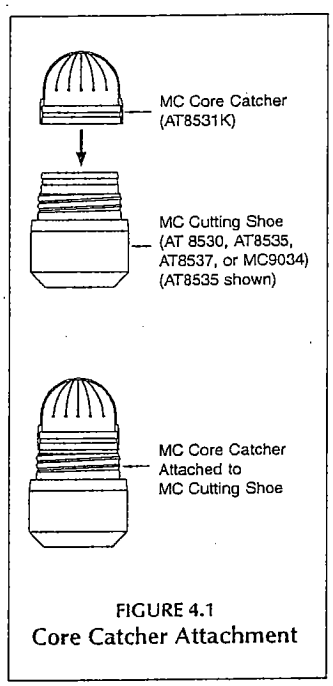


FIGURE 4.1
Core Catcher Attachment

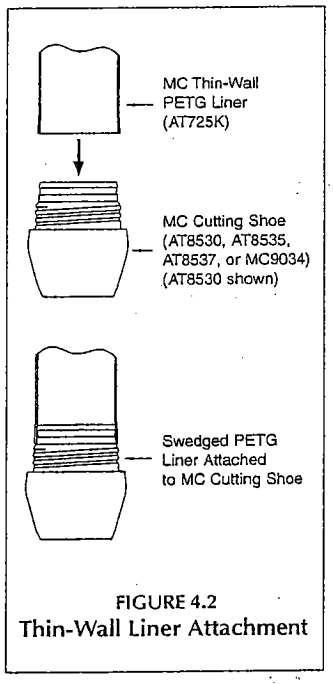


FIGURE 4.2
Thin-Wall Liner Attachment

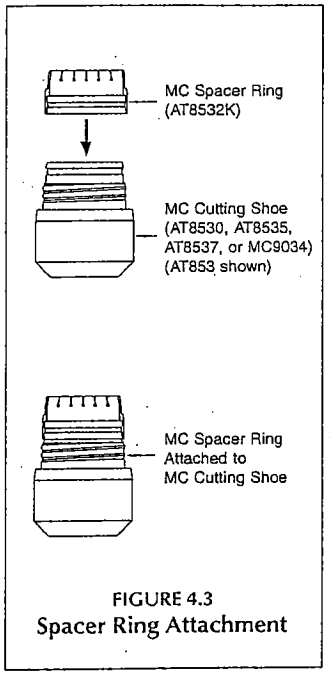


FIGURE 4.3
Spacer Ring Attachment

Refer to Figure 4.4 for identification of sampler parts and assembly sequence

2. Thread the cutting shoe into one end of an MC Sample Tube (Fig. 4.5). Tighten shoe with MC Combination Wrench (Fig. 4.6) until end of sample tube contacts machined shoulder of cutting shoe.

3. Insert a liner into the opposite end of the sample tube (Figure 4.7). The liner is all ready installed if using thin-wall PETG liners (AT725K) without an MC Core Catcher.

4. Thread an MC Drive Head into the top of the sample tube (Fig. 4.8) and securely tighten with the MC Combination Wrench (Fig. 4.9). Ensure that the end of the sample tube contacts the machined shoulder of the drive head.

Sampler Assembly is Complete.

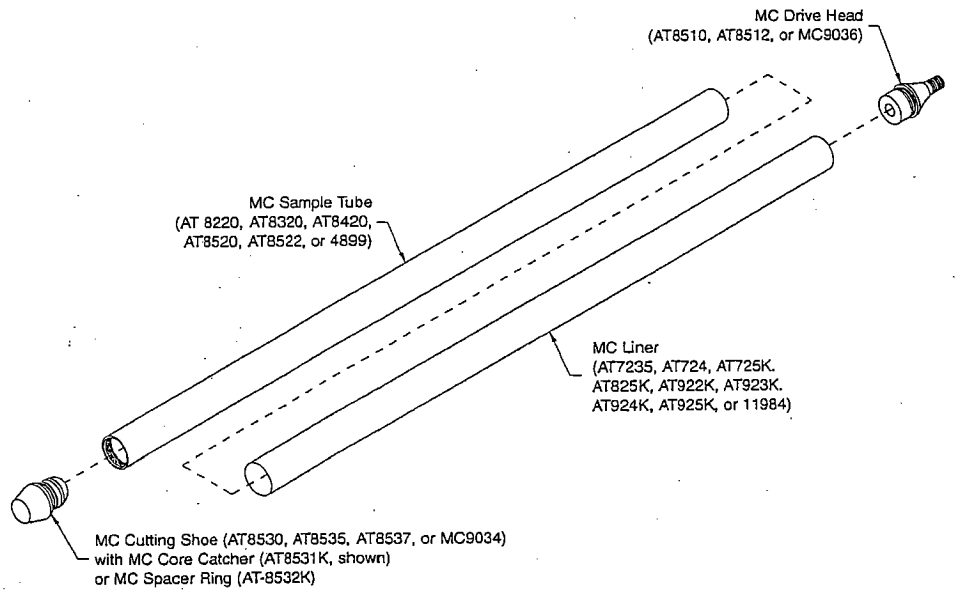


FIGURE 4.4
Macro-Core® Open-Tube Sampler Assembly

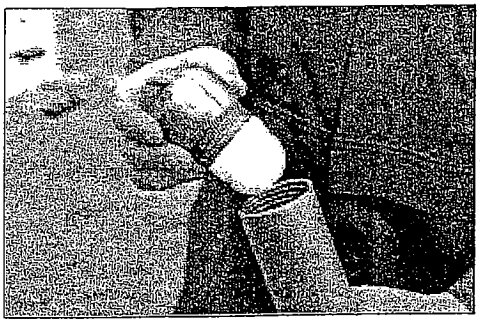


Figure 4.5. Thread an MC Cutting Shoe (shown with MC Core Catcher) into either end of a MC Sample Tube.

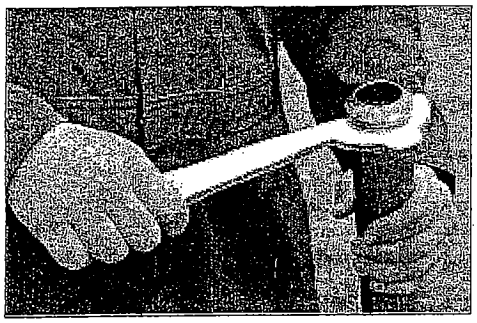


Figure 4.6. Tighten MC Cutting Shoe with MC Combination Wrench.

Figure 4.7. Insert liner into opposite end of MC Sample Tube.

Figure 4.8. Thread MC Drive Head into top of MC Sample Tube.

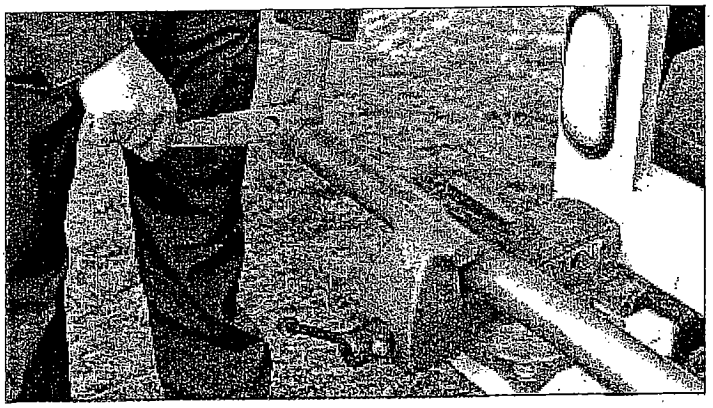


Figure 4.9. Tighten MC Drive Head with MC Combination Wrench. A vise is often used to hold the MC Sample Tube during this step.

4.4 Stop-Pin Coupler

The Stop-Pin Coupler attaches the Stop-Pin to the Piston Rod (Fig. 4.10). When connected together, these three parts form the Stop-Pin/Piston Rod Assembly. All three items may be ordered either individually or together as one complete assembly. Refer to Section 3.0 for specific assembly and item part numbers.

It is not always necessary to use the stop-pin coupler with the MC Piston Rod System. The coupler allows the piston rod to be removed from the sampler along with the stop-pin so that sample recovery is not hindered by the weight of the piston rod. If you find that recovery is not a problem with the formation you are sampling (such as clays), do not use the stop-pin coupler.

If sampling in formations where sample recovery may be a problem (such as loose sands), the stop-pin coupler is highly recommended. Removing the piston rod with the stop-pin significantly reduces the amount of tooling weight that the soil core must support as the sampler is driven. Sample compression is also reduced when the stop-pin coupler is utilized.

Instructions for connecting the stop-pin coupler to the stop-pin and piston rod are given below.

1. Hold a piston rod in vertical position with leading end resting on a solid surface.
2. Place a Stop-Pin Coupler on top of the Piston Rod and tap with a hammer to seat (Fig. 4.11).
3. Snap a Stop-Pin into the coupler using a hammer or 12-inch probe rod and drive cap (Fig. 4.12).

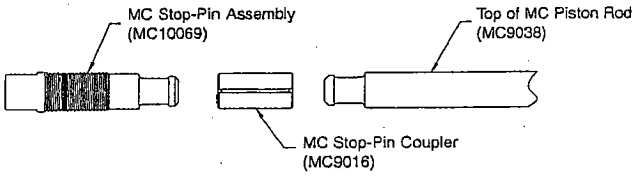


FIGURE 4.10
MC Stop-Pin Coupler Attaches MC Stop-Pin to MC Piston Rod

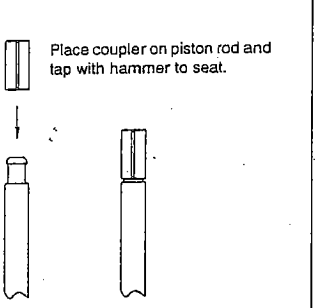


FIGURE 4.11
Tap Stop-Pin Coupler onto Piston Rod

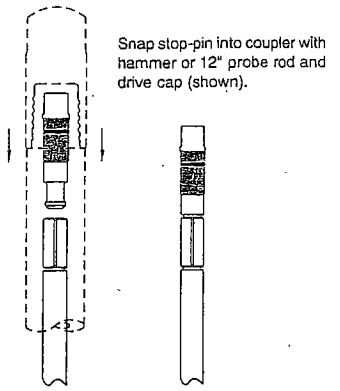


FIGURE 4.12
Tap Stop-Pin into Coupler with Probe Rod

4.5 MC Piston Rod Sampler (closed-point system) Assembly

The MC Piston Rod System seals the leading end of the sampler with a point assembly that is held in place with a piston rod and stop-pin. Once advanced to the top of the sampling interval, the stop-pin is removed with extension rods that are inserted down through the probe rod string. The piston rod will be extracted along with the stop-pin if a stop-pin coupler was used. Refer to Section 4.4 for help in determining when a stop-pin coupler is needed.

NOTE: The MC Piston Rod System requires an MC9036 MC Drive Head and an MC9034 MC Cutting Shoe. No other Macro-Core® drive heads or cutting shoes are compatible with this system. The larger 1.25-inch OD Probe Rods are also required to operate MC Piston Rod System.

1. Install an O-ring in the machined groove on the piston rod point (Fig. 4.13). Lubricate the O-ring with a small amount of deionized water.

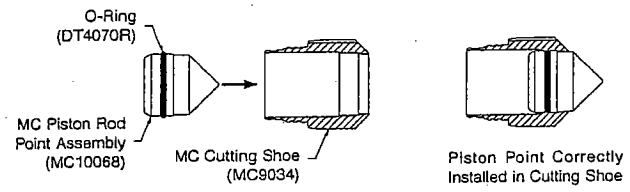


FIGURE 4.13
Installation of MC Piston Rod Point Assembly in MC Cutting Shoe

2. Push the piston rod point completely into the cutting shoe as shown in Figure 4.13.

3a. (With MC Core Catcher) Place the open end of a core catcher over the threaded end of the cutting shoe as shown in Figure 4.14. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

NOTE: AT725K (thin-wall PETG) liners have a swedged end that is slipped directly over the groove in the cutting shoe (Fig. 4.15). To use a core catcher with these liners, simply cut approximately 0.25 inches (6 mm) of material from the swedged end of the liner and continue to Step 4.

3b. (Without Core Catcher) Push the base of an MC Spacer Ring onto the threaded end of the cutting shoe until it snaps into place (Fig. 4.16).

NOTE: With the exception of AT725K (thin-wall PETG) liners, all liners must utilize either a spacer ring or core catcher. Thin-wall liners have a swedged end which slides directly over the end of the cutting shoe. If using thin-wall liners, attach the liner to the cutting shoe (Fig. 4.15) before proceeding.

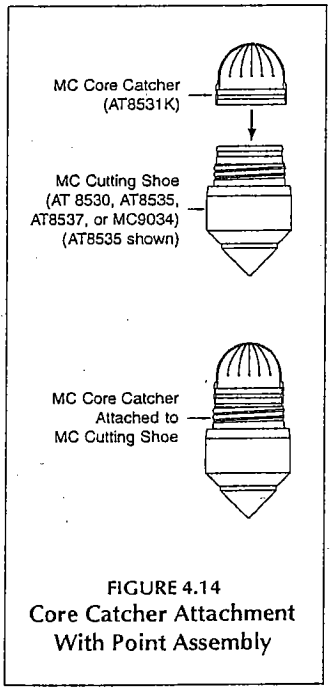


FIGURE 4.14
Core Catcher Attachment
With Point Assembly

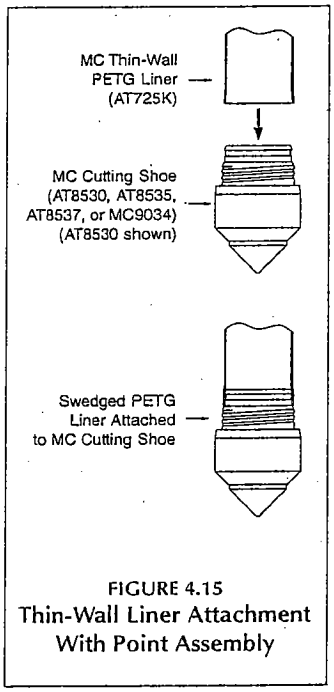


FIGURE 4.15
Thin-Wall Liner Attachment
With Point Assembly

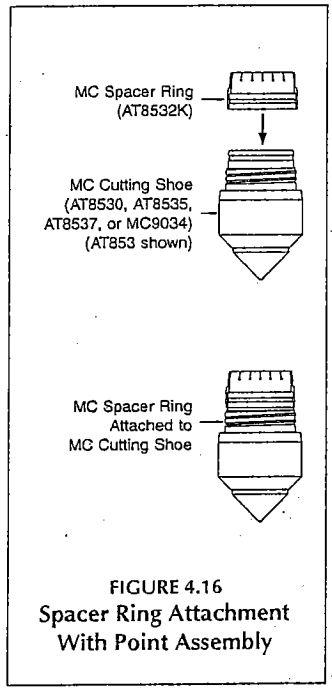


FIGURE 4.16
Spacer Ring Attachment
With Point Assembly

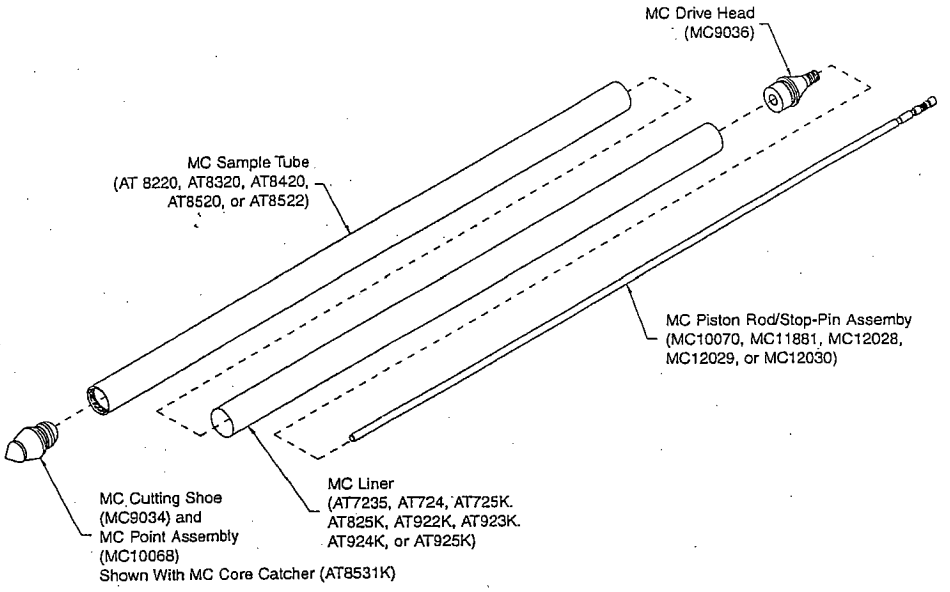


FIGURE 4.17
Macro-Core® Closed-Point Sampler Assembly

Refer to Figure 4.17 for identification of sampler parts and assembly sequence

4. Thread the cutting shoe (with point) into one end of an MC Sample Tube. Tighten until the end of the sample tube contacts the machined shoulder of the cutting shoe.

5. Insert an appropriate MC Liner into the sample tube (Fig. 4.18). The liner is all ready installed if using thin-wall PETG liners without a core catcher.

6. Thread an MC Drive Head into the top of the sample tube (Fig. 4.19) and securely tighten with the combination wrench (Fig. 4.20) until the end of the sample tube contacts the machined shoulder of the drive head.

(continued on Page 16)

Figure 4.18. Insert liner into opposite end of MC Sample Tube.

Figure 4.19. Thread MC Drive Head into top of MC Sample Tube.

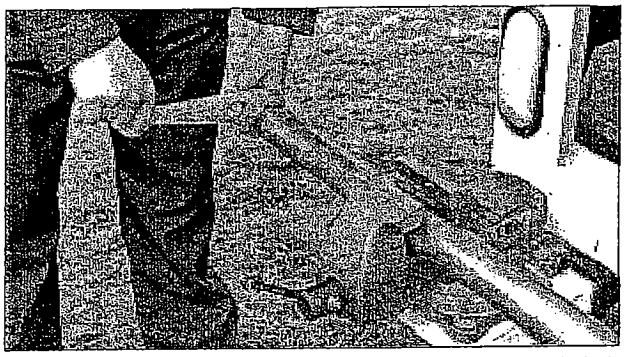


Figure 4.20. Tighten MC Drive Head with MC Combination Wrench. A vise is often used to hold the MC Sample Tube during this step.

7. Insert an MC Piston Rod/Stop-Pin Assembly through the drive head until the stop-pin threads contact the top of the drive head (Fig. 4.21). Ensure that an O-ring has been placed on the stop-pin.

   The leading end of the piston rod may hangup on the core catcher during assembly. When this happens, raise the assembly 6-8 inches above the core catcher and then allow the assembly to fall back down into the sampler. This should allow the piston rod to pass through the fingers of the core catcher.

   Note: The MC Stop-Pin Coupler may be omitted under certain sampling conditions. Refer to Section 4.4 for information regarding when a coupler is needed and instructions for coupler installation.

8. Thread the stop-pin into the drive head (left-hand threads) with an adjustable or 1/2-inch combination wrench. Fully tighten the stop-pin and then back it off slightly (~10 degrees). This avoids locking the stop-pin threads and allows it to later be unthreaded from the ground surface with extension rods.

Sampler Assembly is Complete.

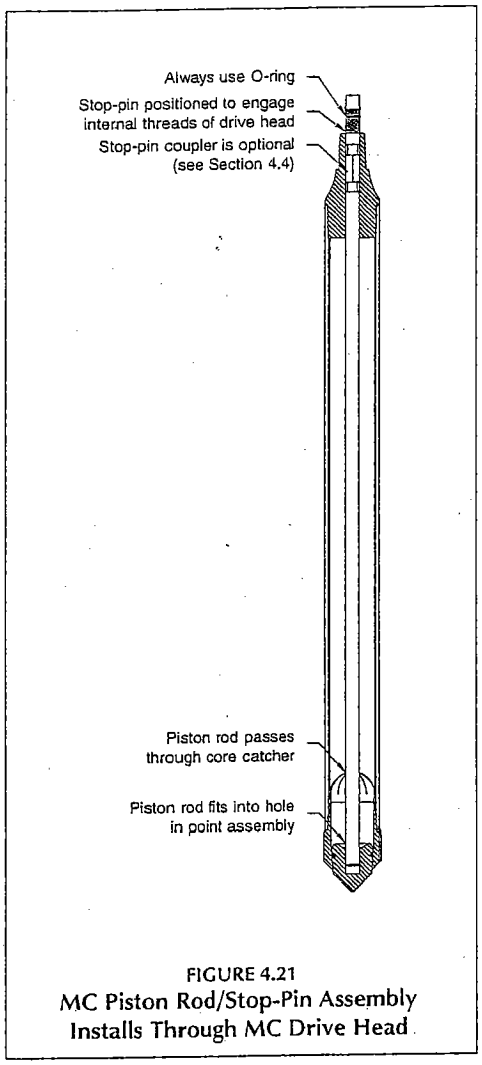


FIGURE 4.21
MC Piston Rod/Stop-Pin Assembly Installs Through MC Drive Head

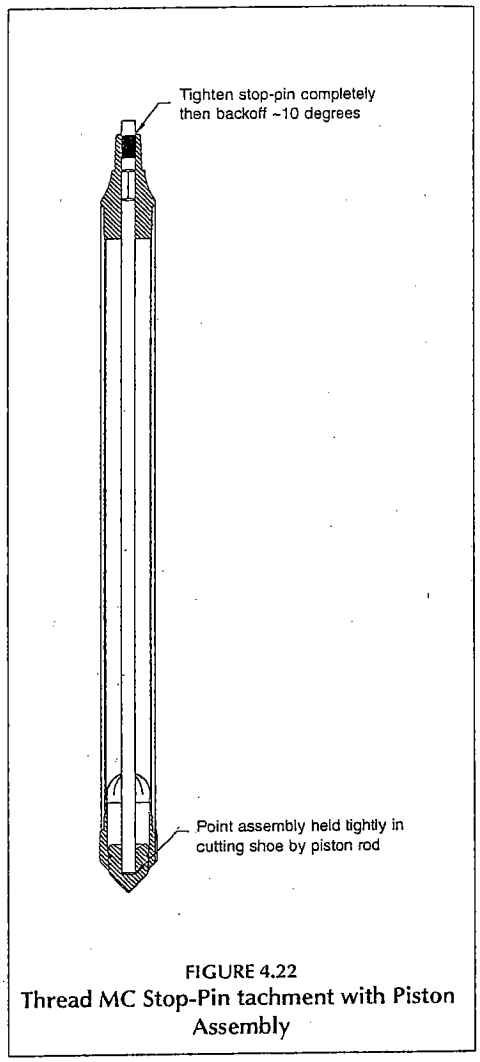


FIGURE 4.22
Thread MC Stop-Pin tachment with Piston Assembly

4.6 Pilot Hole

A pilot hole prevents excessive sampler wear in tough soils and saves time when a discrete soil core is desired. The pilot hole is created by driving a 2.0-, 2.5-, or 3.0-inch MC Pre-Probe (see Section 3.0 for part numbers) to the top of the sampling interval. Soil surfaces containing gravel, asphalt, hard sands, or rubble should be pre-probed to reduce wear on the cutting shoe and to avoid damage to the sampler. To save time when collecting a discrete soil core, pre-probe to the sampling interval rather than coring to depth with the sampler.

4.7 Open-Tube Sampling

The Macro-Core® Open-Tube Sampler is used to gather continuous soil cores beginning from ground surface. A representative soil sample is obtained by driving the assembled sampler one sampling interval into the subsurface through undisturbed soil. Upon retrieving the sampler, the liner and soil core are removed. The sampler is then properly decontaminated, reassembled with a new liner, and inserted back down the same hole to collect the next soil core.

Instructions for operationg of the Open-Tube Macro-Core® Sampler are given in this section.

1. Thread a Drive Cap (AT1200) onto the drive head of an assembled Open-Tube Macro-Core® Sampler as shown in Figure 4.23. (Refer to Section 4.3 for sampler assembly).

2. Raise the probe unit hammer assembly to its highest position by fully extending the probe cylinder.

3. Position the MC Sampler for driving as shown in Figure 4.24. Place the sampler directly under the hammer with the cutting shoe centered between the toes of the probe foot. The sampler should now be parallel to the probe derrick. Step back from the unit and visually check sampler alignment.

4. Apply static weight and hammer percussion to advance the sampler until the drive head reaches the ground surface (Fig. 4.25A)

   NOTE: Activate hammer percussion whenever collecting soil. Percussion helps shear the soil at the leading end of the sampler so that it moves into the sample tube for increased recovery.

5. Raise the hammer assembly a few inches to provide access to the top of the sampler.

6. Remove the drive cap and thread a Pull Cap (AT1204) onto the sampler drive head.

7. Lower the hammer assembly and hook the hammer latch over the pull cap (Fig. 4.26). Raise the hammer assembly to pull the sampler completely out of the ground.

8. Procede to Section 4.9 for instructions on recovering the soil core from the MC Sampler.

To sample consecutive soil cores, advance a clean sampler down the previously opened hole (Fig. 4.25B) to the top of the next sampling interval (Fig. 4.25C). Drive the tool string the length of the sampler to collect the next soil core (Fig. 4.25D). Switch to an MC Piston Rod Sampler if excessive side slough is encountered.

NOTE: Use caution when advancing or retrieving the sampler within an open hole. Low side friction may allow the sampler and probe rods to drop down the hole when released. To prevent equipment loss, hold onto the tool string with a pipe wrench when needed.

Figure 4.23. Thread drive cap onto sampler drive head.

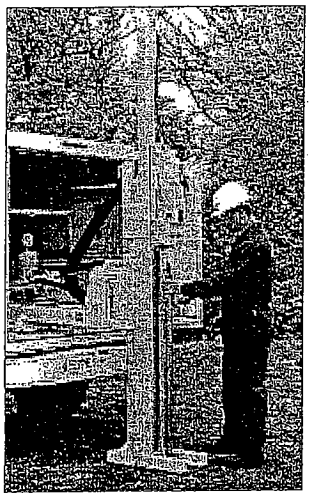
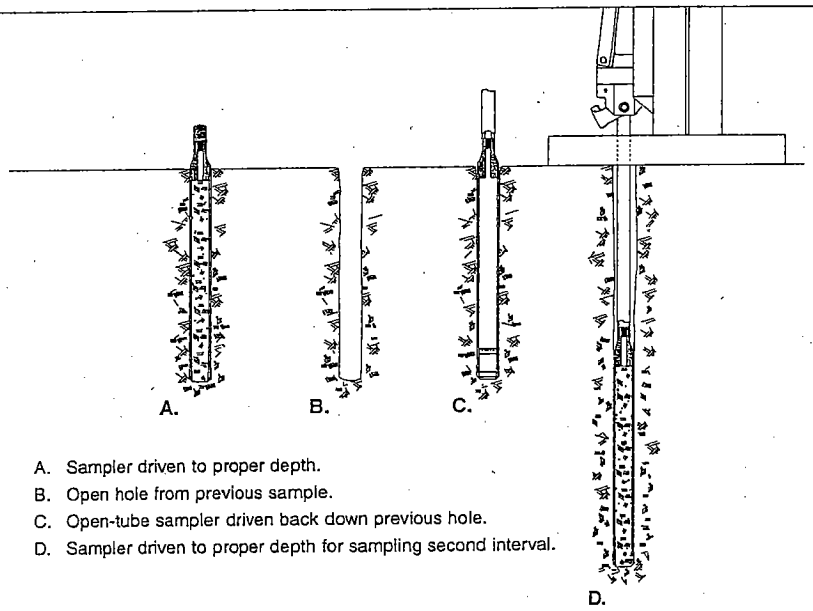


Figure 4.24 MC Sampler positioned for driving into subsurface.

Figure 4.26. Hook hammer latch onto pull cap.



A. Sampler driven to proper depth.
B. Open hole from previous sample.
C. Open-tube sampler driven back down previous hole.
D. Sampler driven to proper depth for sampling second interval.

FIGURE 4.25
Phases of Macro-Core® Open-Tube Soil Sampling

4.8 Closed-Point Sampling with the MC Piston Rod System

Material collapsing from the probe hole sidewall can make it difficult to collect representative soil cores from significant depths with an open-tube sampler. To overcome this problem, the Macro-Core® Sampler can be equipped with a point assembly that is held tightly in the cutting shoe with a piston rod and threaded stop-pin. This allows the sealed sampler to pass through the slough material and then opened at the appropriate sampling interval. Intructions for sampling with the MC Piston Rod System are given in this section.

NOTE: The MC Piston Rod System is designed for continuous core sampling. A probe hole must be opened above the sampling interval either by removing soil with an open-tube Macro-Core® Sampler or by preprobing to depth. Never drive the MC Piston Rod System through undisturbed soil.

1. Attach a Slotted Drive Cap (AT1202) to the drive head of an assembled MC Piston Rod Sampler as shown in Figure 4.27. (Refer to Section 4.5 for sampler assembly.)

   NOTE: The MC Stop-Pin extends slightly from the top of the MC Drive Head. A slotted drive cap is therefore required to allow room for the stop-pin (Fig. 4.27). A standard drive cap may be used once probe rods are added to the tool string.

2. Raise the probe unit hammer assembly to its highest position by fully extending the probe cylinder.

3. Place the leading end of the MC Sampler into the **previously opened hole** (Fig. 4.28A).

4. Advance the sampler down the open hole for the full stroke of the probe machine.

   NOTE: Use caution when advancing the sampler down an open hole. Low side friction may allow the sampler and probe rods to drop down the hole when released. To prevent equipment loss, hold onto the tool string with a pipe wrench when needed.

5. Remove the slotted drive cap and thread a probe rod onto the MC Drive Head. Thread a standard Drive Cap (AT1200) onto the probe rod.

6. Continue advancing the sampler and adding probe rods to the tool string until the desired sampling interval is reached (Fig. 4.28B).

7. Raise the hammer assembly and retract the probe derrick to gain access to the top probe rod.

8. Remove the drive cap and insert extension rods down the inside of the probe rod string. A male Extension Rod Quick Link and an MC Extension Rod Quick Link Connector should be placed on the leading end of the extension rod string (Fig. 4.29) if an MC Stop-Pin Coupler was used during assembly. Nothing is placed on the leading extension rod if a stop-pin coupler was not used.

   Use Extension Rod Couplers or Extension Rod Quick Links (Fig. 4.30) to connect extension rods together until the leading rod contacts the stop-pin . Use an Extension Rod Jig (Fig. 4.30) to hold the down-hole rods while adding more rods to the string.

9. Attach an Extension Rod Handle (Fig. 4.30) to the rod string and slowly rotate the handle clockwise to engage the stop-pin threads. The rods will become harder to turn when the stop-pin threads are fully engaged. Pull up on the rod string to ensure that it is connected to the stop-pin. Continue rotating and periodically lifting the extension rods until the stop-pin is completely unthreaded from the drive head.

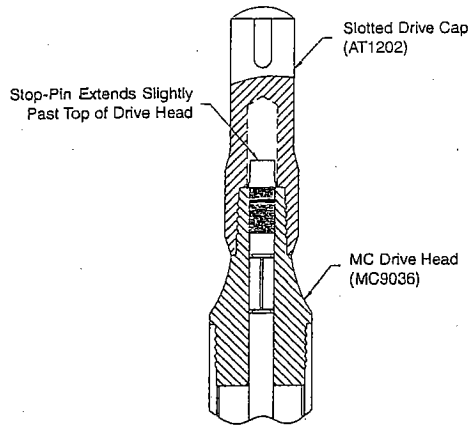
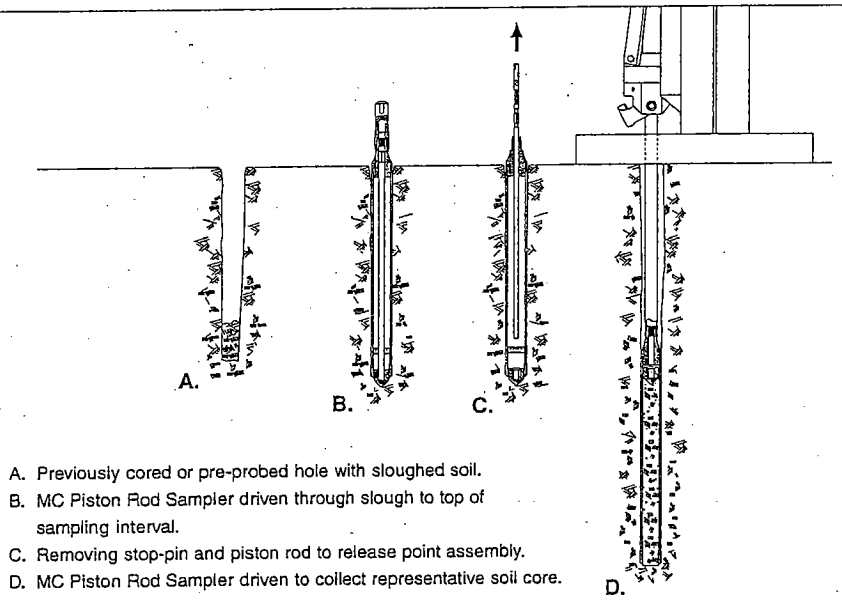


FIGURE 4.27
Slotted Drive Cap Accomodates Stop-Pin



A. Previously cored or pre-probed hole with sloughed soil.
B. MC Piston Rod Sampler driven through slough to top of sampling interval.
C. Removing stop-pin and piston rod to release point assembly.
D. MC Piston Rod Sampler driven to collect representative soil core.

FIGURE 4.28
Phases of Macro-Core® Closed-Point (Piston Rod System) Sampling

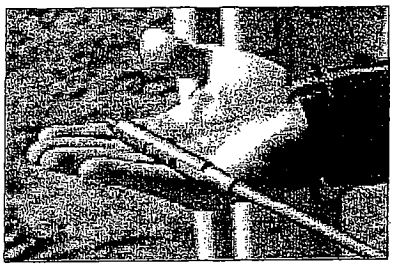


Figure 4.29. Use an MC Extension Rod Quick Link Connector if stop-pin coupler was used in sampler.

NOTE: If the stop-pin is excessively difficult to unthread, pull the entire tool string up approximately 2 inches. This should relieve the force exerted on the point assembly and make releasing the stop-pin much easier.

10. Lift and remove extension rods until the stop-pin is visible above the drive head (Fig. 4.28-C). The stop-pin and piston rod will both be removed from the sampler if a stop-pin coupler was used during assembly (Fig. 4.31-A). Only the stop-pin will be connected to the last extension rod if a coupler was not used (Fig. 4.31-B). Remove the extension rod and stop-pin if the piston rod is not attached.

11. If the piston rod is attached to the stop-pin, carefully unhook the extension rod and male quick link from the MC Extension Rod Quick Link Connector (Fig. 4.31-A). Take care not to deform the stop-pin coupler when removing the extension rod. Now remove the piston rod from inside the tool string.

12. Thread the Drive Cap (AT1200) onto a probe rod and then attach the probe rod to the tool string.

13. Completely raise the probe unit hammer assembly and reposition the probe derrick over the tool string.

14. Apply static weight and hammer percussion to advance the tool string the length of the sampler and collect the soil core (Fig. 4.28-D).

    NOTE: Activate hammer percussion whenever collecting soil. Percussion helps shear the soil at the leading end of the sampler so that it moves into the sample tube for increased recovery.

15. Raise the hammer assembly a few inches to provide access to the top of the tool string.

16. Remove the drive cap and thread a Pull Cap (AT1204) onto the top probe rod.

17. Lower the hammer assembly and hook the hammer latch over the pull cap. Raise the hammer assembly to pull the first probe rod out of the ground. Remove the rod and place the pull cap on the next rod of the tool string. Continue pulling probe rods until the MC Sampler is brought to the ground surface.

    NOTE: Use caution when retrieving the MC Sampler from depth. Low side friction may allow the sampler and probe rods to drop down the hole when released. To prevent equipment loss, hold onto the tool string with a pipe wrench when needed.

18. Procede to Section 4.9 for instructions on recovering the soil core from the MC Sampler.

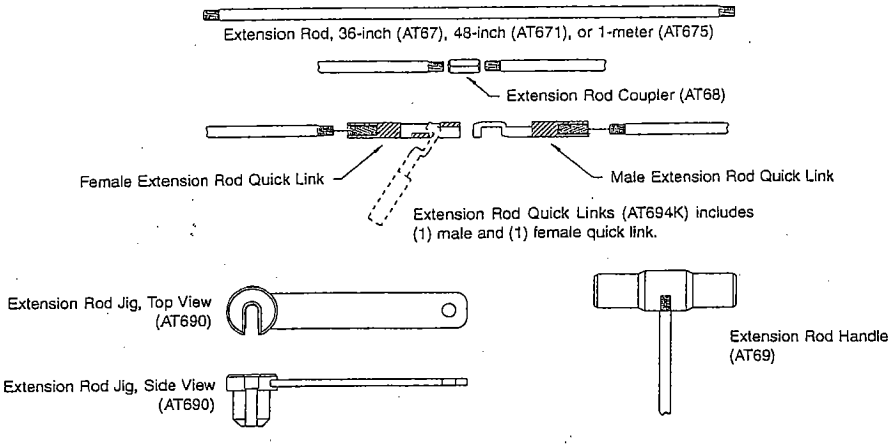


FIGURE 4.30
Extension Rods and Accessories

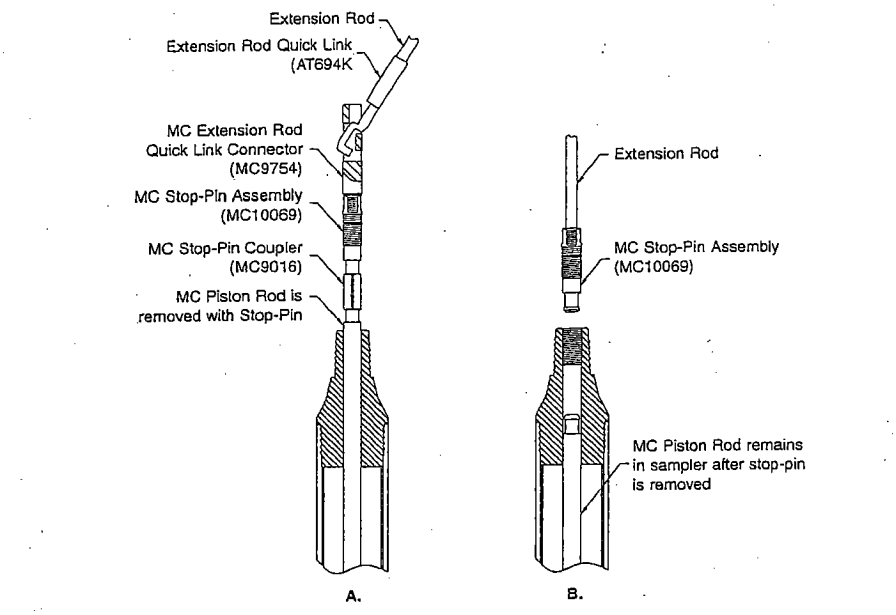


FIGURE 4.31
MC Piston Rod is Removed With Stop-Pin if Stop-Pin Coupler was Used

4.9 Soil Core Recovery

The soil sample is easily removed from the Macro-Core® Sampler by unthreading the cutting shoe and pulling out the liner. A few sharp taps on the cutting shoe with the combination wrench will often loosen the threads sufficiently to allow removal by hand. If needed, the exterior of the cutting shoe features a notch for attaching the combination wrench to loosen tight threads (Fig. 4.32). With the cutting shoe removed (Fig. 4.33), simply pull the liner and soil core from the sample tube (Fig. 4.34).

If the closed-point sampler is used, the MC Piston Rod Point Assembly is now retrieved from the end of the liner (Fig. 4.35). Secure the soil sample by placing a vinyl end cap on each end of the liner.

Undisturbed soil samples can be obtained from Teflon®, PVC, and PETG liners by splitting the liner. Geoprobe offers two tools for cutting sample liners. The MC Liner Cutter Kit (AT8000K) is used to make longitudinal cuts in the liner and includes a tool that holds the liner for cutting (Fig. 4.36). The MC Liner Circular Cutting Tool (AT8050) is used to segment the liner by cutting around the outside circumference of the liner (Fig. 4.37).

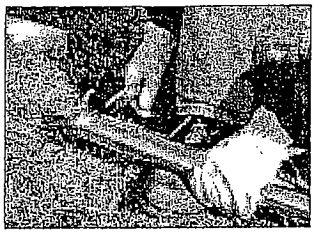


Figure 4.32. Loosening the MC Cutting Shoe with the MC Combination Wrench.

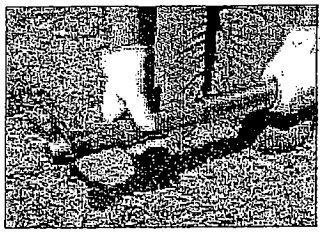


Figure 4.33. Removing MC Cutting Shoe and liner from MC Sampler Tube.

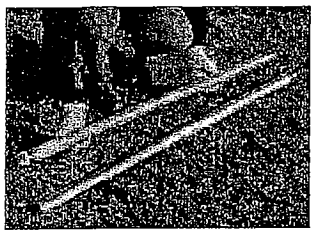


Figure 4.34. Macro-Core® liner filled with soil core.

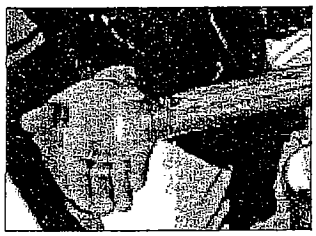


Figure 4.35. MC Piston Rod Point Assembly is retrieved from top of liner.

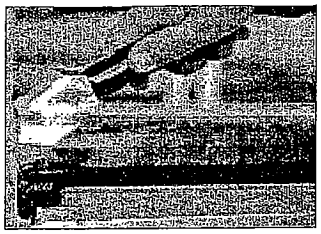


Figure 4.36. MC Liner Cutter makes two longitudinal cuts in polymer liners.

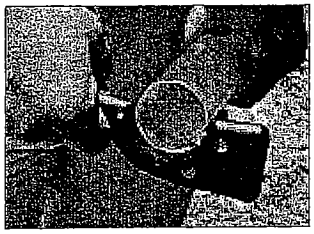


Figure 4.37. MC Circular Cutting Tool cuts around the outside of MC liner.

4.10 MC Piston Rod Sampler Tips

Macro-Core® Samplers are available in lengths of 24 inches, 36 inches, 1 meter, 48 inches, and 60 inches. This means that MC Sample Tubes, MC Liners, MC Piston Rods and MC Piston Rod/Stop-Pin Assemblies are also available in these five sizes. Keep this in mind when ordering Macro-Core® parts to ensure that the items you receive are of the appropriate length.

During development of the MC Piston Rod System, it was common for operators to remove the MC Piston Rod/Stop-Pin assembly from inside the probe rods with the last extension rod still threaded onto the stop-

pin. The MC Stop-Pin Coupler is not designed to withstand the considerable side load placed on it by the extension rod and is easily damaged if the extension rod is allowed to swing around unsupported. The MC Quick Link Connector was developed to prevent damage to the coupler by allowing the last extension rod to be disconnected from the piston rod/stop-pin assembly before removing the assembly from the probe rods. Always use the quick link connector whenever the sampler is assembled with a stop-pin coupler.

4.11 Tips to Maximize Sampling Productivity

The following suggestions are based on the collective experiences of Geoprobe operators:

1. Organize your truck or van. Assign storage areas to all tools and equipment for easy location. Transport sample tubes, piston rods, extension rods, probe rods, and liners in racks. Above all, minimize the number of items lying loose in the back of the vehicle.

2. Take three or four samplers to the field. This allows the collection of several samples before stopping to clean and decontaminate the equipment. A system is sometimes used where one individual operates the probe while another marks the soil cores and decontaminates the used samplers.

3. A machine vise is recommended. With the sampler held in a vise, the operator has both hands free to remove the cutting shoe (Fig. 4.38), drive head, and sample liner (Fig. 4.39). Cleanup is also easier with both hands free. Geoprobe offers an optional Machine Vise (FA300) that mounts directly on the probe derrick (Fig. 4.40).

4. Extension Rod Quick Links (Fig. 4.41) are real time savers. A good method for deploying extension rods is to assemble sections of up to three rods using threaded connnectors. Each section is then connected with Quick Links so that up to three rods can be added or removed from the string at once.

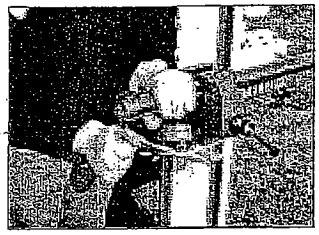


Figure 4.38. Removing MC Cutting Shoe with sample tube held in machine vise.

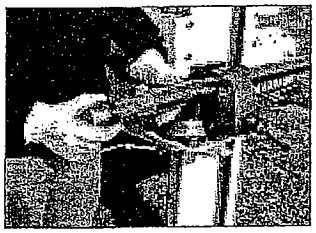


Figure 4.39. Removing filled liner with sample tube held in machine vise.

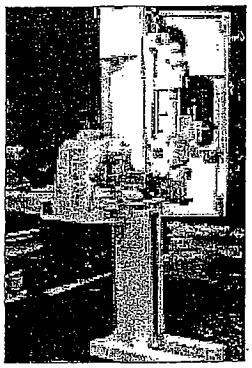


Figure 4.40. Machine vise mounted directly on Geoprobe Soil Probing Unit.

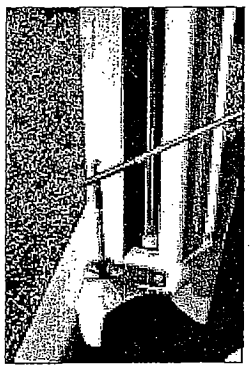


Figure 4.41. Using Extension Rod Quick Links to connect Extension Rods.

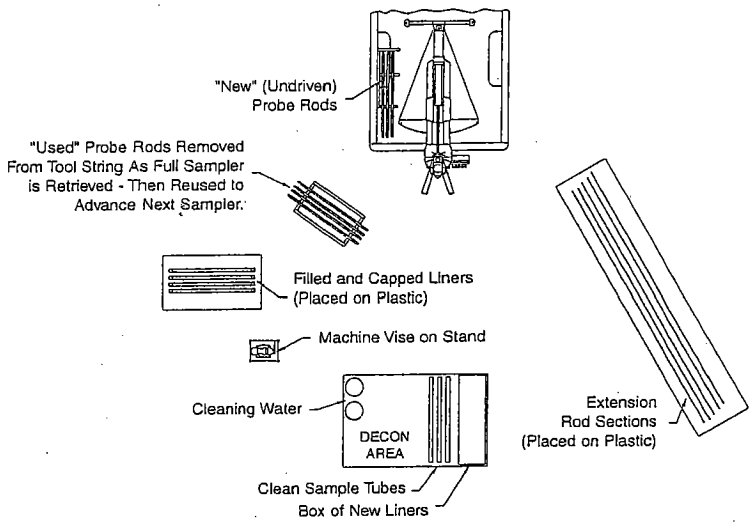


FIGURE 4.42
Equipment Layout Example to Maximize Sampling Productivity.

5. When releasing the stop-pin, a pair of locking pliers can be used to turn the extension rods. Locking pliers may be quicker and easier to install than the extension rod handle.

6. Organize your worksite. Practice with the sampler to identify a comfortable setup and then use this layout whenever sampling. An example layout is shown in Figure 4.42.

   A collapsible table or stand is handy to hold decontaminated sampler tubes and liners. Equipment may also be protected from contamination by placing it on a sheet of plastic on the ground.

   Instead of counting probe rods for each trip in-and-out of the probe hole, identify separate locations for "new" rods and "used" rods. Collect the first sample from the open hole using "new" rods. As each probe rod is removed during sampler retrieval, place it in the "used" rod location. Now advance a clean sampler back down the same hole using all of the rods from the "used" location. Add one "new" rod to the string and then drive the tools to collect the next soil core. Once again, remove each probe rod and place it in the "used" rod location as the sampler is retrieved. Repeat this cycle using all the "used" rods to reach the bottom of the probe hole, and one "new" rod to fill the sampler.

7. Cleanup is very important from the standpoint of operation as well as decontamination. Remove all dirt and grit from the threads of the drive head, cutting shoe, and sample tube with a nylon brush (BU700). Without sufficient cleaning, the cutting shoe and drive head will not thread completely onto the sample tube. The threads may be damaged if the sampler is driven in this condition.

Ensure that all soil is removed from inside the sample tube. Sand particles are especially troublesome as they can bind liners in the sampler. Full liners are difficult to remove under such conditions. In extreme cases the soil sample must be removed from the liner before it can be freed from the sample tube.

8. Although MC Drive Heads are available for open-tube sampling with 1.0-inch OD probe rods, 1.25-inch rods are recommended for the Macro-Core® Sampler. The larger rod diameter limits downhole deflection of the tool string and ultimately provides a more durable system. The double-lead thread design also makes the 1.25-inch rods thread together faster than previous 1-inch probe rods.

9. The Heavy-Duty MC Cutting Shoe (AT8535) is machined with more material at the critical wear areas. It can be used in place of the Standard MC Cutting Shoe (AT8530) and is designed to lengthen service life under tough probing conditions.

   Expansive clays and coarse sands can "grab" and collapse liners as the sample tube is filled with soil. A 1/8-inch Undersized MC Cutting Shoe (AT8537) helps alleviate this problem. The smaller core (1.375 inches OD) allows expanding clays and coarse sands to travel past the liner without binding.

   The standard, heavy-duty, and undersized cutting shoes will not accept the MC Piston Rod Point Assembly (MC10068). Only the MC9034 cutting shoe is compatible with the MC Piston Rod System.

10. Maximize the thread life of the sample tube by varying the ends in which the drive head and cutting shoe are installed. The dynamic forces developed while driving the sampler are such that the threads at the drive head wear more quickly than at the cutting shoe. Regularly switching ends will maintain relatively even wear on the sample tube.

5.0 REFERENCES

Geoprobe Systems, September, 1997, "97-98 Tools and Equipment Catalog."

Geoprobe Systems, May, 1995, "1995-96 Tools and Equipment Catalog."

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STRATEGIC DIAGNOSTICS INC.

TNT EnSys® SOIL TEST SYSTEM

RAPID FIELD SCREEN

User's Guide

IMPORTANT NOTICE

The range of this test is between 1 and 30 ppm TNT/TNB/DNT. The relative standard deviation is 8% The least detectable concentration is 0.7 ppm (TNT).

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of TNT. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

PHASE 1 TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

ITEMS INCLUDED IN TEST KIT

- ☐ 2 Cuvette stopper plugs
- ☐ 1 Ampule cracker
- ☐ 20 Syringe filters
- ☐ 20 Wooden spatulas
- ☐ 20 Extraction jars
- ☐ 1 Bulb pipette
- ☐ 1 Developer solution
- ☐ 1 - 50mL graduated conical tube
- ☐ 1 TNT control ampule
- ☐ 20 - 30cc syringes
- ☐ 20 Weigh boats

ITEMS NOT INCLUDED IN TEST KIT

- ☐ 2 matched HACH cuvettes
- ☐ Paper towels
- ☐ Disposable gloves
- ☐ Acetone
- ☐ Hach DR/2000 or DR/2010
- ☐ Calculator
- ☐ Waste container
- ☐ Balance

READ BEFORE PROCEEDING

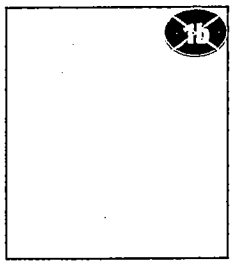
- For some matrices, air drying the soil samples may result in better TNT recovery or more reproducible data.
- A slightly modified protocol should be used if the primary analyte of concern is DNT. Please refer to the modification outlined on page 6.
- It is recommended that a control be run each day. See page 8 for instructions.
- SDI's EnSys® TNT Soil Test System is designed for use with either of Hach models DR/2000 or the newer DR/2010 spectrophotometers. Protocols for use of both instruments are provided in this User's Guide. Ensure the instrument protocol followed is appropriate for the instrument being used.
- The Hach DR/2000 is designed to turn off after a few minutes of inactivity. Press the "READ/ENTER" key every few minutes to prevent DR/2000 from turning off. If DR/2000 turns off, use Reference cuvette to rezero. Newer DR/2000 models and the DR/2010 have an overide "constant on" feature that allows the machine to run indefinitely. Refer to the Instrument Operation: Spectrophotometer Setup section of the HACH DR/2000 or DR/2010 User's manuals.

If you are using the TNT test in conjunction with the RDX test it is important to save your sample extracts. They will be used in the RDX test. Remember to cap the extracts tightly after use. An RDX kit without extraction set-ups can be purchased specifically for this purpose.

PHASE 1 TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

CLEAN CUVETTES



1a Fill 2 Hach matched cuvettes with approximately 5 mL water.

1b Cap each with cuvette stopper plug and, holding plug in place, shake vigorously for 3 seconds.

1c Empty into waste container.

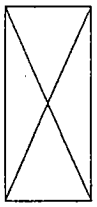
1d Fill cuvettes with approximately 5 mL acetone.

1e Cap each with cuvette stopper plug and, holding plug in place, shake vigorously for 3 seconds.

1f Empty into waste container.

1g Repeat acetone wash (steps 1d - 1f).

1h Wipe outside of cuvette with paper towels. Take care to especially clean the side labeled "25 mL" and the side opposite.



Cuvette

Cuvette stopper

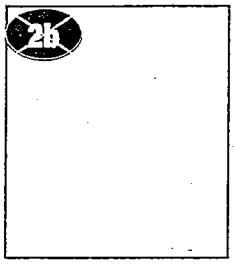
PHASE 1 TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Designate a "Reference" and "Sample" cuvette.

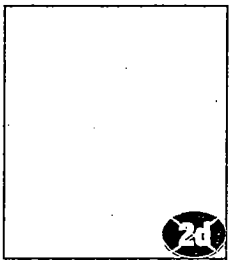
SPECTROPHOTOMETER PREPARATION



2a1 Turn on Hach DR/2000. The instrument will read "SELF-TEST" followed by "Method?". Select Method "0" and press the "READ/ENTER" key.

or

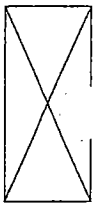
2a2 Turn on the Hach DR/2010. The instrument will read "Self-Test V.xx", then "Enter Program #". Press the [Shift] key (do not hold) and then the [ABS/8] key. Note: Select Program # "0" may also be used to select absorbance mode on the DR/2010.



2b Rotate the wavelength dial until the small display shows: 540 nm.

2c Fill both cuvettes with acetone to the 25 mL line.

2d Insert "Reference" cuvette into cell holder on Hach DR/2000 or DR/2010 with side marked "25 mL" on the right.



Cuvette

2e1 Close light shield of the DR/2000 and press "CLEAR/ZERO" key to establish the reference. The display will read "WAIT" and then "0.000 Abs.".

or

2e2 Close the light shield of the DR/2010 and press the [ZERO] key. The display will read "Zeroing..." then "0.000 Abs.".

2f Remove the "Reference" cuvette and place the "Sample" cuvette in the cell holder.

2g1 On the DR/2000, press the "READ/ENTER" key and record the absorbance on the worksheet as "$Abs_{background}$".

or

2g2 On the DR/2010, press the [READ] key and record the absorbance on the worksheet as "$Abs_{background}$".

2h If reading is greater than 0.002 in magnitude (+ or -), clean cuvettes and redo steps 2a - 2g.

2i Empty acetone from "Sample" cuvette into waste container.

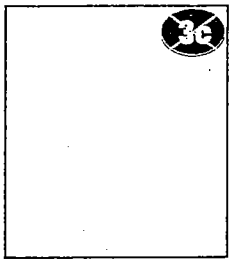
PHASE 2 SAMPLE EXTRACTION & PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Sample should be mixed to ensure a homogeneous sample.

WEIGH SAMPLE

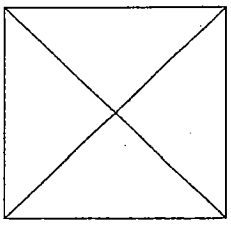


3a Place an unused weigh boat on pan balance.

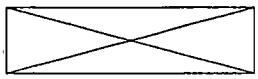
3b Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

3c Weigh out 10+/- 0.1 grams of soil.

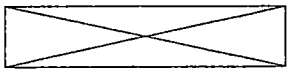
3d If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.



Weigh Boat

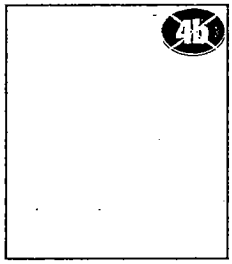


Pan balance



Wooden spatula

EXTRACT TNT



4a Measure 50 mL acetone in the 50mL graduated conical tube.

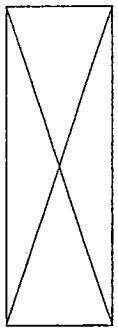
4b Pour acetone into an extraction jar.

4c Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

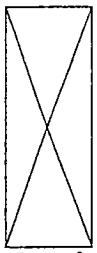
4d Recap extraction jar tightly and shake vigorously for three minutes.

4e Allow to settle for five minutes.

Repeat steps 3a - 4e for each sample to be tested.

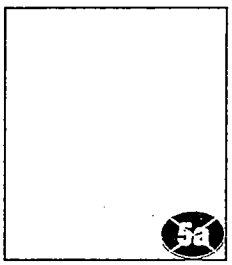


50mL Graduated Conical Tube



Extraction jar

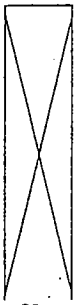
FILTER SAMPLE



5a Place tip of 30 cc syringe into liquid above the sediment layer in the extraction jar and draw up 25 mL of the sample.

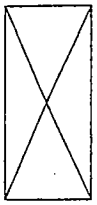
5b Screw the syringe filter onto the end of the syringe.

5c Press the plunger firmly and dispense the sample into the "Sample" cuvette.



30 cc syringe

Syringe filter

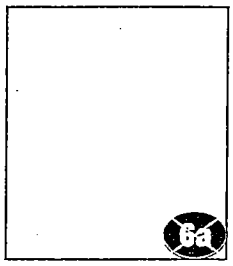


Cuvette

PHASE 3 SAMPLE ANALYSIS

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ SAMPLE



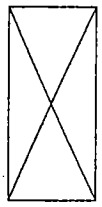
6a Place the "Sample" cuvette in the cell holder.

6b Press the "READ/ENTER" key and record the absorbance on the worksheet as "$Abs_{initial}$".

6c Remove the "Sample" cuvette from the cell holder.

6d Add 1 drop of Developer Solution.

6e Cap the "Sample" cuvette and shake vigorously for 3 seconds.



Cuvette

DNT Analysis Note:

For analysis of samples containing DNT, and/or where DNT concentration is of concern, samples must be allowed to develop for 10 minutes before reading sample absorbance. This will not effect color development for other nitroaromatics.

6f Remove the cuvette stopper and place the "Sample" cuvette in the cell holder.

6g Press the "READ/ENTER" key and record the absorbance on the worksheet as "Abs_{sample}".

6h Clean cuvette between samples using procedure in steps 1a - 1h.

PHASE 4 INTERPRETATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

INTERPRETATION OF RESULTS

7a Multiply the "$Abs_{initial}$" value for each sample by 4. Enter these values on the worksheet.

7b Subtract this value from the "Abs_{sample}" values for each sample and record on the worksheet.

7c Divide the adjusted sample value by 0.0323 and record on the worksheet. This value is the TNT concentration of the sample in parts per million.

$$TNT_{(ppm)} = \frac{Abs_{sample} - (Abs_{initial} \times 4)}{0.0323}$$

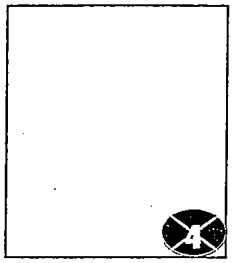
Note: For sample concentrations greater than 30ppm the sample extract should be diluted with acetone and reanalyzed. Remember to multiply the result by the dilution factor in order to determine the correct concentration.

CONTROL (QA/QC) CHECK

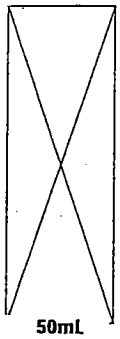
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

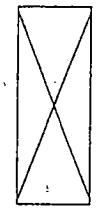
- **The TNT control is optional, but it is recommended that it be run daily.**

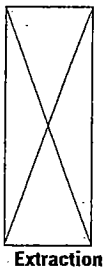
PREPARE CONTROL

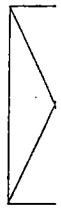


1. Measure 50 mL acetone in the 50mL graduated conical tube.
2. Pour into extraction jar.
3. Open TNT control ampule by slipping ampule cracker over top, and then breaking tip at scored neck.
4. Transfer entire contents of TNT control ampule into extraction jar using bulb pipette.
5. Cap extraction jar and shake vigorously for 3 seconds.



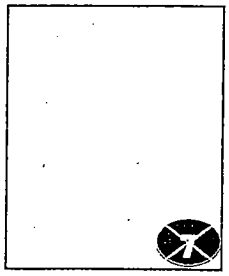


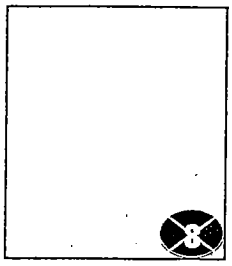


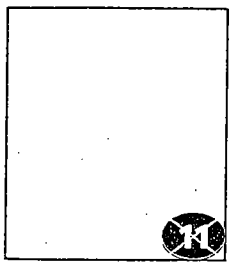


Bulb pi

ANALYZE THE CONTROL



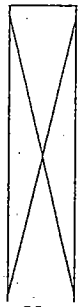


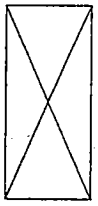


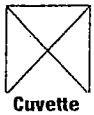
7. Place tip of 30 cc syringe in extraction jar and draw up 25 mL.
8. Attach syringe filter and dispense into "Sample" cuvette.
9. Add 1 drop of developer solution.
10. Cap the cuvette and shake vigorously for 3 seconds.
11. Remove the cuvette stopper and place in the cell holder.
12. Press "READ/ENTER" key and record the absorbance on the worksheet as "$Abs_{control}$".

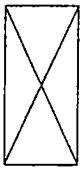
    Absorbance must be between 0.307 - 0.373 for the test to be in control.

    If test is not in control, clean "Sample" cuvette, and then redo steps 7-12 using the remaining liquid from the extraction jar.
13. If test is in control clean "Sample" cuvette before proceeding with samples.









QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each SDI EnSys® TNT Soil Test System contains enough material to perform twenty complete tests.

The TNT Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with the test.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-544-8881.

Validation Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

Strategic Diagnostics Inc. does not guarantee that the results with the TNT Soil Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

How It Works

Controls, Samples, and color-change reagents are added to cuvettes. The concentration of TNT in an unknown **Sample** is determined by evaluating how much color is developed.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or components from one Test System with reagents or components from another Test System.
- Do not use the Test System after its expiration date.
- The sample must be analyzed immediately after adding the Developer Solution.
- Results may not be valid if DR/2000 reading for **Control** is outside of the range of 0.307 - 0.373.

Storage and Handling Precautions

- Wear protective gloves and eye wear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- If acetone comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Operate test at temperatures greater than 4° C/40° F and less than 39° C/100° F.
- After use, dispose of kit components in accordance with applicable federal and local regulations.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS SDI EnSys® TEST SYSTEM

Please read the following before proceeding with field testing.

SAMPLING

The result of your screening test is only as valid as the sample that was analyzed. Samples should be homogenized thoroughly to ensure that the 10 grams you remove for field testing is representative of the sample as a whole. All other applicable sample handling procedures should be followed as well.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

One control is provided with each Kit to provide internal test system quality control. Test runs resulting in a number that falls outside of the specified range should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. SDI recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. Sample Documentation
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of field analysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of SDI tests; a TNT control analysis should be performed daily (see the instructions in the User's Guide)

D. **Method blank** - field analyze fresh acetone

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis (optional)** - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

SDI's Technical Support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives. Call 1-(800) 544-8881.

TNT SOIL TEST - ABBREVIATED PROCEDURE	
STEP	PROCEDURE
1	• Clean cuvettes • Zero the spectrophotometer at 540 nm
2	• Add 10 g soil and 50 ml acetone to extraction jar • Shake 3 minutes, let settle • Draw up 25 mL extract, filter into cuvette
3	• Read $Abs_{initial}$, record • Add 1 drop developer solution, shake • Read Abs_{sample}, record
4	• Multiply $Abs_{initial}$ by 4 • Subtract from Abs_{sample} • Divide by 0.0323 • $TNT_{(ppm)} = \frac{Abs_{sample} - (Abs_{initial} \times 4)}{0.0323}$

TNT SOIL TEST KIT WORKSHEET

Abs background _____ Abs control _____

1	2	3	4	5	6
SAMPLE #	Abs initial	Abs sample	Abs initial x4	Abs final (Column 3 - Column 4)	TNT CONC ppm (Column 5/0.0323)

46472-18

DR/2000 SPECTROPHOTOMETER INSTRUMENT MANUAL

For Use With Software Version 3

PLACE CALIBRATION
DATA LABEL HERE

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Certification

Hach Company certifies this instrument was tested thoroughly, inspected and found to meet its published specifications when it was shipped from the factory.

The DR/2000 Spectrophotometer has been tested, and is certified as indicated to the following instrumentation standards:

Part 15 of FCC Class "A" Limits: Supporting test records by Amador Corp., certified compliant by Hach Company

EN 55 011/CISPR 11 "B" Limits (EMI) per 89/336/EEC EMC: Supporting test records by Amador Corp., certified compliance by Hach Company

EN 50 082-1 (Immunity) per 89/336/EEC EMC: Tested by Amador Corp. and certified by Hach Company. Standards include:

IEC 801-2 (ESD)
IEC 801-4 (Fast Transient)
IEC 801-3 (RF & EM Field)

Radio Frequency Interference

"This digital apparatus does not exceed the Class A Limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications."

"Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada."

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. Shielded cables must be used with this unit to ensure compliance with the Class A FCC limits. Because this instrument operates on and generates radio frequency energy, interference to radio and television reception may occur. If such interference does occur, the operator should take the necessary steps to correct the interference. The following techniques of reducing interference problems are applied easily.

1. Verify that the DR2000 instrument and the battery eliminator are not the source of the interference by removing all power (both AC and battery) from the instrument.
2. Disconnect the battery eliminator from the DR/2000 instrument and AC line to verify that the DR/2000 operating from battery power is not the source of interference.
3. If the DR/2000 Instrument appears to be th source of the interference, move it away from the device receiving the interference.
4. If the interference occurs only when operating the DR/2000 instrument with the battery eliminator, move the battery eliminator's AC connection to a different outlet.
5. Reposition the device receiving the interference, or its receiving antenna to a location where interference does not occur.
6. Try combinations of the above.

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OPERATION

Because of the inherent dangers in handling chemical samples, standards and reagents, Hach Company strongly recommends the user of this product review the Material Safety Data Sheets and become familiar with safe handling procedures and proper usage prior to handling any chemical.

1.1 Instrument Description

The Hach Model DR/2000 Spectrophotometer shown in *Figure 1* is a microprocessor-controlled, single-beam instrument suitable for colorimetric testing in the laboratory or the field. The instrument is precalibrated for over 120 different colorimetric measurements and has provisions for user-entered calibrations as well as future Hach methods.

Test results can be displayed in percent transmittance, absorbance or concentration in the appropriate units of measure. The instrument offers automatic ranging in the preprogrammed parameters, operator-selected languages (a choice of 14), full prompting during testing and error messages for procedural or instrument troubleshooting. A built-in timer helps the operator observe specific reaction times called for in the test procedures by having the appropriate times programmed into the calibration data for that test. The timer also can be used manually by the operator independent of the stored methods. RS232 interface capability allows an external printer or computer to interface with the spectrophotometer, and a 0 to 1-volt analog output is provided for a recorder.

The spectrophotometer can operate on battery power or ac line power using the battery eliminator/charger unit supplied with the accessories. The battery holder supplied holds six D-size, alkaline, dry cells (batteries not supplied) that powers the instrument for approximately 100 tests. An optional rechargeable battery is available, and can be recharged with the battery eliminator/charger supplied with the instrument. The eliminator/charger ***cannot*** be used to charge rechargeable D-size batteries, however.

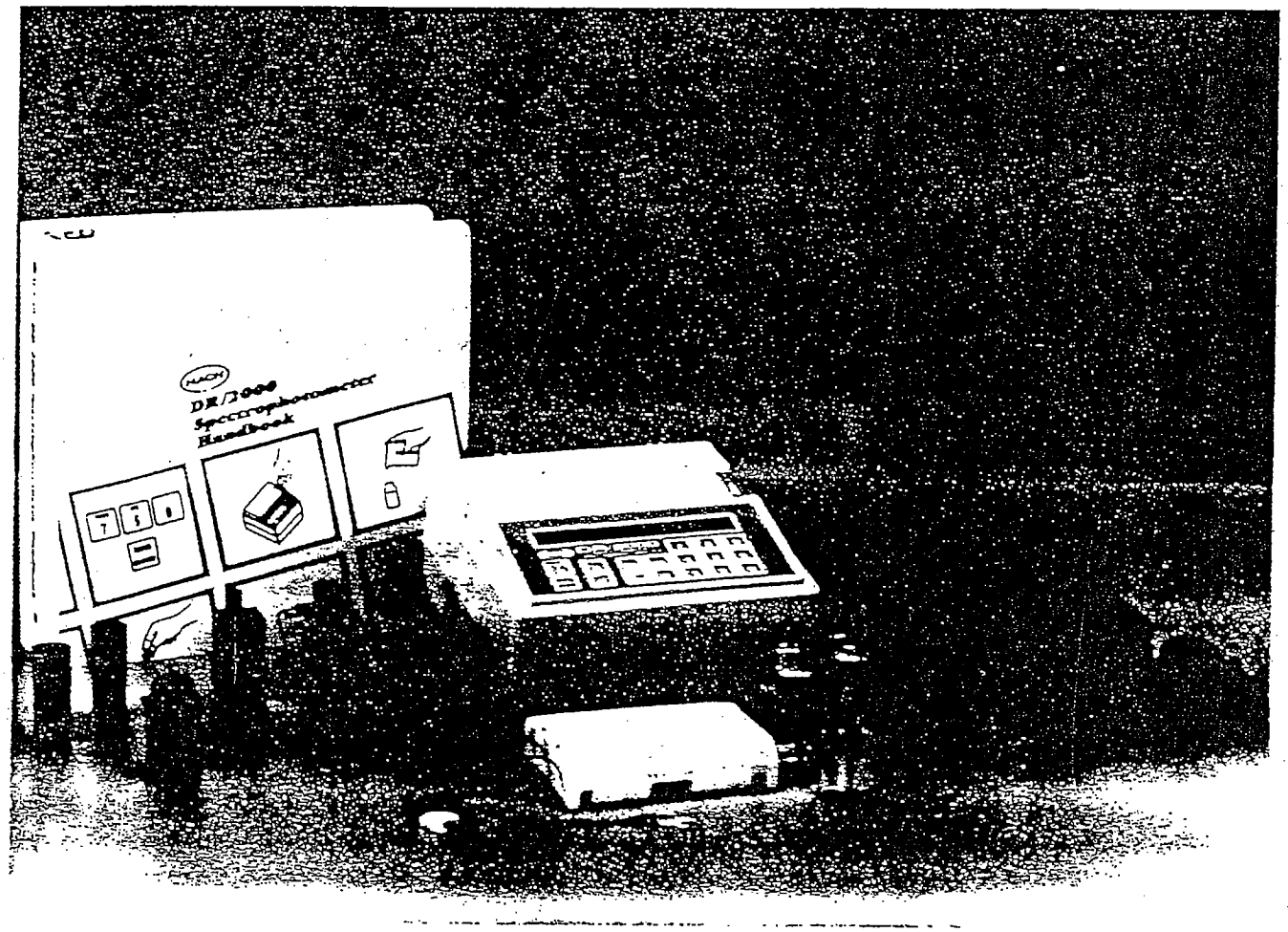


FIGURE 1 MODEL DR/2000 SPECTROPHOTOMETER

WARNING

Do not attempt to recharge D-cell batteries. Connecting them to the eliminator/charger creates the potential for an explosion and serious injury or equipment damage.

ADVERTENCIA

No intente recargar las pilas D corrientes. Si se conectan al eliminador/cargador, se crea el riesgo de explosión y de serias lesiones al operario o daños al equipo.

ADVERTÊNCIA

Não tente recarregar as pilhas tipo D. A ligação das baterias ao eliminador/carregador cria a possibilidade de uma explosão e lesão grave ou danos ao equipamento.

DANGER

Ne pas tenter de recharger les piles taille D. Leur raccordement à un chargeur crée un risque d'explosion et de blessures graves ou de dommages pour l'équipement.

WARNUNG

Die D-Zellen-Batterien dürfen nicht wiederaufgeladen werden. Ein Netzanschluß oder Anschluß an den Lader stellt eine Explosionsgefahr dar und kann schwere Verletzungen oder Geräteschaden zur Folge haben.

1.2 Accessories

Accessories supplied with the DR/2000 Spectrophotometer include:

Matched Sample Cells (2)
Battery Eliminator/Charger
Battery Holder (for 6 D-size batteries)
AccuVac Vial Adapter
AccuVac Zeroing Vial
Spare Lamp
Manual Set
COD Vial Adapter
13-mm Test Tube Adapter
Calibration Filter Assembly
Light Shield Cap
Instrument Dust Cover

In addition to these accessories, several optional accessories are available from Hach Company (refer to *section 7 Replacement Parts and Accessories*).

2.1 Unpacking

Remove the instrument and accessories from the shipping container and inspect each item for any damage that may have occurred because of rough handling or extreme weather conditions during shipment. Verify that the items listed in *section 1.2 Accessories* are included. If any items are missing or damaged, please contact Hach Customer Service, Loveland, Colorado for instructions. The toll-free number is 800-227-4224. For customers outside the United States, contact the Hach office or distributor serving you.

2.2 Supplying Operating Power

2.2.1 Battery Eliminator/Charger

If line power is used, connect the battery eliminator/charger cable plug to the **POWER** jack on the back of the instrument, and connect the power cord to the eliminator/charger and line power receptacle. When the battery eliminator charger is connected and operating, the instrument operates on line power only and the battery can not power the instrument. If the optional rechargeable battery is installed, the instrument can be operated and the battery charged in this configuration. To operate on battery power, the eliminator/charger must be disconnected from the instrument (see section *4.1 Battery Installation* for battery installation). If the eliminator/charger is connected to the instrument but not plugged into a line power receptacle, the instrument will not operate.

NOTE

The battery eliminator/charger unit is switchable for 115V or 230V operation. Be sure the voltage selector switch on the underside of the eliminator/charger is set to the appropriate position, and a suitable power cord is attached before plugging in the unit. Improper setting can result in serious damage to the instrument and eliminator/charger when power is applied.

2.3 Pour-Thru Cell Setup

The optional Pour-Thru Cell Assembly must be assembled before use. *Figure 2 Pour-Thru Cell Assembly* illustrates the assembled unit.

The kit includes:

- Pour-Thru Cell
- Stand Assembly
- Glass Funnel
- Stand Pipe
- 1/8" ID plastic tubing (6 ft)
- 1/4" ID rubber tubing (12 ft)
- Instruction Sheet

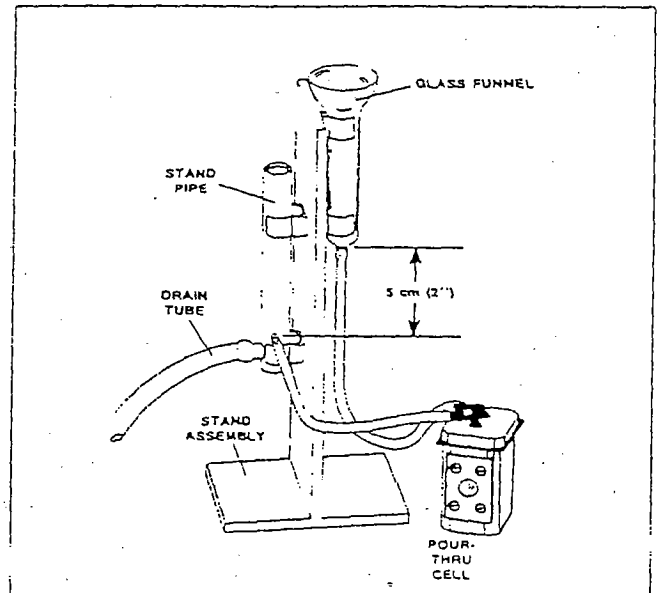


FIGURE 2 POUR-THRU CELL ASSEMBLY

CAUTION

Do not use the Pour-Thru Cell in tests that call for the use of organic solvents such as toluene, chloroform, trichloroethane or cyclohexanone. These solvents may not be compatible with the plastic components of the Pour-Thru Cell creating the potential for equipment damage and chemical exposure for the analyst.

ADVERTENCIA

No utilice la Célula de Flujo Continuo para pruebas que requieran el uso deo solventies orgánicos tales como tolueno, cloroformo, tircloretano o ciclohexanona. Es posible que estos solventes sean incompatibles con los componenetes de material plástico de la Célula de Flujo Continuo y existe el riesgo de daños al equipo y exposición del analista a las substancias químicas.

AVISO

Não use a Pilha de Vazamento em testes que exigem o uso de dissolventes orgánicos como tolueno, cloroformo, tricloroetano e ciclohexanona. Existe a possibilidade que estes dissolventes não dejam compativeis com os componentes de plástico da Pilha de Vazamento, o que pode criar a possibilidade de

estrago ao equipamento e exposição quimica para o analista.

ATTENTION

Ne pas utiliser la cuve à circulation dans les techniques d'analyses qui utilisent des solvants organiques tels que le toluène, le chloroforme, le trichloroéthane ou la cyclohexanone. Les solvants organiques peuvent ne pas être compatibles avec les composants en plastique de la cuve à circulation et endommager l'équipement en créant un risque chimique pour l'opérateur.

WARNHINWEIS

Die "Pour-Thru-Zelle" darf nicht in Tests verwendet werden, die organische Lösungsmittel wie Toluol, Chloroform, Trichlorethan oder Cyclohexanon erfordern. Die Möglichkeit besteht, daß diese Lösungsmittel nicht mit den Kunstoffkomponenten der "Pour-Thru-Zelle" kompatibel sind und somit Geräteschaden verursachen und eine Chemikaliengefahr für den Untersuchungschemiker darstellen können.

2.4 Sample Cell Adapter Installation

The light path is from right to left as you view from the front of the instrument. When placing one of the adapters into the cell holder, have the light path ports in the adapters with the same orientation. All of the adapters can be rotated 180 degrees with no affect on the optics. For a list of the available adapters, refer to section *7 Replacement Parts and Accessories*.

SECTION 3 INSTRUMENT OPERATION

3.1 Description of Operating Controls

Figure 3 shows the spectrophotometer controls. indicators and connections, and their functional descriptions are given in *Table 1*.

Table 1. Operating Controls, Indicators and Connections

Item No.	Name	Description
1	Cell Compartment Cover	Light shield for sample cell compartment. Contains list of stored program numbers on underside
2	Wavelength Control	Used to select wavelength in nanometers appropriate for test parameter
3	Display	LCD window divided into three function areas: wavelength, numeric output and alphanumeric message. Indicates wavelength, prompts and gives measurement results in operational modes. Displays menu options when scrolling through menu with arrow keys. Provides error messages when invalid entries are made.
4	TIMER/7 Key	Initiates timer function when used with shift key. Has numeric key function when shift key is not used.
5	-/8 key	Used to enter negative value in edit mode when used with shift key. Has numeric key function when shift key is not used.
6	+/9 key	Numeric key function. Not used with shift key.
7	CONC/6 key	Initiates concentration readout mode when used with shift key. Has numeric key function when shift key is not used.
8	ABS/5 key	Initiates absorbance readout mode when used with shift key. Has numeric key function when shift key is not used.
9	%T/4 key	Initiates percent transmittance readout mode when used with shift key. Has numeric key function when shift key is not used.
10	PROG/3 key	Used to initiate user-entered calibrations when used with SHIFT key and CONFIG/METH key. Also used with SHIFT and TIMER/7 keys to initiate manual timer. Has numeric key function when shift key is not used.
11	EDIT/2 key	Used with SHIFT and CONFIG/METH keys to initiate editing user-entered method. Has numeric key function when shift key is not used.
12	BATT/1 key	Used to check condition of battery when used with shift key. Current battery voltage and battery-life-bar graph will be displayed. Has numeric key function when shift key is not used.
13	CLEAR/ZERO Key	Used with the shift key to erase an erroneous number or symbol in the display before it is entered. Without shift key, used to zero the instrument with the blank solution in the cell holder prior to measuring the sample.
14	0 key	Numeric function only
15	CONFIG/METH Key	Used with shift key to call up configure menu. Without shift key, used to call up method selection menu, beginning with last used method. Also used without shift key as exit key to terminate and return to last valid method used.

Table 1. Operating Controls, Indicators and Connections (continued)

16	READ/ENTER Key	Used to enter data
17	Right/Down Arrow Key	Used to scroll through selected menu or methods
18	Left/Up Arrow Key	Used to scroll through selected menu or methods
19	SHIFT Key	Used to select the top (blue) function of the dual-function keys. Also used to toggle the beeper on and off (see *section 3.4.2 Beeper On/Beeper Off Selection*)
20	POWER Key	Toggles operating power on and off
21	REC Jack	Connection for 0 to 1V analog recorder output
22	POWER Jack	Connection for battery eliminator/charger unit
23	RS-232 Jack	Serial port for printer or computer interface

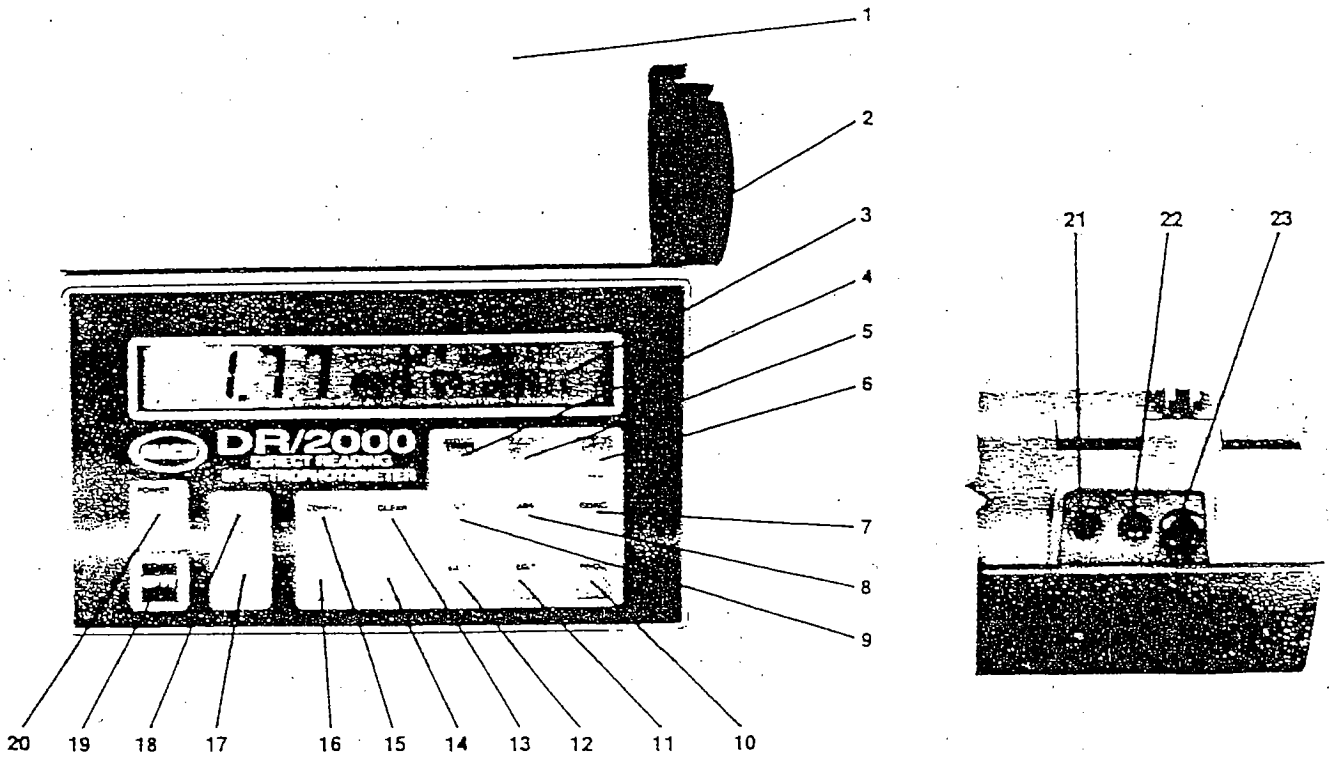
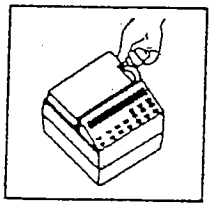


FIGURE 3 OPERATING CONTROLS, INDICATORS AND CONNECTORS

3.2 Testing With Programmed Methods

The DR/2000 Spectrophotometer Procedures Manual provides illustrated, step-by-step procedures for performing all the factory-entered methods. The intent of the material presented in this instrument manual is to provide supplemental information on how the instrument operates to perform the necessary functions, and how to use the various special operating features offered. Once you become familiar with the instrument, the instructions in the procedure manual are sufficient to analyze your samples. For those operators who add their own methods, we recommend that a copy of the User-Entered Calibration Worksheet be placed in the procedures manual to provide a single-source for all the instrument's test capabilities (see *Appendix A.1*).

The following graphic presentation is typical of most programmed test methods and is run in the momentary mode. A more detailed discussion follows.

Step	Action/Keystroke(s)	Display
1. Turn on Power	I O	SELF-TEST V3.1 SELF-TEST 15, 14 - - - METHOD #?
2. Select Stored Program; for example:	2 2 5 READ ENTER	METHOD # ? 225 P225 DIAL nm TO 522
3. Set Wavelength	 READ ENTER	P225 DIAL nm TO 522 mg/l $CaCO_3$ Mg
4. Insert Blank and Set Zero	CLEAR ZERO	WAIT 0.00 mg/l $CaCO_3$ Mg
5. Place Prepared Sample into Cell Holder	READ ENTER	WAIT 1.00 mg/l $CaCO_3$ Mg

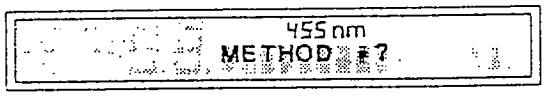
Colorimetric testing with preprogrammed calibrations can be divided into four general phases: spectrophotometer setup, sample preparation, zeroing the instrument and measuring the prepared sample. In the following paragraphs, the scope of each phase is described in detail.

3.2.1 Spectrophotometer Setup

NOTE

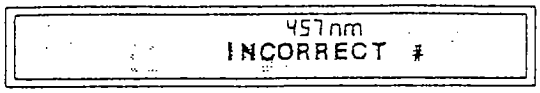
There are a number of instrument operating features that are available as configuration menu options that you may wish to consider at this time. Included in these options are Constant On/Momentary status, data transmittal interval, etc. (refer to *section 3.4 Configure Programming).* An operating feature that is not selected through the configuration menu but is described under Configure Programming is the beeper selection (refer to *section 3.4.2*).

Spectrophotometer setup in this test situation is limited to selecting the method or program number assigned to the desired calibration and selecting the wavelength. Prompting messages will appear in the display at the appropriate times to guide the operator through the procedure. When the instrument is turned on, an initial display of SELF-TEST with a momentary appearance of the software version number appears. The software version number is replaced by a countdown sequence beginning with 15. At the end of the countdown, the first operational prompt to appear is the method prompt:

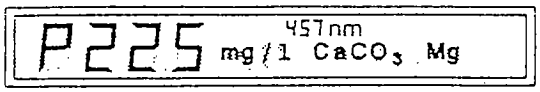


If you wish to select the same program that was last used, you can save keystrokes by answering the method prompt by pressing the METH key. The last used method is recalled even if the instrument was turned off. Since the wavelength setting has not changed, the prompt to adjust the wavelength does not appear in the display and the instrument goes to the zero prompt (for example mg/l $CaCO_3$ Mg). If a different method is desired, proceed as follows to set up the instrument.

The method or program number can be entered with the numeric keys or it can be scrolled to, using the Down or Up Arrow key. Holding the arrow key down allows rapid scrolling. A list of the tests with their numbers is affixed to the underside of the sample compartment cover (light shield). To enter the number with the numeric keys, key in the number and press the READ/ENTER key. If the number is not valid, an error signal sounds (if beeper is on) and the display momentarily reads:



After approximately one second, the display returns to the prompt for the method number. Re-enter the method number properly or use the Down Arrow key to scroll forward or the Up Arrow to scroll backward through the method menu and select from the displayed methods. During scrolling, the method number is displayed in the large digits, and the unit of measure and symbol for the test subject are displayed in the text area; for example,



Once the proper method appears in the display, accept it by pressing the READ/ENTER key. Unless the instrument is already adjusted to the correct wavelength, the display next prompts for the wavelength value; for example:

FIGURE 4 SELECTING WAVELENGTH

Adjust the wavelength control as shown in *Figure 4* until the nanometer (nm) readout matches the prompted value. *Always approach the desired wavelength from the high side for best accuracy and repeatability.* When the values are equal, press the READ/ENTER key to proceed.

NOTE

If the wavelength was not set properly according to the programmed wavelength (within ±1 nm), the wavelength number in the display flashes. You may, however, perform the test with an alternate wavelength by pressing the READ/ENTER key when the alternate value is in the display. The nanometer display flashes continually, indicating the recommended wavelength is not being used.

3.2.2 Sample Preparation

The next task in the colorimetric test is the preparation of the test sample. If the zero solution (or blank) to be used requires some special treatment, it too is prepared at this time. Generally, sample preparation consists of adding the contents of a premeasured reagent powder pillow to 25 mL of the sample (*figure 5 Adding Pillow of Reagent*), and allowing time for a color reaction to take place.

FIGURE 5 ADDING PILLOW OF REAGENT

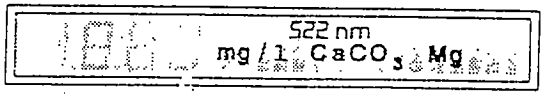
NOTE

It is important to observe the waiting period specified in the particular test procedure to be certain that the color (due to the reaction of the reagent with the substance being measured) develops fully. Many procedures also give a maximum time limit after which the color may begin to fade.

The DR 2000 Spectrophotometer has color development times programmed into the method software, and the operator is notified with a series of short beeps when the time has elapsed. The timer must be initiated, however, by pressing SHIFT TIMER at the time the countdown should begin.

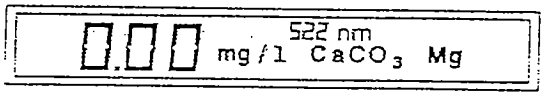
3.2.3 Zeroing the Spectrophotometer

The instrument must be zeroed for each test or series of tests. This establishes a zero reference for the measurement and is done by placing a solution recognized as the zero concentration in the cell holder and pressing the ZERO key. The next prompt display indicating readiness for this function appears as:



Place the zero solution (blank) in the instrument (with the 25-mL fill line to the left or right) and press the ZERO key (see *Figure 6 Placing Blank Solution in Cell Holder*). While the instrument is zero calibrating (which may take up to 8 seconds), the display reads:

When the zero calibration is completed, the display shows a zero result:



You now are ready to measure unknown samples.

NOTE

Once the zero reference point has been established, several samples often can be measured merely by placing them into the cell holder and closing the light shield. If in the MOMENTARY mode, you must press the READ/ENTER key for each measurement. The instrument can be re-zeroed at any time by placing the zero solution (blank) into the instrument and pressing the ZERO key.

3.2.4 Measuring The Prepared Sample

In the CONSTANT ON mode, just place the prepared sample into the cell compartment (with the 25-mL mark to the left or right as shown in

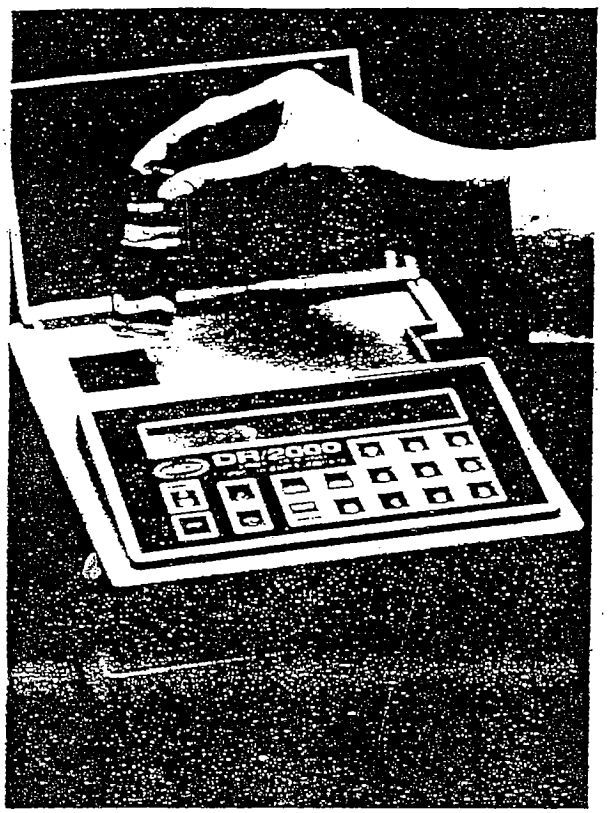
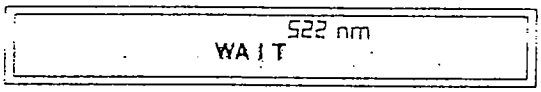
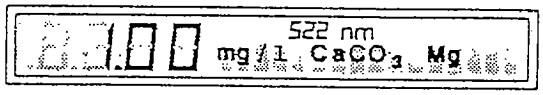


FIGURE 6 PLACING BLANK SOLUTION IN CELL HOLDER

Figure 7) and close the light shield. The test result is displayed immediately and is updated every 0.4 of a second. In the **MOMENTARY** mode, however, you must press the **READ/ENTER** key when ready to take the reading. The display shows:



In about 6 seconds, the test result appears; for example:



The corresponding absorbance or percent transmittance values are displayed simply by pressing **SHIFT, ABS** or **SHIFT, %T**, respectively. **SHIFT, CONC** restores the concentration display.

NOTE

The absorbance or percent transmittance measurements can be made without selecting a method. When the method prompt is displayed, press **SHIFT, ABS** or **SHIFT, %T**. After establishing the zero reference point, absorbance or percent transmittance measurements are displayed.

FIGURE 7 PLACING PREPARED SAMPLE IN CELL HOLDER

3.3 Ability To Store Additional Methods

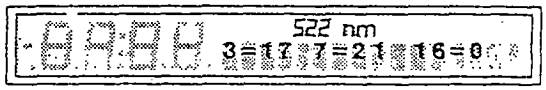
There is room to store 75 additional methods (50 User Methods and 25 Hach Updates) in the instrument with data point memory structure allocated as follows:

40 methods at 3 points maximum
25 methods at 7 points maximum
10 methods at 16 points maximum

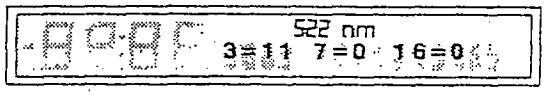
When a method is entered, the instrument determines the availability of the smallest memory structure that contains the number of data points entered. For example, a method with two or three data points is put into a 3-point data structure if one is available. If the method had four to seven data points, it is put into a 7-point data structure if one is available. The 16-point data structure is used for a method with eight to 16 data points. In all cases, the

instrument finds the smallest data structure available that holds the data.

Initially, the maximum number of data points that can be entered for a method is sixteen. After the sixteenth standard (0 through 15) is accepted, the instrument terminates data entry and stores the method for future use. If all ten of the 16-point structures become full, the maximum number of data points becomes seven, and likewise, if all the 7-point data structures become full, three becomes the maximum allowable data points. At the first occurrence of a data point structure becoming full (and thus a reduction in the maximum allowable data point), the operator is alerted to the condition by a display of the data structure status. For example:



Indicates that there are 17 three-point and 21 seven-point data structures available, but no more 16-point data structures available. From this point on, the instrument provides the status display each time a new user-enter method is initiated, and automatically terminates the method entry and stores the data points as a new method after the seventh data point (sixth standard) is accepted. Should all the 7-point data structures be used, a possible status display could be:



If, on the other hand, the smaller data structures become filled first, and there are 16-point structures available, there is no status display because there is no reduction in the maximum allowable data points.

Memory space is shared between user-entered methods and Hach Updates. It is important that data points are selected carefully to conserve as much flexibility as possible and not waste the large data structures.

There are provisions for 50 user-entered methods (#950 through #999), and an additional 25 method numbers for Hach Updates. If additional methods over the 50 user-entered or 25 Hach Update methods are attempted, the instrument error beeps.

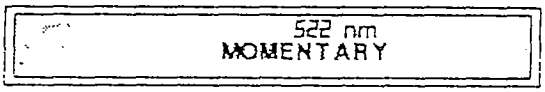
3.4 Configure Programming

A number of operational features are provided by the DR/2000 Spectrophotometer software. *Figure 8* lists the menu and submenu entries and their functions. Beeper selection, although not part of the configure menu, also is included here. In the following sections, each of the features is discussed.

3.4.1 Constant On/Momentary Mode Selection

This option allows selection of the **CONSTANT ON** or the **MOMENTARY** mode. Constant On causes the lamp to stay on continuously, and allows you to take readings without pressing the **READ/ENTER** key each time. The instrument automatically reads whatever solution is in the cell holder. The Momentary mode is normally used when operating on battery power because the lamp is on for only a short period while taking a measurement. To make the selection, call up the configuration menu by pressing **SHIFT. CONFIG.** The display shows the present mode, for example:

If you want Constant On, leave it and return to where you were (with **METH** key), or go to the next item in the menu with the scroll key. If you want to change to the momentary option, press **READ/ENTER**. The display changes to:



3.4.2 Beeper On/Beeper Off Selection

When the beeper is on, it sounds each time a key is pressed, indicating that the keystroke is accepted by the instrument. When Beeper Off is selected, there is no key sound except when turning the instrument on and off, or at timer and low battery alarms. The beeper selection is made by holding the **SHIFT** key down for approximately three seconds (until the beeper sounds). This can be done at any time and during any phase of operation.

This beeper selection is independent of the beeper heard with the timer or the low battery signals. They are always active when the appropriate condition occurs.

MEASUREMENT MESSAGES

Message	Function
METHOD #?	Select a method.
DIAL nm TO 450	Adjust wavelength dial.
ZERO SAMPLE	Establish zero concentration.
WAIT	Instrument is busy.*
mg/l Cu	Concentration measurement (example).
%T	Percent transmittance measurement.
Abs	Absorbance measurement.
WAIT	Instrument is busy.*
SAMPLE #: 1	Sample identification number.

CONFIGURATION SELECTION MESSAGES

Message	Function
MOMENTARY	Set the measurement mode.
CONSTANT ON	(Toggle selection with the READ/ENTER key.)
SEND AT 60 SEC	Set print-output interval with number keys (0, 10 - 9999 seconds).
SEQUENCE OFF	Enable or disable the sequencing of the printed sample ID number.
SEQUENCE ON	(Toggle selection with the READ/ENTER key.)
TIMER	Select the manual timer. Enter time interval with the NUMBER keys.
MM:SS TIMER	Start the timer with the READ/ENTER key.
LANGUAGE	Select the language to be used for messages.
ENGLISH	English (the current language will be displayed first)
FRANÇAIS	French
ITALIANO	Italian
ESPAÑOL	Spanish
PORTUGUES	Portuguese
DEUTSCH	German
NEDERLANDS	Dutch
NORSK	Norwegian
SVENSKA	Swedish
DANSK	Danish
SUOMI	Finnish
TURKÇE	Turkish
ΕΛΛΗΝΙΚΑ	Greek
ニホンゴ	Japanese

*[illegible]

FIGURE 8

MENU DESCRIPTION, SHEET 1

USER-ENTERED METHODS MESSAGES

Message	Function
USER METHODS	User-entered methods
ENTER METHOD:	Enter a new user-entered method.
ENTER nm	Enter the method wavelength.
DECIMAL? 00.00	Set the concentration decimal position.
UNITS?	Select the unit of measure.
SYMBOL?	Enter the method description symbols.
TIMER?	Enter method timer values.
MM:SS TIMER	Enter timer values as minutes and seconds.
DIAL nm TO 455	Set the correct wavelength (skipped if wavelength is already correct).
ZERO SAMPLE	Prepare instrument for measuring the standards.
# 0 STANDARD	Assign zero absorbance and concentration.
# 1 STANDARD	Enter the concentration and measure the absorbance for standard #1.
# 2 STANDARD	Repeat for additional standards up to #15.
EDIT #:	Use edit function to modify an existing user-entered method.
EDIT #: 951	Enter existing method # to edit.
ENTER nm 455	Edit method wavelength.
DECIMAL? 000.0	Edit concentration decimal position.
mg/l	Edit units message.
mg/l pqrstuvwxyz	Edit symbol message.
TIMER:	Add timers to the method.
00:30 TIMER 1	Edit an existing method timer.
MM:SS TIMER 2	Add a timer value as minutes and seconds.
# 0 STANDARD	Assign zero absorbance and concentration.
# 1 STANDARD	Edit data pair #1.
# 2 STANDARD	Edit or add data pairs #2 to #15.
EDIT #:	Use edit function to enter a new method with known data pairs.
ENTER #:	An existing method # was not entered: a new method will be created.
ENTER nm	Enter the method wavelength.
DECIMAL? 00.00	Set the concentration display decimal position.
UNITS?	Select the unit of measure.
SYMBOL?	Enter the method description symbols.
TIMER?	Enter method timer values.
MM:SS TIMER	Enter timer values as minutes and seconds.
# 0 STANDARD	Assign zero absorbance and concentration.
# 1 STANDARD	Enter data pair #1.
# 2 STANDARD	Enter data pairs #2 to #15.
ERASE #:	Erase a user-entered method.
ARE YOU SURE?	Caution: READ/ENTER key will erase method.
TRANSMIT #:	Print data for a user-entered method.

FIGURE 8

MENU DESCRIPTION, SHEET 2

HACH UPDATE MESSAGES

Message	Function
HACH UPDATE	Hach method update.
ENTER #:	Enter Hach method update (requires validation).
#:	Enter factory supplied validation number.
ERASE #:	Erase a Hach method (requires validation).
#:	Enter factory supplied validation number.

MAINTENANCE/TROUBLESHOOTING MESSAGES

Message	Function
ADJUST nm	Recalibrate wavelength using calibration filter assembly.
ARE YOU SURE?	Confirm wavelength adjustment.
RECALL WARNINGS	Display list of any instrument warnings.
	Blank display indicates no errors.*
OFFSETS	Marginal offsets.*
ZERO	Failure to zero.*
ERR#	Call Hach Service.*
RESET WARNINGS	Clear any instrument warnings.
COMPLETED	All warnings are cleared.

MOMENTARY WARNINGS AND MESSAGES

Message	Function
WAIT	Instrument is busy.*
**********	Invalid key press.*
INCORRECT #	Improper number entry.*
COMPLETED	The requested action is finished.*
LID OPEN?	Excess light on the photocell.*
LAMP OUT?	Insufficient light on the photocell.*
LOW BATTERY	Battery voltage marginal.*

*Display presented briefly then followed by previous or next display.

FIGURE 8 MENU DESCRIPTION, SHEET 3

3.4.3 Send At (Transmit Interval) Selection

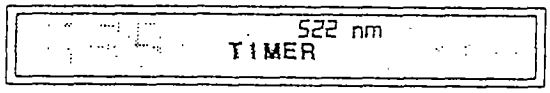
This function is applicable when operating in the Constant On mode only. The instrument can be programmed to transmit measurement data via the serial I/O port at time intervals ranging from 10 to 9999 seconds (refer to section *3.11*). It also can be programmed to transmit on demand only by setting the time interval to zero seconds. Data is then transmitted each time the READ/ENTER key is pressed. The desired time interval is selected by pressing SHIFT, CONFIG, scrolling to SEND AT 15 SEC and entering the desired interval with the numeric keys. Then press the READ/ENTER key.

3.4.4 Sequence Off/Sequence On Selection

Test samples can be numbered for identification in the measurement data transmitted through the serial I/O port. When the SEQUENCE ON is selected, the first measurement of a method is automatically numbered #1 and subsequent measurements incremented by 1. If the operator chooses, another number can be assigned and the incrementing begins with that number. The new number can be entered at any time, and the next printed data reflects the new entry. The selection is made by pressing SHIFT, CONFIG, scrolling to SEQUENCE OFF and then making the choice. Sequence Off or Sequence On is toggled with the READ/ENTER key. When the desired choice is in the display, it is selected.

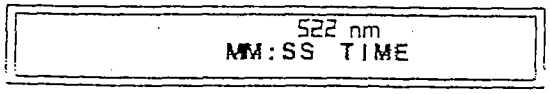
3.4.5 Timer

The manual timer is an additional feature that allows the operator to use the timer independently from the method timer, as long as the method timer is not currently in use. You can select the timer by pressing SHIFT, PROG, TIMER. The display shows:



You also can select the timer by pressing SHIFT, CONFIG and scrolling to TIMER.

Accept with the READ/ENTER key and the display shows:



Key in the desired time, and when you wish to start the time period, press READ/ENTER. Return to the point where you left the method by pressing the METH key. At the end of the period, the instrument sounds a series of beeps.

When you wish to use the manual timer independently and do not return to a method, the display first momentarily shows the time that was entered, and then begins the time countdown. When the time expires, the beeper sounds. The timer can be aborted while it is displayed by pressing SHIFT, TIMER.

The manual timer is not available, however, while the method timer is running. An attempt to use the manual timer at that point results in an error signal when READ/ENTER is pressed in response to the timer prompt. If the METH key is pressed and you are back to an alphanumeric display, SHIFT, PROG, TIMER recalls the timer function in progress.

NOTE

An error signal (4 beeps and a string of asterisks in the display), when READ/ENTER is pressed to begin a timed period, is an indication that a timer is already in use.

3.4.6 Language

Fourteen languages are programmed into the DR/2000 Spectrophotometer. They are English, French, Italian, Spanish, Portuguese, German, Dutch, Norwegian, Swedish, Danish, Finnish, Turkish, Greek and Japanese. Select the language of choice by pressing SHIFT, CONFIG and scrolling to LANGUAGE. Press READ/ENTER and scroll through the language menu until the desired language is displayed. Then enter it with the READ/ENTER key. The display reverts back to the LANGUAGE menu message that always appear with English spelling. The instrument continues to display in the selected language until changed again by the operator.

3.4.7 Recall Warnings

This feature identifies the problem area or areas when a warning indication occurs during instrument operation. The warning indication is a flashing EEE in the wavelength field of the display. When this condition occurs, the operator must determine which diagnostic warning applies and perform a warning reset to restore the instrument to operation. Proceed as follows:

1. Press SHIFT, CONFIG to enter the configuration menu.

2. Scroll to **RECALL WARNINGS** in the display and press the **READ/ENTER** key. The display identifies the appropriate problem area or areas of those listed below:

OFFSET
ZERO
ERR# n (1-10)

After the warnings are momentarily displayed, the display reverts back to Recall Warnings.

3. Perform the *Reset Warning* procedure. If a warning message recurs, contact the Hach office or service center serving you.

3.4.8 Reset Warnings

Following a warning message (flashing **EEE** in the wavelength field) all warnings must be reset to clear the warning message. Before resetting, document the warning message for future use. Proceed as follows.

1. Press **SHIFT, CONFIG** to enter the configuration menu.

2. Scroll to **RESET WARNINGS** in the display and press **READ/ENTER**. The warnings will be reset and the display shows **COMPLETED** momentarily and then reverts back to **RESET WARNINGS**. Return to where operation was interrupted by the warning message by pressing **METH**.

3.4.9 User Methods

In addition to the factory-installed methods, program numbers 950 through 999 are reserved for storage of user-entered methods. There are two different techniques available for entering user-entered calibrations. In the standard technique (*section 3.4.9.1*) the absorbance values of a series of standards are measured and stored in memory. If the absorbance and concentration values already are known, an alternate technique (*section 3.4.9.2*) may be used that utilizes the editing function to enter the absorbance and concentration values via the keypad. No standard solutions are needed.

NOTE

The Constant On mode is recommended when creating a user-entered method (section *3.4.9.1*). In the Momentary mode, the instrument turns off automatically if no key is pressed for five minutes resulting in the loss of any data points or edits entered.

Prior to entering a calibration, the operator must determine the optimum wavelength, timing sequences (if any) and workable range of the method. The Sample User-Entered Calibration Worksheet shown in *Appendix A.1* is a valuable guide in creating a user-entered method and providing documentation for future reference. A blank form is included in *Appendix A.2*.

The calibration curves of user methods may have positive or negative slopes, but they must be based on absorbance (% transmittance not allowed) and they must pass through the origin that represents zero concentration.

It is important that the standards adequately describe the curve over the range of interest. Because this is largely dependent on the shape of the curve, it may be necessary to prepare a preliminary curve using extra data points as an aid in selecting the appropriate standards.

If the curve is linear, only two concentration data points are needed. For example, standards with a zero absorbance and a standard with 1.000 absorbance are appropriate. However, if the curve is nonlinear, additional data points are needed to achieve good accuracy. Up to sixteen data points can be entered for a single calibration curve. *Figure 9* illustrates why additional data points are necessary to adequately describe nonlinear curves.

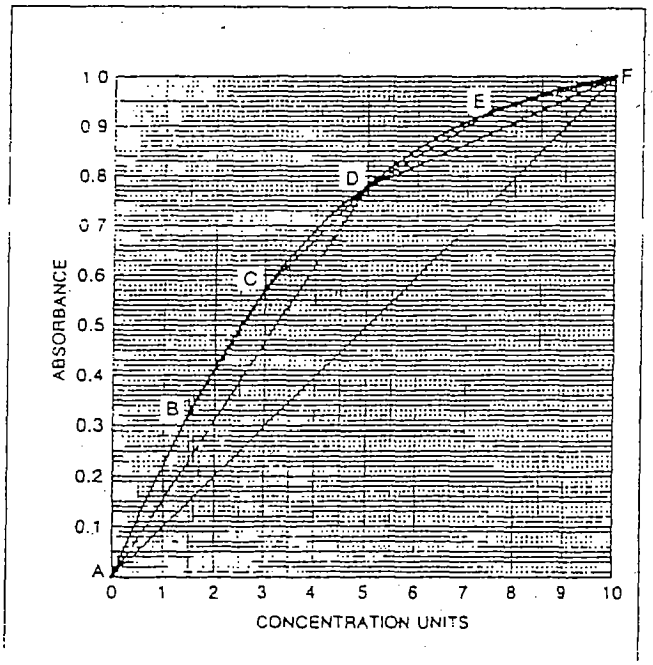


FIGURE 9 CALIBRATION CURVE

If only points A and F are entered, the instrument bases its calculation on a straight line (A-F), and the result is grossly in error. By adding the data point D, the curve is greatly improved with the two straight lines A-D and D-F, but in some regions of the curve, measurements still may not be accurate enough. Further improvement is gained when data points B, C and E are entered, giving straight lines A-B, B-C, C-D, D-E and E-F.

The **USER METHODS** submenu consists of the selections **ENTER METHOD**, **EDIT #:**, **ERASE #:**, and **TRANSMIT #:**. The use of these features is discussed in section *3.4.9.1* through *3.4.9.5*.

3.4.9.1 Entering User-Entered Methods

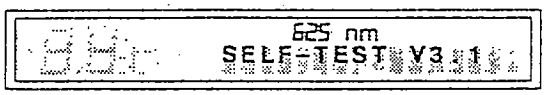
Spectrophotometer Setup

This phase of the user-entered calibration involves:

- Selecting Constant On mode
- Establishing program number
- Selecting wavelength
- Selecting decimal position
- Selecting or creating unit of measure
- Creating symbol or name of constituent being measured
- Establishing timer selections if needed

At any point during the following procedure, the operator can terminate entering the calibration, and exit by pressing **METH** and answering the **ABORT?** query with **READ/ENTER**. All entered data is lost, and the procedure must be started from the beginning. If the **METH** key is pressed by mistake, and you do **not** wish to accept the **ABORT**, press any key other than **READ/ENTER**.

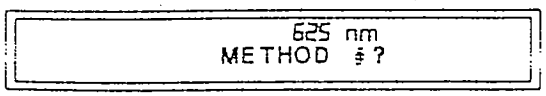
1. Turn the instrument on with the I/O key. An automatic self test is initiated. The initial display:



appears momentarily and then changes to

SELF-TEST 15 (beginning count down number)

and count down while the self test occurs. At the end of the countdown, the display changes to the method prompt:

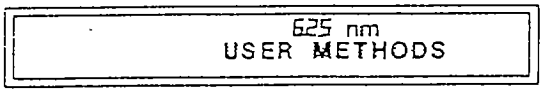


2. Select the Constant On mode and then return to the method prompt as described in section *3.4.1*.

3. The **ENTER METHOD** selection of the **USER METHODS** submenu can be selected in either of two ways:

a. The easiest way is to key in **SHIFT**, **PROG**, **METH**, and the display shows:

b. The other way is to key in **SHIFT**, **CONFIG** and scroll through the configuration menu to

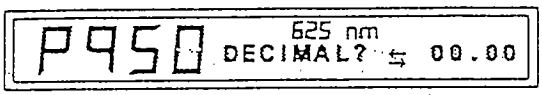


Then press **READ/ENTER** to get

Regardless of which technique is used to reach the **ENTER METHOD** prompt, press **READ/ENTER** to proceed. The display reveals the program number assigned to the user method and gives the next prompt:

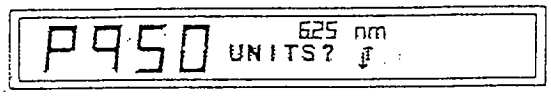
(The number 950 is used as an example here: the actual program number displayed is the lowest, unassigned number between 950 and 999 available at the time).

4. Now enter the wavelength for the method. Using the numeric keys, key in the appropriate numbers and enter by pressing the **READ/ENTER** key. Dial to the same wavelength with the control knob. If the wavelength is outside of the acceptable range (400 to 900 nm), the display momentarily flashes **INCORRECT #** and then reverts to the wavelength prompt. If the wavelength is accepted, the display gives the next prompt:



5. The decimal prompt in the display is asking for the appropriate measurement resolution for this test. Set the decimal point position using the arrow keys.

SHIFT key is not used. When set properly, press READ/ENTER. The display gives the next prompt:

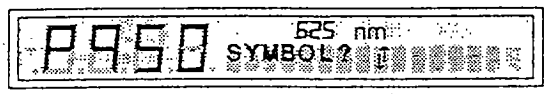


6. The descriptive field for displaying units of measure and symbols can contain up to sixteen characters. Use the arrow keys to select one of the available units of measure. The menu includes: (blank) mg/l µg/l g/l ppm Lbs/Ac kg/ha % g/kg mg/kg mg/100g mg% UNITS FTU Mol/l mMol/l meq/l Oz/gal.

NOTE

The first display in the units menu is blank (no unit). If the desired unit is not included above, selection of the blank reserves all sixteen character spaces for input at the next (SYMBOL) prompt; a custom unit can then be constructed along with the symbol describing the method.

When the appropriate units selection appears in the display, press the READ/ENTER key. The display then prompts:



7. In the remaining spaces in the descriptive field, various characters can now be added to construct a chemical symbol or otherwise describe the method.

There are two techniques for constructing the symbol. In addition to scrolling through the menu, characters are selected by entering appropriate numeric codes with the keypad. The specific numeric code for each character is listed in *Table 2*. Simply key in the appropriate numeric code and press the READ/ENTER key; the referenced character appears in the display. To replace a displayed character entered by mistake, press SHIFT, CLEAR and key in the correct number. Press READ/ENTER. To accept the character, press READ/ENTER again. The cursor advances to the next position. Characters that are accepted can be edited by pressing SHIFT, Left Arrow to erase and back space; then new characters can be entered in their place. After the last character is accepted, press READ/ENTER once more to accept the character string and advance to the next prompt. Numeric codes especially are convenient if the symbol is long or complicated. Considerable time is saved by eliminating scrolling.

Constructing a new symbol by *scrolling* requires that the operator utilize the numerous characters stored as menu entries in this instrument. By holding down either arrow key, you can scroll through the menu rapidly until you are close to the character being sought, and then proceed slowly in steps until the desired character appears in the display. To select the displayed character, press the READ/ENTER key. The cursor advances to the next position. Continue the procedure to complete the symbol. After the last character is selected, press the READ/ENTER key a second time to accept the character string and advance to the next prompt. A list of the characters available in the order of their position in the menu is given below.

_ abcdefghijklmnopqrstuvwxyz

Following the z, a series of special characters appear (refer to *Table 2*).

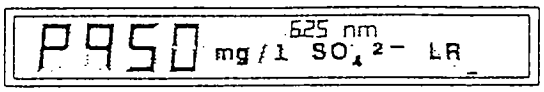
The number of some special characters in a single display is limited to four.

Following the special characters, a series of symbols and numbers appear.

< > . / : ; = ? # 0 1 2 3 4 5 6 7 8 9 - +

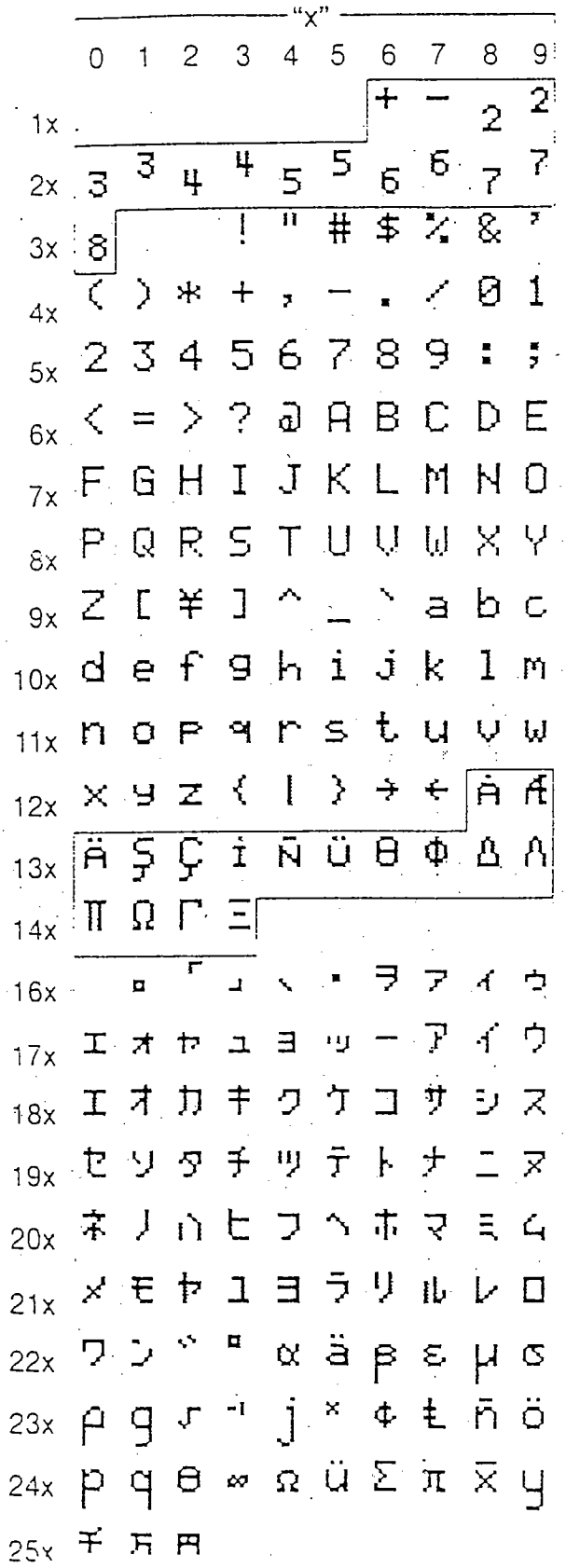
During scrolling, these characters appear full size. Those that can be used for subscript and superscript characters are converted by pressing the shift key once for subscript and twice for superscript. Subscripts are available for numbers 2 through 8, and superscripts are available for numbers 2 through 6, "-" and "+". This is illustrated in the example below.

Scrolling Example: With the first press of the down arrow, the display changes to show the unit of measure with the cursor positioned at the first position available to begin the symbol. If mg/l is selected as the unit of measure, the display shows:



Resume scrolling and continue until the first character is in the display. For example, to

Table 2. Numeric Code vs Character



NOTE

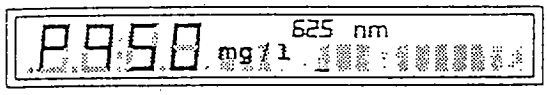
How to select characters by code numbers:

In the left column, the "x" represents the second or third digit of the code number and is supplied by the column number in which the desired character is found. For example, if you wanted to select a lower case "k", you would use the first two digits from the row in which the "k" is found, 10, and then use the number of the column, 7, as the third digit of the code number. Thus, keying in 107 with the numeric keys of your spectrophotometer and pressing READ/ENTER will cause "k" to appear in the display. Top accept it as correct, press READ/ENTER again. The "k" will be accepted and the cursor will move to the next position, ready to receive the next character code.

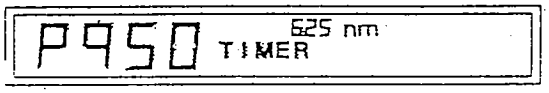
The characters in the areas that are boxed are limited in number to four that can be selected in any one message. They can be repeated, but only four different characters can be used.

construct a display for a low-range test of sulfate, scroll to obtain the letter s in the display. The letter is lower case and must be changed to an upper case by using the shift key. Accept the upper case S with the READ/ENTER key, and the cursor advances to the next space. Scroll for the letter o, capitalize the letter to O with the SHIFT key and accept it with the READ/ENTER key. Scroll back for a 4 and change it to a subscript by pressing the SHIFT key once. Press the READ/ENTER key to accept. Scroll to 2, change it to a superscript by pressing the SHIFT key twice, and enter it with READ/ENTER. Scroll for a minus sign, and press the SHIFT key to make it a superscript.

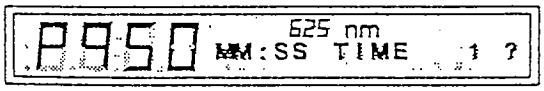
To distinguish this low-range sulfate method from the sulfate method already in memory, add LR at the end of the symbol field in the display. Scroll to the blank space character. During scrolling, the blank appears between underline and the letter "a". Accept it with the READ/ENTER key. You can enter up to four blank spaces and then enter L and R. The display shows:



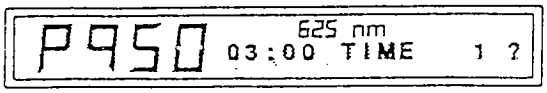
After examining the display to see that everything is correct, press the READ/ENTER key a second time to accept and store the entire display. The display then gives the next prompt:



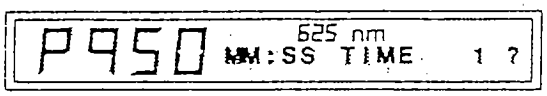
5. The timer sequences is bypassed entirely, when the timer is not needed, by pressing READ/ENTER in response to the timer prompt; the next prompt is then displayed. If this is a timed procedure, press SHIFT, TIMER. The next prompt is:



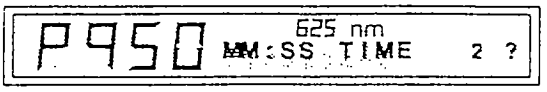
The interval for the first time period is entered as minutes and seconds by using the number keys to overwrite the letters MM:SS. Leading zeros must be keyed in. For example, a three-minute time period is displayed as:



If the displayed interval is incorrect, press SHIFT, CLEAR and the display returns to:

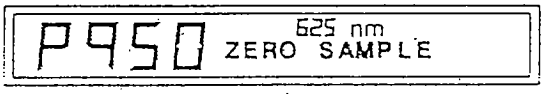


New values can now be keyed in. When the correct minutes and seconds are shown in the display, press the READ/ENTER key to store the interval in memory. At this point, the display prompts:

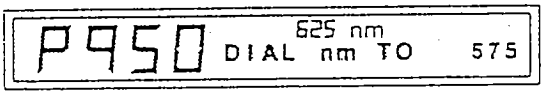


If more timed intervals are needed, repeat the above steps. Up to four time intervals can be stored. When all interval entries are complete, store the entire sequence by pressing READ/ENTER once if all four intervals are used, or two times if less than four are entered.

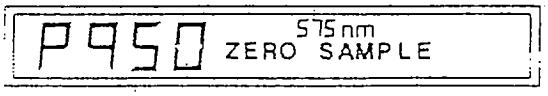
If the wavelength control is adjusted to match the wavelength keyed in Step 4, the display now shows the zero prompt:



If the wavelength control is not adjusted to match the selected wavelength, the display prompts:

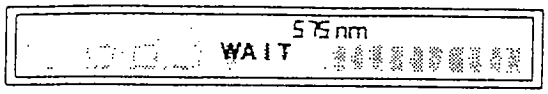


Adjust the wavelength control on the right side of the instrument to obtain the selected wavelength in the display. When correctly displayed, press the READ/ENTER key. The display now gives the zero prompt:

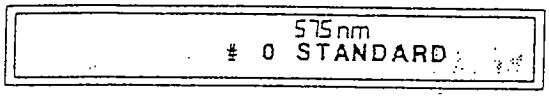


Entering Calibration Data Points

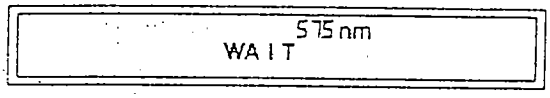
9. Place a sample cell containing clear water in the cell holder, close the cover and press the ZERO key. The instrument makes internal adjustments, and while doing so displays:



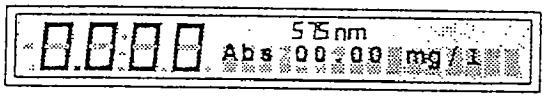
followed by a display prompting:



10. Remove the clear-water sample cell and replace it with a cell containing the 0.0 concentration sample. Close the cover and press the READ/ENTER key. The instrument sets the absorbance to zero, and while doing so displays:



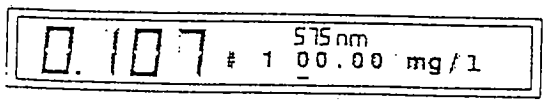
followed by:



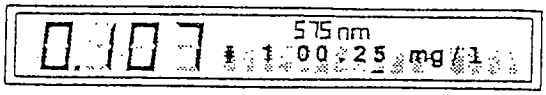
The actual units and decimal place displayed depend on the selections made earlier during Steps 5 and 6. At this point, the measurement can be repeated or accepted.

Accept the zero point for the calibration curve by pressing the READ/ENTER key. The next prompt asks for the next standard, that is:

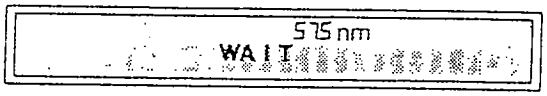
11. Insert the first (lowest concentration) standard in the cell holder and close the cover. (Any timing intervals defined in Step 8 must be observed during the preparation of the 0.0 concentration sample and calibration standards.) Press the READ/ENTER key and the display changes to:



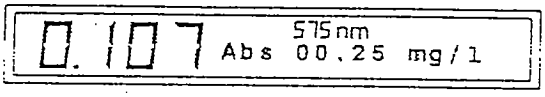
Key in the appropriate concentration; for example:



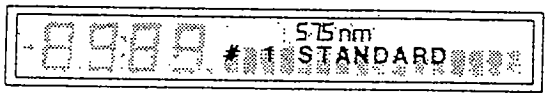
All digits must be entered until the number displayed is correct as shown, including any leading zeros to the left of the decimal; keystroke errors are cleared by pressing SHIFT, CLEAR. Accept the correct entry with the READ/ENTER key. The display first reads:



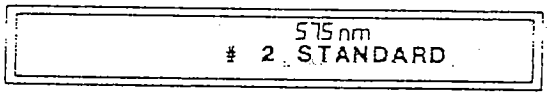
followed by a display of both the absorbance (relative to the 0.0 concentration sample) and the concentration of the first standard; for example:



This data pair (concentration and absorbance) is rejected and the steps repeated by pressing SHIFT CLEAR; the display then reverts back to:

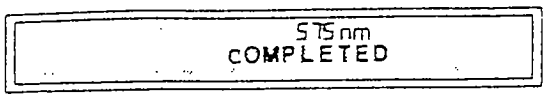


To accept the data pair, press READ/ENTER. The data pair are stored in memory as calibration data point number 1. The display now prompts for the next standard:

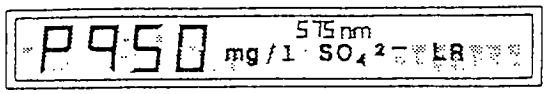


12. Repeat the above procedure as for entering standard 1 for all calibration standards. It is important that the standards be entered in order of increasing analyte concentration; this is done regardless of whether the absorbance values increase in this sequence (a positive-sloping curve) or decrease (a negative-sloping curve). Because all absorbance values are relative to a 0.0 concentration sample that is set to zero absorbance, negative-sloping curves have negative absorbance values.

13. When all calibration data points are entered, conclude the calibration by pressing SHIFT, READ/ENTER. The display now reads:



followed by the method just created, such as:



14. The procedure now is stored. The user-entered calibration mode is terminated, and the instrument has returned to regular operation with the just completed user method in the display. It is good laboratory practice to again measure each of the standard solutions used in the calibration to verify your work. If corrections are needed, refer to section *3.4.9.3 Editing User-Entered Methods*.

If ever there is insufficient memory to store a user-entered method, evaluate the user-entered methods, and determine if data can be eliminated to make room for the new method (refer to section *3.4.9.4 Erasing User-Entered Methods*). The maintenance of a log of user-entered methods is useful both as a record of what is in memory, in case of accidental loss, and as a review document to evaluate for changing test requirements. Refer to *Appendix A for* an example of a form that would meet these needs.

If only one calibration standard is measured, a straight line between that point and the origin (0 Abs, 0 Conc) is calculated, and measurements are linearly interpolated along that line. If two or more data points (up to a maximum of sixteen) are entered, a point-to-point, straight-line approximation of the curve is constructed and measurements are linearly interpolated along the appropriate line segments.

To use a user-stored method, either scroll to the method or enter the program number with the keypad. Any timing intervals stored in the program must be observed when testing samples with the method. Because all absorbance values are relative to the zero concentration reference, a 0.0 concentration sample must be used to set zero absorbance at the **ZERO SAMPLE** prompt prior to testing samples.

If the concentration of a sample exceeds the last point on the calibration curve, the display flashes the highest concentration value as a warning of the over-range condition. The method should be repeated on a fresh sample that is diluted to fall within range of the calibration curve.

If the concentration of the sample is less than that of the reagent blank used to set zero absorbance, a flashing zero is displayed, and the instrument should be rezeroed.

3.4.9.2 Alternate Method For Entering User-Entered Method

When the absorbance and concentration values for the data points already are known from a previously performed calibration, a convenient way to enter a user-entered method is to use the editing function to enter the values as described below. In this procedure the operator just enters the values for concentration and absorbance with the sample holder empty. No standard solutions are needed and no measurements are taken. At any point during the procedure, the operator can terminate and exit by pressing **METH** and answering the **ABORT?** query with **READ/ENTER**. If the **METH** key is pressed by mistake, pressing any key other than **READ/ENTER** clears the abort message. Proceed as follows:

1. With the **METHOD #?** prompt in the display, press **SHIFT**, **EDIT**, **METH**. The display shows:

An alternate way to reach this menu item is to press **SHIFT**, **CONFIG**, scroll to and select **USER METHODS** with the **READ/ENTER** key and then scroll to **EDIT #**:

2. Press **READ/ENTER**. The next available user method number appears in the display along with the wavelength prompt.

3. Using the numeric keys, key in the desired wavelength. Press **READ/ENTER** to accept the wavelength.

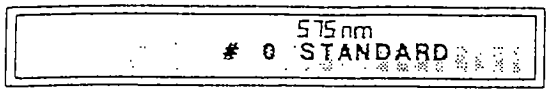
4. Edit the decimal position using the arrow keys, and enter it with the **READ/ENTER** key.

5. Select a unit of measure using the arrow keys, and enter it with the **READ/ENTER** key.

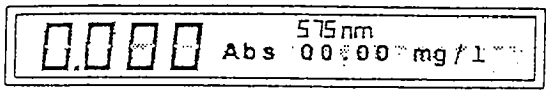
6. Construct the appropriate symbol to describe the parameter and accept it with the **READ/ENTER** key (refer to Step 7 of section *3.4.9.1 Entering User-Entered Methods*).

7. If the timer is needed for this method, press **SHIFT**, **TIMER** and proceed as described in Step 8

of section *3.4.9.1 Entering User-Entered Methods*. If no timer is needed for this method, press READ/ENTER in response to the original TIMER prompt. The display shows, for example:

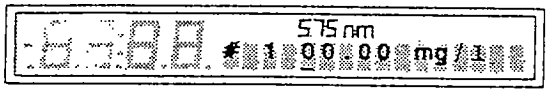


8. Press READ/ENTER. The next display is the data pair:



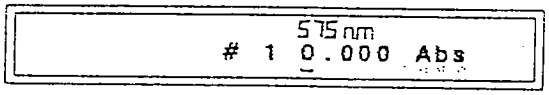
9. Press READ/ENTER. The prompt for number 1 standard is displayed.

10. Press READ/ENTER to get the edit prompt for standard 1 concentration.



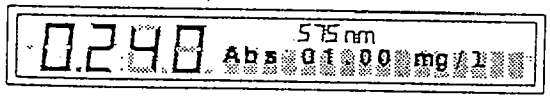
Key in the appropriate concentration for standard 1 and enter it with the READ/ENTER key.

11. The edit prompt for absorbance now is in the display.



Key in the absorbance value for standard 1 and accept it with the READ/ENTER key.

12. The data pair for standard 1 now is displayed. For example:

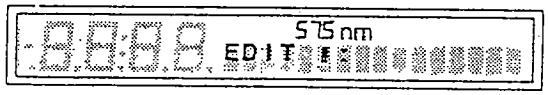


Accept with READ/ENTER or reject it by pressing SHIFT, CLEAR to revert back to the prompt for number 1 standard and make the corrections. When the number 1 standard values are accepted, the prompt for the next standard is displayed. If more data points are needed, repeat Steps 10, 11 and 12 for each additional data pair. When all data pairs are entered, press SHIFT, READ/ENTER to exit the USER METHODS menu. The display momentarily shows COMPLETED and goes to the methods menu with the newly entered method number in the display. You now can select that method with the READ/ENTER key or scroll to any other method.

3.4.9.3 Editing User-Entered Methods

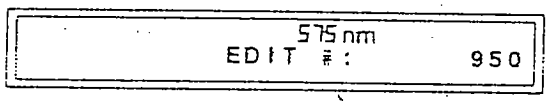
All method information stored previously by the operator can be reviewed and changed to add, delete or modify data points. At any point during the editing function, the operator can terminate the procedure and exit by pressing METH and answering the ABORT? query with READ/ENTER. If the METH key is pressed by mistake, pressing any key other than READ/ENTER clears the abort message. To select a user-entered method for review or modification, proceed as follows:

1. Press the SHIFT, EDIT, METH keys at the METHOD ? prompt. The following display results:

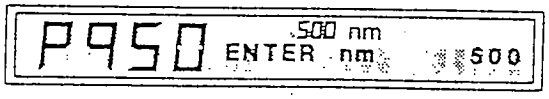


An alternate way to reach this menu item is to press SHIFT, CONFIG, scroll to and select USER METHODS with the READ/ENTER key, and then scroll to EDIT #

2. Key in the number of the method to be edited using the numeric keys. For example:



Enter the program number by pressing the READ/ENTER key. The display reads:

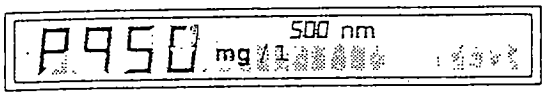


Press READ/ENTER if the wavelength is correct or change the wavelength to the proper value and accept it with the READ/ENTER key.

3. The next prompt is the decimal prompt:

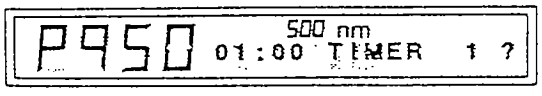
Press READ/ENTER if the present display is correct as is. To change the decimal point position, use the arrow keys to display the desired decimal position. For example:

4. Press the READ/ENTER to accept the change and proceed to the units prompt:



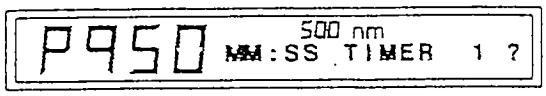
Press READ ENTER if the present unit is correct as is. To change the unit of measure, use the arrow keys to select the new unit and press READ/ENTER. The next prompt includes the symbol, such as:

5. Press READ/ENTER if the present display is correct as is. If not, the symbol can be erased by pressing SHIFT, CLEAR, or the SHIFT, Left Arrow is used to back space and erase the characters preceding the cursor. When the symbol is edited, press READ/ENTER. If the timer was used in the original calibration, the display shows the first time interval, such as:

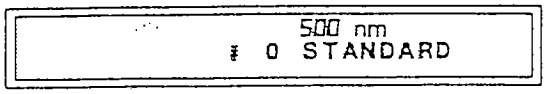


6. Press READ/ENTER if the present display is correct as is. If the timer selection needs editing, key in the changes and press READ/ENTER. The display goes to time 2 for the next edit.

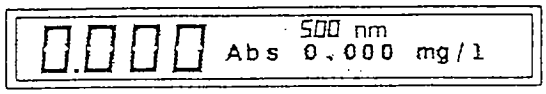
If the timer function was not used in the original entry but is now needed, press SHIFT, TIMER at the TIMER prompt. The display shows:



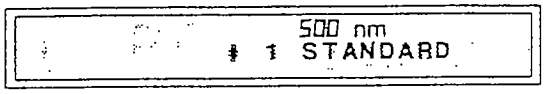
Proceed with the timer requirements. At the end of timer editing, press READ/ENTER to advance the display to the zero standard prompt:



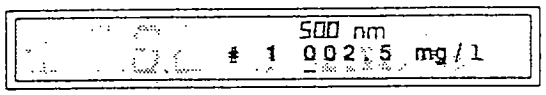
7. Press READ/ENTER. The next display shows the absorbance and concentration of the zero standard:



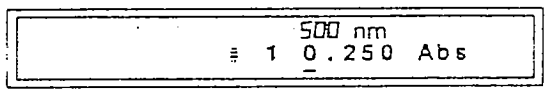
Press READ/ENTER. The display changes to the #1 standard prompt:



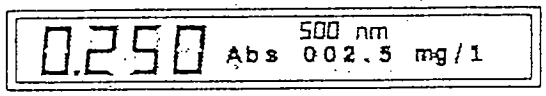
8. Press READ/ENTER. The concentration value of #1 standard now can be edited.



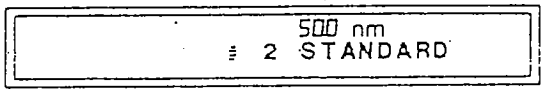
When correct, press READ/ENTER. The absorbance value of #1 standard now can be edited.



When correct, press READ/ENTER to view the data pair.



When correct, press READ/ENTER to go to the next standard.

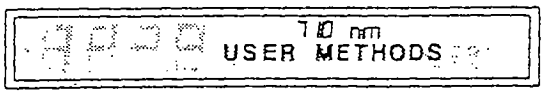


9. Continue through the data points, editing where desired. After the last data point is checked, press SHIFT, READ/ENTER to permanently accept the changes and return to the operational mode.

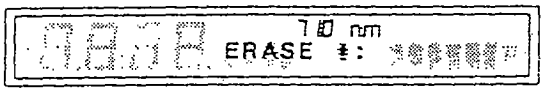
3.4.9.4 Erasing User-Entered Methods

User-entered calibrations can be erased (one method at a time) and the method numbers can be re-used for new calibrations. Proceed as follows:

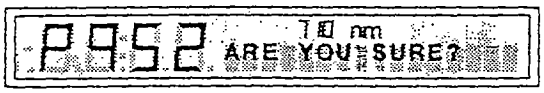
1. With the method prompt appearing in the display, press SHIFT, CONFIG and scroll to:



2. Press READ/ENTER and scroll to



3. Enter the program number (for example 952) using the numeric keys and press READ/ENTER. The display shows:



4. If no, press any key other than READ/ENTER. If yes, press READ/ENTER again. The display momentarily shows COMPLETED and then reverts to:

3.4.9.5 Transmitting User-Entered Calibration Data

Calibration data can be transmitted via the RS232 port. Once the instrument knows what method to transmit, it does so when the READ/ENTER key is pressed. The instrument beeps at the end of the transmission and the TRANSMIT #: display returns. *Figure 10* illustrates a typical printer tape. Proceed as follows:

1. Press SHIFT, CONFIG. When the display shows CONSTANT ON or MOMENTARY, scroll to USER METHODS.

2. Press READ/ENTER and scroll to TRANSMIT #:

3. Key in the number of the method (using number keys) with TRANSMIT #: in the display. Press READ/ENTER. The calibration data is transmitted and the display gives a momentary COMPLETED. and then reverts to TRANSMIT #:

NOTE

You can not transmit data from another method until the present transmission is completed. If you try, a WAIT message is displayed until the new data can be sent.

3.4.10 Hach Updates

This feature is included to provide a means of adding new Hach methods. Hach methods are permanently stored and can be revised only under the direction of Hach Company who must provide the directions and necessary codes to make the change. Request Hach update information from the Hach office or distributor serving you.

```
METH #: 950
   WL: 725
UNITS: ug/l
 TIME: 300 600 0 0 seconds
PNT  CONC_   ABS__
 0:  0.000   0.000
 1:  1.000   0.100
 2:  2.000   0.200
 3:  3.000   0.300
 4:  4.000   0.400
 5:  5.000   0.500
 6:  6.000   0.600
 7:  7.000   0.700
```

FIGURE 10 SAMPLE PRINTER TAPE, USER METHOD CALIBRATION DATA

3.4.11 Lamp Recalibration (ADJUST nm)

This feature provides automatic recalibration after replacement of the lamp (refer to section *5.3 for the Lamp Calibration procedure*).

3.5 Using the Pour-Thru Cell

The Pour-Thru sample cell is an optional accessory that improves accuracy and convenience. It is particularly advantageous for measurements of very low concentrations. Because the same optical characteristics exist for both zeroing and measuring, or when comparing measurements of different samples, any error resulting from optical differences between individual sample cells is eliminated. Assembly of the Pour-Thru cell is described in Section 2. Install the Pour-Thru cell in the spectrophotometer as follows:

1. Examine the glass windows in the Pour-Thru cell. If either is dirty or smudged, clean with a soft, lint-free cloth or optical tissue.

2. Insert the Pour-Thru cell into the instrument cell holder with the windows aligned with the windows in the cell holder (see *Figure 11*). With the inlet and outlet ports toward the front, the inlet tube is on the left. Be sure the Pour-Thru cell is fully inserted to prevent any light leakage around the gasket. The cell compartment cover can remain open when using this accessory.

3. Adjust the relative heights of the stand pipe and funnel to ensure proper drainage for the funnel. The funnel drains completely with the final level of liquid in the tube about 5 cm (2 inches) below the tip of the funnel. Initially, adjust the stand pipe so that the inlet is 5 cm below the tip of the funnel (see *Figure 2*).

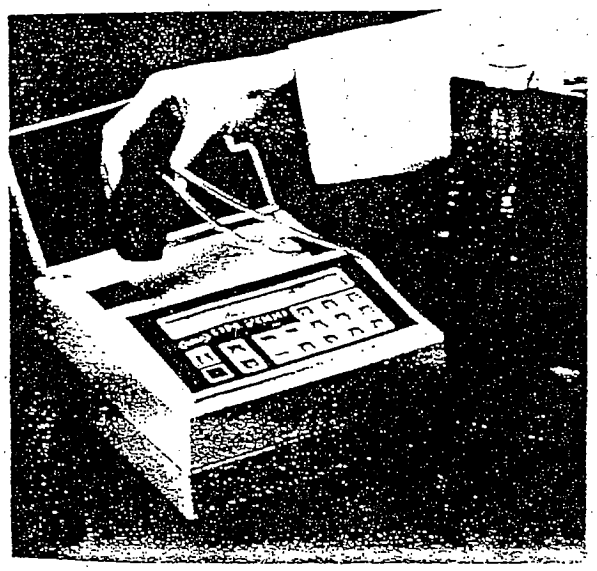


FIGURE 11 INSTALLING POUR-THRU CELL

4. Pour 25 to 50 mL of demineralized water into the funnel and allow the funnel to drain. If necessary, move the stand pipe up or down to achieve the proper liquid level. When properly adjusted, the funnel drains smoothly and stops draining at the correct level.

The drain tube attached to the stand pipe must drain freely. It should always remain below the outlet of the stand pipe, and should not run horizontally any more than necessary. Preferably, the tube should be as short as possible with the outlet end inserted into a drain (or suitable collecting vessel if treatment is necessary before discharge).

CAUTION

Do not use the Pour-Thru Cell in tests that call for the use of organic solvents such as toluene, chloroform, trichloroethane or cyclohexanone. These solvents may not be compatible with the plastic components of the Pour-Thru Cell creating the potential for equipment damage and chemical exposure for the analyst.

ADVERTENCIA

No utilice la Célula de Flujo Continuo para pruebas que requieran el uso deo solventies orgánicos tales como tolueno, cloroformo, tircloretano o ciclohexanona. Es posible que estos solventes sean incompatibles con los componenetes de material plástico de la Célula de Flujo Continuo y existe el riesgo de daños al equipo y exposición del analista a las substancias químicas.

AVISO

Não use a Pilha de Vazamento em testes que exigem o uso de dissolventes orgánicos como tolueno, cloroformo, tricloroetano e ciclohexanona. Existe a possibilidade que estes dissolventes não dejam compatíveis com os componentes de plástico da Pilha de Vazamento, o que pode criar a possibilidade de estrago ao equipamento e exposição química para o analista.

ATTENTION

Ne pas utiliser la cuve à circulation dans les techniques d'analyses qui utilisent des solvants organiques tels que le toluène, le chloroforme, le trichloroéthane ou la cyclohexanone. Les solvants organiques peuvent ne pas être compatibles avec les composants en plastique de la cuve à circulation et endommager l'équipement en créant un risque chimique pour l'opérateur.

WARNHINWEIS

Die "Pour-Thru-Zelle" darf nicht in Tests verwendet werden, die organische Lösungsmittel wie Toluol, Chloroform, Trichlorethan oder Cyclohexanon erfordern. Die Möglichkeit besteht, daß diese Lösungsmittel nicht mit den Kunstoffkomponenten der "Pour-Thru-Zelle" kompatibel sind und somit Geräteschaden verursachen und eine Chemikaliengefahr für den Untersuchungschemiker darstellen können.

3.6 Using the AccuVac Vial Adapter

Hach Company's line of AccuVac Ampul reagents can be used in the DR/2000 Spectrophotometer with the aid of the adapter provided in the accessories. Test procedures for the AccuVac reagents are designated in the procedure manual and in the list of methods on the underside of the cell compartment cover. If using the instrument in direct sunlight, use the light shield cap to cover the cell holder.

Reagents are contained in sealed, evacuated vials and are mixed with the water sample by partially immersing the ampul and breaking off the tip to allow sample to be drawn in. Reacted sample is

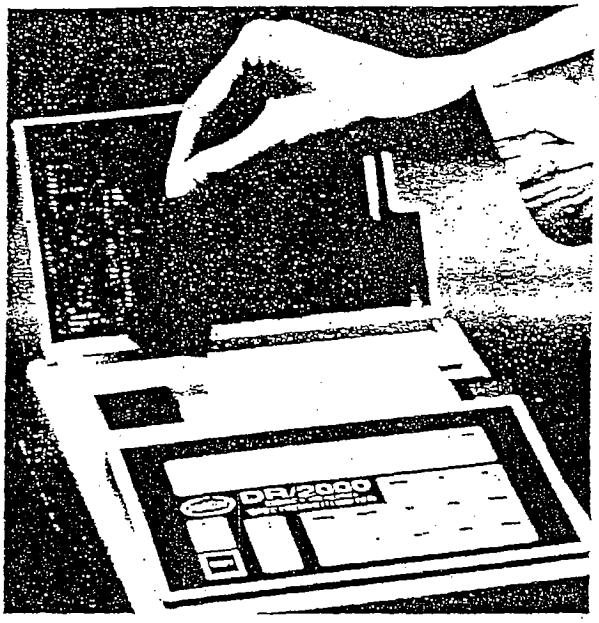


FIGURE 12 INSTALLING ACCUVAC VIAL ADAPTER

measured in the ampul once the adapter is installed in the instrument. Proper orientation of the adapter in the sample cell compartment places the grip tab of the adapter toward the back of the compartment (see *Figure 12*).

3.7 Using the COD Vial Adapter

Two of the methods for chemical oxygen demand (COD) determinations included in the DR/2000 Procedures Manual use a COD Reactor and premixed reagent vials for both the digestion process in the reactor and for making the colorimetric measurement. With the COD Vial Adapter installed in the spectrophotometer sample cell compartment, reagent vials are placed in the instrument for measurement. The COD Vial Adapter also holds a standard 16-mm test tube

The COD vial adapter is placed in the instrument's sample cell compartment with the orientation mark toward the left (see *Figure 13*). A light shield cover is included with the adapter and must be in place when taking the COD measurement. The cell compartment cover remains open.

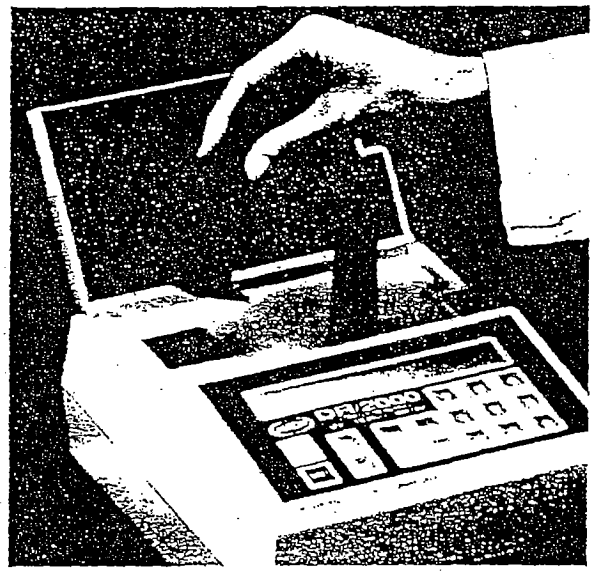


FIGURE 13 INSTALLING COD VIAL ADAPTER

3.8 Using the 13-mm Test Tube Adapter

This test tube adapter is placed in the instrument cell holder with the orientation mark to the right (see *Figure 14 Installing Test Tube Adapter*). Proper placement is necessary to match the left-to-right light path. Because of the height of the test tube,

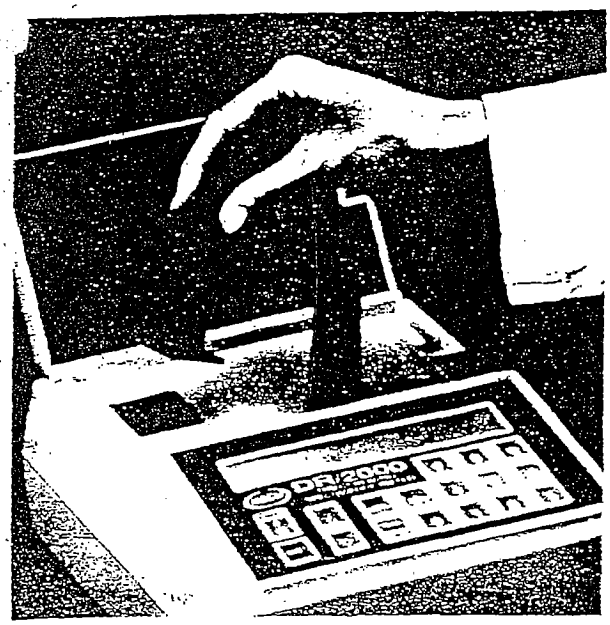


FIGURE 14 INSTALLING TEST TUBE ADAPTER

the adapter comes with its own light shield that must be in place when readings are taken. The cell compartment cover remains open.

3.9 Using the 1-cm Cell Adapter

Standard 1-cm square cuvettes can be used with the DR/2000 Spectrophotometer when Hach's 1-cm adapter (optional accessory) is installed in the cell holder. One-centimeter cuvettes are not supplied with the instrument, but are available as optional accessories either individually or in optically matched pairs.

The adapter is placed in the instrument cell compartment with the handling tab to the rear (see *Figure 15 Installing 1-cm Cell Adapter*). This position orients the adapter correctly in the light path. When using glass cuvettes, place them in the adapter with the clear sides in the left-to-right optical path. The cell compartment cover must be closed while taking readings. If operating the instrument in direct sunlight, cover the cell holder with the light shield cap supplied with the accessories.

3.10 Using the Light Shield Cap

The light shield cap, supplied with the accessories, can be used instead of closing the cell-compartment

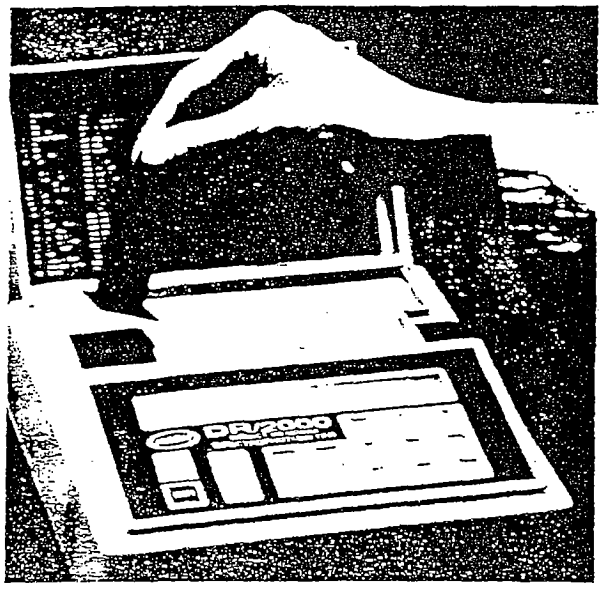


FIGURE 15 INSTALLING 1-cm CELL ADAPTER

cover, and always should be used when operating the instrument in direct sunlight (refer to *Figure 16 Installing Light Shield Cap*).

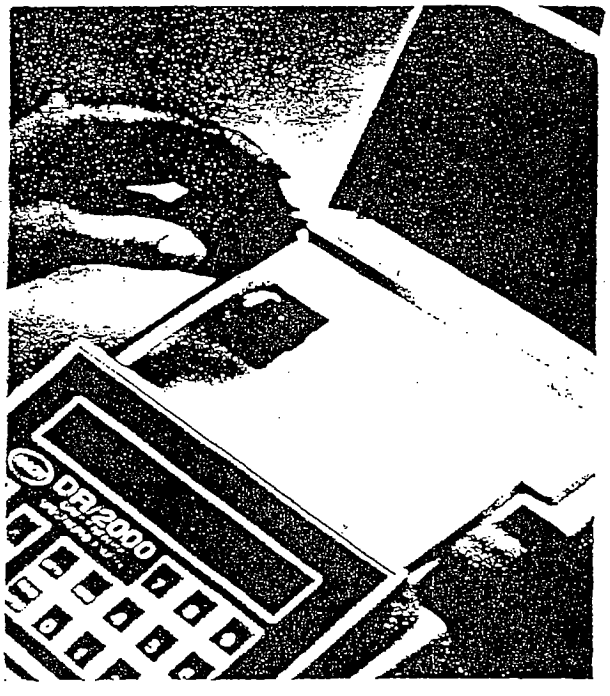


FIGURE 16 INSTALLING LIGHT SHIELD CAP

3.11 Setup and Use of Citizen Printer

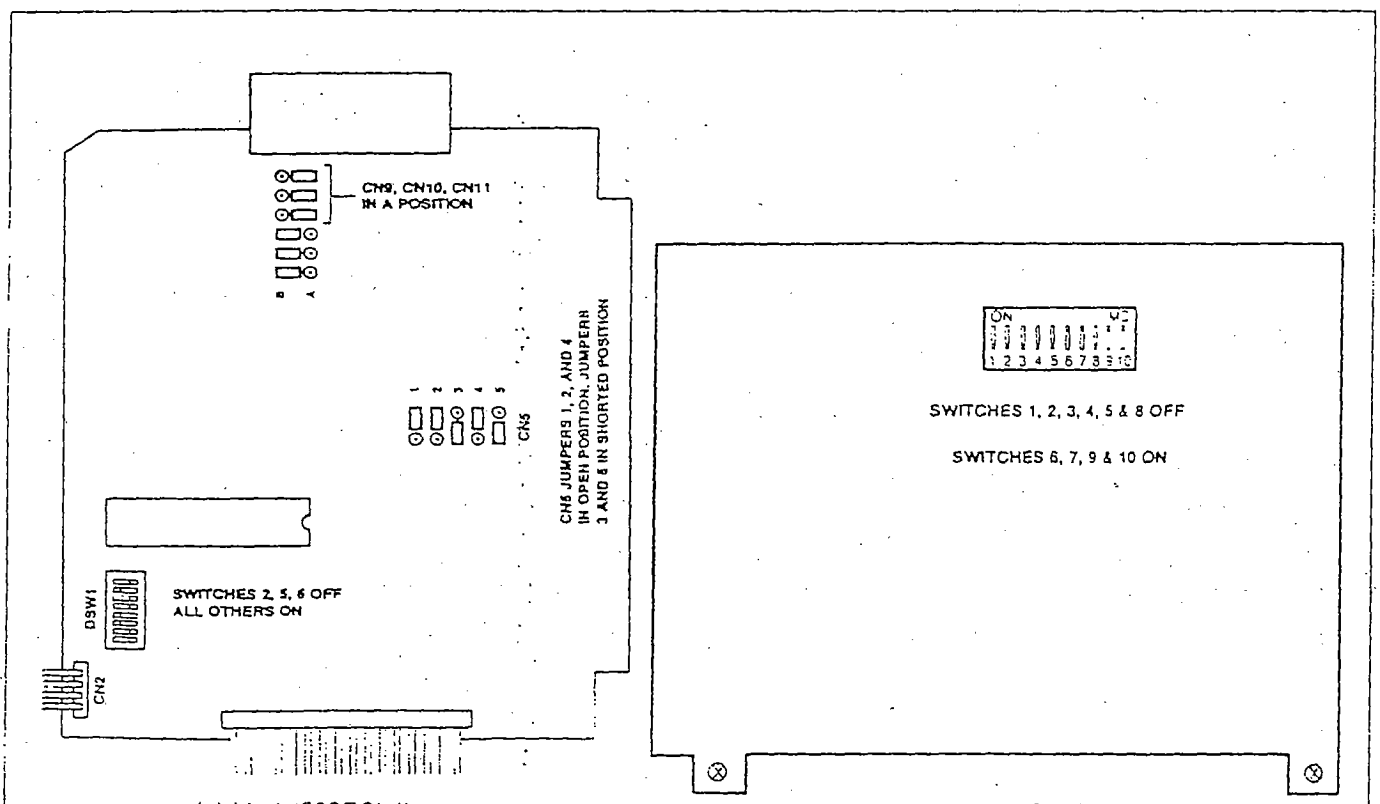
Follow all of the manufacturer's instructions shown on the printer and in the printer manual when configuring for compatibility with the DR/2000 Spectrophotometer. A permanent record of test results is obtained by using the RS232 serial output to drive a printer.

WTH	CONC	UNITS	ABS	TRANS	WL	SMP_ID
950	0.818	ug/l	0.001	99.8	725	
950	0.812	ug/l	0.001	99.7	725	# 1828
950	0.653	ug/l	0.065	86.0	725	# 1829
950	0.652	ug/l	0.065	86.1	725	# 1830
950	0.629	ug/l	0.063	86.5	725	# 1831
950	0.630	ug/l	0.063	86.5	725	# 1832
950	0.575	ug/l	0.057	87.6	725	# 1833
950	0.574	ug/l	0.057	87.6	725	# 1834

FIGURE 17 PRINTER FORMAT EXAMPLE

Figure 17 provides a sample printout from the forty-column printer listed in the optional accessories in section 7. When operating in the Momentary mode, data from each new measurement is sent to the printer when the READ/ENTER key is pressed to measure the sample. Operation in the Constant On mode provides an automatic printout according to the interval selected. Pressing the READ/ENTER key manually starts the printing, and pressing any key stops the printing (refer to *section 3.4.3 Send At (Transmit Interval) Selection*).

The Citizen printer, listed as an optional accessory in *section 7*, requires some configuring for compatibility with the DR/2000 Spectrophotometer. If you have a Citizen Model 560RSL II printer, remove the metal plate on the bottom of the unit, and set switch and jumper positions on the printer board as follows: CN9, CN10 and CN11 to position "A." Set all DSW1 switches, *except* #2, #5 and #6, to ON (see *Figure 18a*). If you have a Citizen Model iDP-562RSL printer, an opening is provided in the metal plate to access the switches without removing the cover (see *Figure 18b*). Set switch positons on the printer board as follows: #1 through 5 and 8 to OFF. #6,7,9 and 10 to ON. *Refer to "Setting of Preset Jumper" in the Citizen Printer manual.*



(a) Model560RSL II (b) Model iDP-562RSL

FIGURE 18 CITIZEN PRINTER CONFIGURING

3.12 Using a Recorder

The recorder output provided is 0 to 1 V and linear from 0 to 100 %T and 0 to 2 Abs units. It also is linear with concentration measurements. For the factory programmed calibrations, the full-scale limits are predetermined for each stored program. Refer to *Table 3* for these settings when setting up the recorder. In user-entered calibrations, the recorder full scale is equal to the concentration of the last data point entered.

When using the DR 2000 Spectrophotometer with an analog recorder, the 100 percent output level at the recorder is set to a predetermined value for each factory-stored program. Those values are shown in *Table 3* under "limit."

Table 3. Full-Scale Limits

No.	Name	Limit	Units	Parameter
009	Al ECR	0.250	mg/l	aluminum (ECR)
010	Al	0.88	mg/l	aluminum
020	Ba	105	mg/l	barium
025	Ba AV	123	mg/l	barium (AV)
030	Benzotriazole	17.6	mg/l	benzotriazole
040	B	15.4	mg/l	boron
050	Br_2	4.95	mg/l	bromine
055	Br_2 AV	4.95	mg/l	bromine (AV)
060	Cd	88	ug/l	cadmium
070	Cl^-	24.5	mg/l	chloride
072	ClO_2 LR	1.14	mg/l	chlorine dioxide (LR)
075	ClO_2 HR	700	mg/l	chlorine dioxide (HR)
080	Cl_2 F&T	2.20	mg/l	chlorine, free & total
085	Cl_2 F&T AV	2.20	mg/l	chlorine, free & total (AV)
090	Cr^{6+}	0.66	mg/l	chromium, hexavalent
095	Cr^{6+} AV	0.66	mg/l	chromium, hexavalent (AV)
100	Cr	0.66	mg/l	chromium, total
105	Cr^{3+}	22.0	g/l	chromium, trivalent
110	Co	2.20	mg/l	cobalt
120	Color (PtCo)	550	units	color (platinum cobalt)
130	Cu (soil)	11.0	ppm	copper in soil
135	Cu Bicinch.	5.50	mg/l	copper, bicinchoninate
140	Cu Bicinch. AV	5.50	mg/l	copper, bicinchoninate (AV)
145	Cu Porph.	231.0	ug/l	copper, porphyrin.
160	CN^-	0.220	mg/l	cyanide
170	Cyanuric Acid	52	mg/l	cyanuric acid
180	DEHA	495	ug/l	diethylhydroxylamine
190	F^-	2.20	mg/l	fluoride
195	F^- (ampule)	2.20	mg/l	fluoride, ampules

Table 3. Full-Scale Limits (continued)

No.	Name	Limit	Units	Parameter
200	Formaldehyde	385	ug/l	formaldehyde (LR)
220	$CaCO_3$ Ca	4.15	mg/l	hardness, calcium as $CaCO_3$
221	Ca	1.67	mg/l	hardness, calcium
225	$CaCO_3$ Mg	4.16	mg/l	hardness, magnesium as $CaCO_3$
226	Mg	1.01	mg/l	hardness, magnesium
231	N_2H_4	509	ug/l	hydrazine
240	I_2	7.70	mg/l	iodine
242	I_2 AV	7.70	mg/l	iodine (AV)
250	Fe (soil)	69.3	ppm	iron in soil
255	Fe^{2+}	3.30	mg/l	iron, ferrous
257	Fe^{2+} AV	3.30	mg/l	iron, ferrous (AV)
260	Fe FZ	1.430	mg/l	iron, total (FerroZine)
265	Fe FV	3.30	mg/l	iron, total (FerroVer)
267	Fe FV AV	3.30	mg/l	iron, total (FerroVer) (AV)
270	Fe TPTZ	1.98	mg/l	iron, total (TPTZ)
272	Fe TPTZ AV	1.98	mg/l	iron, total (TPTZ) (AV)
275	Fe Mo	1.98	mg/l	Iron, Total (FerroMo)
280	Pb	176	ug/l	lead
283	Pb FC LEADTRAK	165	ug/l	extraction
290	Mn LR PAN	0.770	mg/l	manganese (LR)
295	Mn HR	22.6	mg/l	manganese (HR)
300	Mn (soil)	226	ppm	manganese in soil
315	Mo^{6+} LR	3.28	mg/l	molybdenum (LR)
320	Mo^{6+} HR	39.0	mg/l	molybdate (HR)
330	Ni Autocat.	8.80	g/l	autocatalytic
335	Ni Heptoxime	1.98	mg/l	nickel, heptoxime
340	Ni PAN	1.100	mg/l	nickel, PAN
351	N, NO_3 LR	0.44	mg/l	nitrate (LR)
353	N, NO_3 MR	5.0	mg/l	nitrate (MR)
355	N, NO_3 HR	35.8	mg/l	nitrate (HR)
359	N, NO_3 MR AV	4.8	mg/l	nitrate (MR) (AV)
361	N, NO_3 HR AV	35.0	mg/l	nitrate (HR) (AV)
363	N, NO_3 plant	1.80	%	nitrogen (nitrate) in plants
366	N, NO_3 soil	56	ppm	nitrogen (nitrate) in soil

Table 3. Full-Scale Limits (continued)

No.	Name	Limit	Units	Parameter
367	N, NO_3 soil	112	lbs/ac	nitrogen (nitrate) in soil
368	N, NO_3 soil	138	kg/ha	nitrogen (nitrate) in soil
371	N, NO_2 LR	0.330	mg/l	nitrite (LR)
373	NO_2 HR	165	mg/l	nitrite (HR)
375	N, NO_2 LR AV	0.330	mg/l	nitrite (LR) (AV)
380	N, NH_3 Nessler	2.75	mg/l	nitrogen (ammonium), Nessler
385	N, NH_3 Salic.	0.55	mg/l	nitrogen (ammonium), salicylate
391	N, NH_3 soil A/F	440	ppm	nitrogen (ammonium) in soil, A/F
392	N, NH_3 soil A/F	880	lbs/ac	nitrogen (ammonium) in soil, A/F
393	N, NH_3 soil A/F	990	kg/ha	nitrogen (ammonium) in soil, A/F
399	TKN	165	mg/l	nitrogen, total Kjeldahl
401	Quaternary Ammonium	5.5	mg/l	quaternary ammonium compounds
410	Oil in Water	94	ppm	oil in water
420	Organics soil	5.50	%	organic matter in soil
430	COD LR	165	mg/l	oxygen demand, chemical, reactor
435	COD HR	1650	mg/l	oxygen demand, chemical, reactor
440	COD (Reflux)	880	mg/l	oxygen demand, chemical, reflux
445	O_2 HRDO	14.3	mg/l	oxygen, dissolved (HR)
446	O_2 LRDO	880	ug/l	oxygen, dissolved (LR)
448	O_2 SHRDO	49.5	mg/l	oxygen, dissolved (super high range)
450	O_3 DPD	1.54	mg/l	ozone, DPD
452	O_3 DPD AV	1.54	mg/l	ozone, DPD (AV)
454	O_3 Indigo LR	0.27	mg/l	ozone, (indigo) (LR) (AV)
455	O_3 Indigo MR	0.83	mg/l	ozone, (indigo)(mid range)(AV)
456	O_3 Indigo HR	1.65	mg/l	ozone, (indigo) (HR) (AV)
460	Pd	275	mg/l	palladium
470	Phenols	0.220	mg/l	phenols
480	PO_4^{3-} molybdov	50.8	mg/l	(molybdovanadate)
481	P molybdov	16.6	mg/l	phosphorus, reactive (molybdovanadate)
485	PO_4^{3-} amino acid	33.00	mg/l	orthophosphate (amino acid)
487	P amino acid	10.76	mg/l	phosphorus, reactive (amino acid)
490	PO_4^{3-} PV	2.75	mg/l	orthophosphate (PhosVer 3)
492	PO_4^{3-} PV AV	2.75	mg/l	orthophosphate (PhosVer 3)

Table 3. Full-Scale Limits (continued)

No.	Name	Limit	Units	Parameter
494	P PV AV	0.90	mg/l	phosphorus, reactive (PhosVer 3)(AV)
496	P PV	0.90	mg/l	phosphorus, reactive (PhosVer 3)
501	Phosphonates	27.5	mg/l	phosphonates
510	P, PO_4^{3-} plant	0.440	%	phosphorus in plant tissue
521	P soil A/F	248	ppm	phosphorus in soil, (PhosVer 3)
522	P soil A/F	495	lbs/ac	phosphorus in soil. (PhosVer 3)
523	P soil A/F	550	kg/ha	phosphorus in soil, (PhosVer 3)
531	P soil Bic	88.0	ppm	phosphorus in soil, (PhosVer 4)
532	P soil Bic	176	lbs/ac	phosphorus in soil, (PhosVer 4)
533	P soil Bic	198	kg/ha	phosphorus in soil, (PhosVer 4)
550	pAA LMW-10	20.7	mg/l	polyacrylic acid LMW-10
555	pAA LMW-20	22.0	mg/l	polyacrylic acid LMW-20
560	pAA LMW-45	20.9	mg/l	polyacrylic acid LMW-45
581	K soil A/F	406	ppm	potassium in soil, tetraphenylborate
582	K soil A/F	812	lbs/ac	potassium in soil,tetraphenylborate
583	K soil A/F	908	kg/ha	potassium in soil, tetraphenylborate
591	K soil Bic	730	ppm	potassium in soil, tetraphenylborate
592	K soil Bic	1456	lbs/ac	potassium in soil, tetraphenylborate
593	K soil Bic	1631	kg/ha	potassium in soil, tetraphenylborate
630	Suspended Solids	825	mg/l	residue, nonfilterable
640	Se	1.10	mg/l	selenium
645	SiO_2 ULR	1000	ug/l	silica, (Ultra LR)
651	SiO_2 LR	1.760	mg/l	silica (LR)
656	SiO_2 HR	110.0	mg/l	silica (HR)
660	Ag	0.66	mg/l	silver
670	Na_2CrO_4	1247	mg/l	sodium chromate
680	SO_4^{2-}	75	mg/l	sulfate
685	SO_4^{2-} AV	77	mg/l	sulfate (AV)
690	S^{2-}	0.660	mg/l	sulfide
700	S, SO_4^{2-} plant	0.50	%	sulfur, sulfate in plant tissue
705	S, SO_4^{2-} soil	50	ppm	sulfur, sulfate in soil
710	Surfactant,	0.302	mg/l	surfactant, anionic anionic
720	Tannic Acid	9.9	mg/l	tannin & lignin
730	Tolyltriazole	20.6	mg/l	tolyltriazole

Table 3. Full-Scale Limits (continued)

No.	Name	Limit	Units	Parameter
750	FTU Turbidity	461	FTU	turbidity
770	Volatile Acids	3080	mg/l	volatile acid
780	Zn	2.20	mg/l	zinc
790	Zn soil	22.0	ppm	zinc in soil

INSTALLATION/MAINTENANCE

Some of the tasks in this section of the manual have safety issues associated with them. Because the potential for injury to individuals and equipment exists when these safety issues are not addressed, Hach Company strongly recommends that qualified personnel conduct the installation, and that all installation personnel review the associated instructions carefully.

4.1 Battery Installation

The battery compartment is accessible from the underside of the instrument. Make sure the sample cell holder is empty. Lay the instrument upside down on a padded surface, and install batteries as follows:

1. Remove the compartment door as shown in *Figure 19 Battery Installation.*

2. *Alkaline D-Cells*: Install six alkaline D-cells in the battery holder as shown in the battery holder detail in *Figure 19 Battery Installation.*

WARNING

Lead-acid batteries contain sulfuric acid that could be released if the battery case ruptured. If sulfuric acid contacts the skin, immediately flush the contacted area with water for 15 minutes. Remove contaminated clothing.

ADVERTENCIA

Las pilas de plomo-ácido contienen ácido sulfúrico, que puede derramarse al romperse el revestimiento de la pila. Si el ácido sulfúrico hace contacto con la piel, enjuague inmediatamente con agua el área expuesta durante 15 minutos. Quítese la ropa contaminada.

ADVISO

As baterias de chumbo-ácido contêm ácido sulfúrico que pode ser liberado se quebrar a caixa da bateria. Caso o ácido sulfúrico entre em contato com a pele, lave-se imediatamente a parte do corpo que fez contato com água durante 15 minutos. A pessoa deverá tirar a roupa contaminada..

ATTENTION

Les batteries au plomb-acide contiennent de l'acide sulfurique qui peut s'écouler en cas de rupture du corps de la batterie. Si l'acide sulfurique atteint la peau, laver immédiatement la partie atteinte à l'eau pendant 15 minutes. Retirer les vêtements contaminés.

WARNHINWEIS

Bleibatterien enthalten Schwefelsäure, die im Falle einer Batteriegehäusebeschädigung lecken kann. Wenn Schwefelsäure mit der Haut in Berührung kommt, muß die verschmutzte Hautfläche sofort für 15 Minuten mit Wasser gewaschen werden. Die kontaminierte kleidung muß entfernt werden.

NOTE

Do not use nickel-cadmium batteries in this instrument. Voltage is too low for proper operation.

WARNING

Use of nickel-cadmium batteries under a fault condition creates a potential fire hazard.

ADVERTENCIA

La utilización de pilas de níquel-cadmio en condiciones de falla crea el riesgo de incendio.

AVISO

O uso de baterias de níquel-cádmio em condição de falha cria a possibilidade de incêndio.

ATTENTION

L'utilisation de batteries nickel-cadmium dans des conditions inappropriées crée un risque d'incendie.

WARNHINWEIS

Unter einer Störungsbedingung stellt die Verwendung von Nickel-Kadmium-Batterien eine Feuergefahr dar.

CAUTION

Use care when installing the D-cells in the battery holder to be sure that the proper polarities are observed. Improper installation could cause damage to the instrument or injury to the operator.

CUIDADO

Tenga cuidado que los polos estén debidamente orientados al instalar las pilas D en el estuche para pilas. Instalación inadecuada puede dañar el instrumento o lesionar al operario.

PRECAUÇÃO

Tenha cuidado ao instalar as pilhas tipo D no porta-baterias para ter certeza que se observam as polaridades corretas. A instalação incorreta pode causar estragos ao instrumento e lesão grave ou danos ao equipamento.

ATTENTION

Prendre soin de respecter les polarités à l'installation des piles taille D dans le support de

es. Une erreur d'installaiton peut dommager l'appareil et blesser l'opérateur.

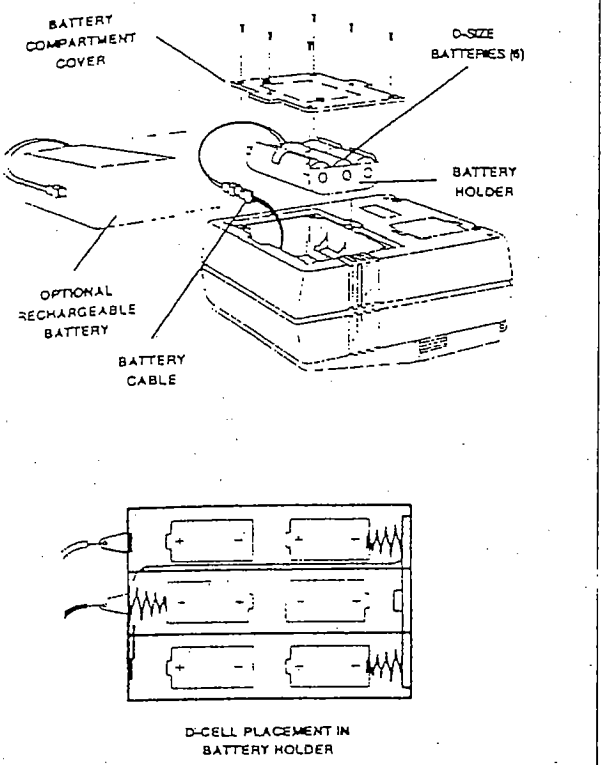


FIGURE 19 BATTERY INSTALLATION

WARNHINWEIS

Während der Installation der D-Zellen im Batteriehalter muß sichergestellt werden, daß die richtige Polarität eingehalten wird. Eine falsche Installation kann das Instrument beschädigen und den Bediener verletzen.

Attaching the D-Cell Battery Holder: Connect the battery cable from the instrument to the battery holder cable connector.

2. *Optional Rechargeable Battery:* If using the rechargeable battery option (instead of D-cells), place the rechargeable battery into the battery compartment, and connect the battery cable from the instrument to the rechargeable battery cable connector.

3. Replace the battery compartment cover, and return the instrument to the upright position.

If the rechargeable lead-acid battery is used, charging the battery for 18 to 20 hours brings the battery to optimum charge. Charging is recommended before extensive use, but the battery is usable when received.

NOTE

If the Battery Eliminator/Charger power cord is disconnected from the AC outlet while the instrument is on and batteries are installed, a steady tone emits from the spectrophotometer that discharges the batteries in time. This is a reminder to turn the instrument off or disconnect the Battery Eliminator/Charger from the instrument.

4.2 Recorder Connection

The recorder output jack on the back panel (REC) takes a sub-miniature phone plug wired as shown in *Figure 20*. A suitable plug is listed under *Optional Accessories* in section *7 Replacement Parts and Accessories*. For optimum performance, use a twisted-pair, shielded, recorder cable with a load impedance greater than 10 kohms.

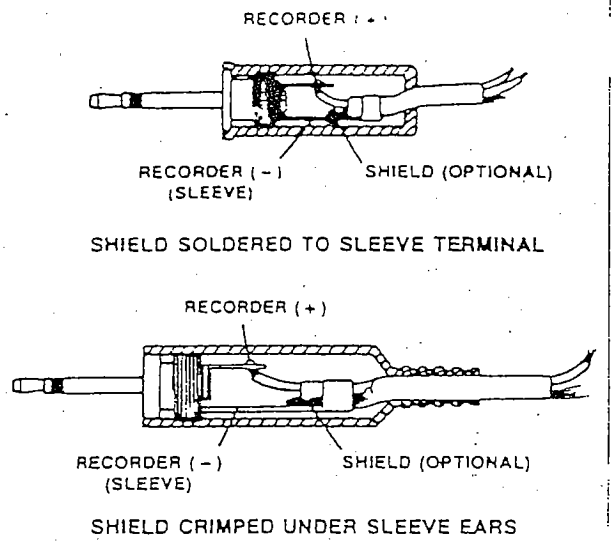


FIGURE 20 RECORDER PLUG CONNECTIONS

4.3 RS232 Connection

The RS232 jack on the back panel mates with a three-conductor, ¼" phone plug wired as indicated in *Figure 21*. A suitable plug is listed under *Optional Accessories* in section 7 *Replacement Parts and Accessories*. The RS232C interface output is an eight-bit data word plus one stop bit and no parity with a baud rate of 1200. It can communicate with either a serial printer or a serial communication port on a computer. If the RS232 feature is used for a serial printer, a printer cable assembly terminated with a standard 25-pin D connector is available as an optional accessory (refer

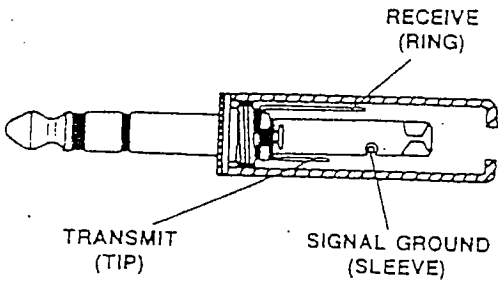


FIGURE 21 RS232 PLUG CONNECTIONS

to section *7 Replacement Parts and Accessories*). With the use of a serial-to-parallel converter, the data string transmitted from the DR/2000 Spectrophotometer prints on any Epson compatible parallel printer of the type normally used with IBM compatible applications.

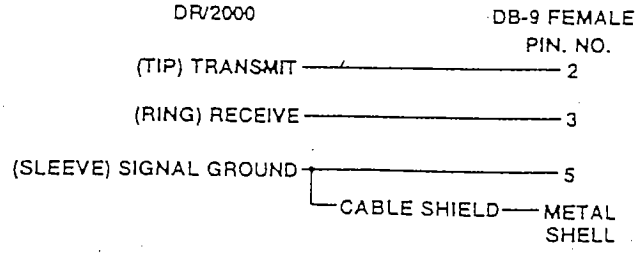
Data is transmitted to the printer as a 39-character string plus the line feed and carriage return.

For optimum performance and protection against ESD, the use of a three conductor shielded cable is recommended. Use a metal shell for the printer or CRT terminal connector, and connect the shield of the cable to the metal shell and to the sleeve (signal ground) of the RS232 plug.

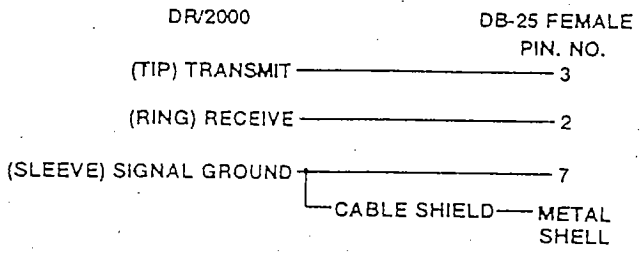
If the appropriate cable assembly is unavailable, construct a replacement as follows:

RS232-C Cable Wiring

For 9-pin serial ports–



For 25-pin serial ports–



SECTION 5 MAINTENANCE

5.1 Cleaning

5.1.1 Spectrophotometer

Keep the spectrophotometer and sample cells clean at all times. Wiped up spills promptly. Use a lens tissue or a soft, lint-free cloth (that will not leave an oil film) to wipe the photocell window located on the left-hand side of the cell holder.

5.1.2 Sample Cells

Clean sample cells with detergent, rinse several times with tap water, and then rinse thoroughly with demineralized water. Rinse sample cells used with organic solvents (chloroform, benzene, toluene, etc.) with acetone before the detergent wash, and again as a final rinse before drying. Polystyrene disposable sample cells are available (refer to section *7 Optional Accessories*).

5.1.3 Pour-Thru Sample Cell

Remove the Pour-Thru cell occasionally to check for accumulation of film on the windows. If the windows appear dirty or hazy, soak in a detergent bath and then rinse thoroughly with demineralized water. Do not use solvents (e.g., acetone) to clean the Pour-Thru cell. The Pour-Thru cell can be disassembled for cleaning if necessary.

CAUTION

Do not use the Pour-Thru Cell in tests that call for the use of organic solvents such as toluene, chloroform, trichloroethane or cyclohexanone. These solvents may not be compatible with the plastic components of the Pour-Thru Cell creating the potential for equipment damage and chemical exposure for the analyst.

ADVERTENCIA

No utilice la Célula de Flujo Continuo para pruebas que requieran el uso deo solventies orgánicos tales como tolueno, cloroformo, tircloretano o ciclohexanona. Es posible que estos solventes sean incompatibles con los componenetes de material plástico de la Célula de Flujo Continuo y existe el riesgo de daños al equipo y exposición del analista a las substancias químicas.

AVISO

Não use a Pilha de Vazamento em testes que exigem o uso de dissolventes orgánicos como tolueno, cloroformo, tricloroetano e ciclohexanona. Existe a possibilidade que estes dissolventes não dejam compatíveis com os componentes de plástico da Pilha de Vazamento, o que pode criar a possibilidade de estrago ao equipamento e exposição química para o analista.

ATTENTION

Ne pas utiliser la cuve à circulation dans les techniques d'analyses qui utilisent des solvants organiques tels que le toluène, le chloroforme, le trichloroéthane ou la cyclohexanone. Les solvants organiques peuvent ne pas être compatibles avec les composants en plastique de la cuve à circulation et endommager l'équipement en créant un risque chimique pour l'opérateur.

WARNHINWEIS

Die "Pour-Thru-Zelle" darf nicht in Tests verwendet werden, die organische Lösungsmittel wie Toluol, Chloroform, Trichlorethan oder Cyclohexanon erfordern. Die Möglichkeit besteht, daß diese Lösungsmittel nicht mit den Kunstoffkomponenten der "Pour-Thru-Zelle" kompatibel sind und somit Geräteschaden verursachen und eine Chemikaliengefahr für den Untersuchungschemiker darstellen können.

5.2 Replacement Instructions

5.2.1 Battery Replacement

When a LOW BATTERY message appears in the display, replace the alkaline, D-cell batteries (or recharge the battery if using the optional rechargeable, lead-acid battery). Make sure that the instrument is turned off and all power to the instrument is disconnected. If D-size alkaline cells are used, replace all six batteries (refer to section *4.1 Battery Installation* for battery installation instructions for D-cell replacement). If a rechargeable battery is installed, recharge as soon as possible.

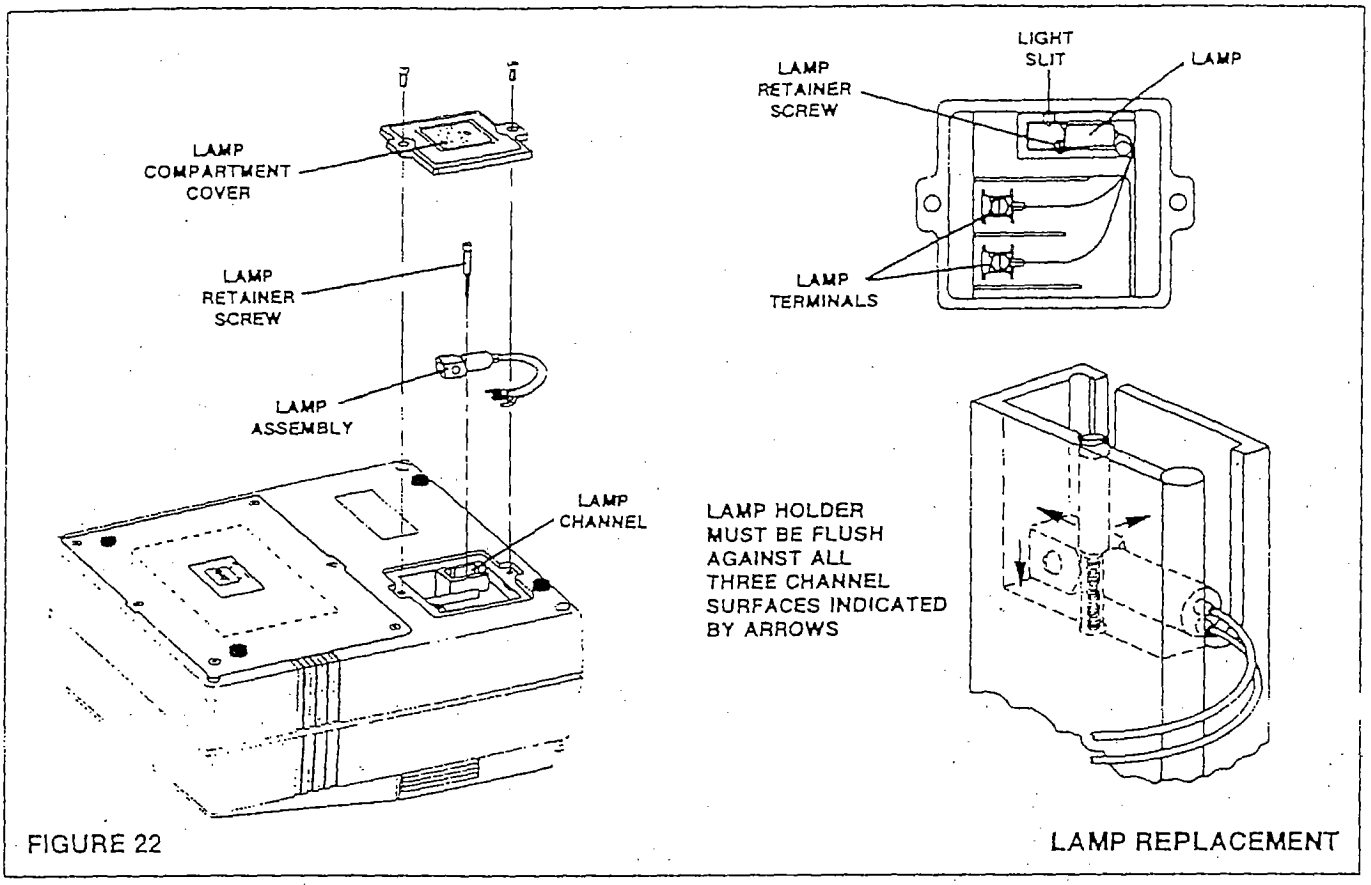


FIGURE 22 LAMP REPLACEMENT

5.2.2 Lamp Replacement

If the lamp fails and must be replaced as determined by information in section *6.2.4 LAMP OUT? Display*, proceed as follows.

1. Disconnect the Battery Eliminator, turn off the power switch and empty the cell holder. Place the instrument upside down on a padded surface.

2. Remove the two screws securing the lamp compartment cover and remove the cover (see *Figure 22 Lamp Replacement*).

3. Remove the lamp retainer screw and metal sleeve from the lamp channel. The sleeve is tapered at the bottom end, and, because of its snug fit, probably needs to be loosened with a tool (needle-nose pliers recommended) for removal. Remove the lamp. Loosen the two terminal screws to free the lamp leads.

4. Place the new lamp in the lamp channel with the lamp light slit toward the light slit in the lamp channel. Push the lamp to the bottom of the lamp channel and install. Firmly tighten the lamp retainer screw and sleeve in the channel to secure the lamp. Secure the sleeve with the beveled end down. The lamp must be held tightly in the proper position, flush against the bottom, the end, and the light slit side of the lamp channel (see *Figure 22 Lamp Replacement*). Connect the lamp leads of the new lamp assembly at the lamp terminals (lead orientation does not matter). Do not overtighten.

5. Install the lamp compartment cover. Return the instrument to the upright position and restore power.

6. Perform the Lamp Calibration Adjustment procedure described in section *5.3 Lamp Calibration Adjustment.*

5.3 Lamp Calibration Adjustment

1. Select the Constant On mode (refer to section *3.4.1 Constant On/Momentary Mode Selection*). Select the percent transmittnace mode by pressing SHIFT, %T.

2. Empty the cell compartment and close the cover. Adjust the wavelength control to approximately 550 nm. Press the ZERO key. The display shows 100.0 %T.

Place the calibration filter assembly into the sample compartment with the orientation projection aligned with the notch in the instrument case. Close the cover.

4. Using the wavelength control on the side of the instrument, begin at 850 nm and slowly adjust the wavelength dial counterclockwise (decreasing wavelength) while observing the transmittance reading in the display. Record the wavelength (nm) where the % transmittance reading is greatest. Turn the wavelength dial back in the other direction to at least 10 nm higher than the value recorded above. Again adjust the wavelength dial counterclockwise slowly while watching the % transmittance display. Stop exactly on the peak (highest) transmittance value. You now are ready to adjust the calibration.

NOTE

Repeat Step 4 as needed until you have stopped dialing exactly on the peak transmittance reading when approaching from the higher wavelength side (counterclockwise direction).

5. With the calibration filter assembly in the cell compartment and the peak transmittance determined in Step 4 displayed, press SHIFT, CONFIG and scroll up in the configuration menu to the ADJUST nm display. Press READ/ENTER. The display shows ARE YOU SURE?.

6. Press READ/ENTER. The calibration adjustment takes place. A good adjustment gives a momentary display of COMPLETED with 808 in the nm field, and then reverts to ADJUST nm. If you are unable to obtain a good adjustment, contact the Hach service center serving you.

SECTION 6 TROUBLESHOOTING

6.1 Introduction

Correcting problem conditions with the DR/2000 Spectrophotometer in the field is limited to responding to the error messages presented in the display. Other problems must be handled by a Hach technician at a service center. Refer to *section 7 Repair Service. Do not attempt servicing anything other than battery and lamp replacement. There are no other field-serviceable parts. Opening the instrument case will void the warranty.*

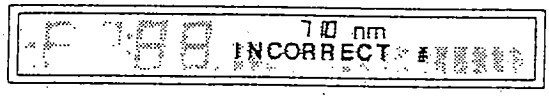
6.2 Operational Messages

6.2.1 ********** Display

When a key is pressed that calls for the instrument to perform a function it cannot do at that time, a string of 16 asterisks appears in the display momentarily, and, if the beeper is activated, three beeps sound.

6.2.2 INCORRECT # Display

The instrument displays:



when the number keyed in is not available for the operation expected. If a method number is keyed in, and the incorrect number message appears, a mis-keyed number may be the cause.

User-entered method numbers must range from 950 to 999. Entering a number outside the appropriate range for these procedures results in the incorrect number message. When this error message displays, re-enter the proper number, or scroll to the desired method or option.

6.2.3 LID OPEN? Display

This display is most likely to occur if the cell compartment is not covered during zeroing. Close the cover or use the light shield cap and repeat the step. This message also occurs when the cover is open when the instrument is turned on. Closing the cover, using the light shield cap, or installing the Pour-Thru cell is recommended when the instrument is turned on.

6.2.4 LAMP OUT? Display

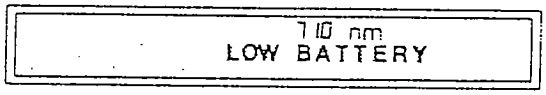
Occurs when insufficient light is present to take a measurement. It may be the result of a faulty lamp, an improperly positioned lamp, an adapter placed incorrectly in the cell compartment, a dark sample in the cell compartment during zeroing, low lamp voltage or some other electronic problem. Investigate each possibility, beginning with those relating to operator methodology. If the LAMP OUT? display cannot be corrected, contact the Hach service center or distributor serving you.

6.2.5 Concentration Out Of Range Display (flashing display)

An out-of-range condition is indicated by a flashing value in the display. It means that the displayed concentration value exceeds the range of the programmed calibration. Make sure the test procedure is followed correctly and rerun the test. Each Hach test has an upper concentration value that defines the method range. Measurements beyond that range may be unreliable.

6.2.6 LOW BATTERY Display

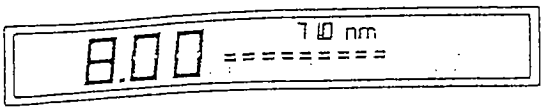
The instrument continuously monitors battery voltage. If the battery voltage falls to a level indicating less than ten percent battery life remains, the instrument automatically warns the operator at one minute intervals by beeping and displaying the



message for two seconds, and then returning the display to normal operation. When the battery voltage falls below 7.2 volts, the instrument automatically switches to the momentary mode to conserve battery life. If the voltage measures less than 7.0 volts, when the instrument is turned on, the instrument beeps, displays LOW BATTERY and turns off again. Replace the batteries, or, if a rechargeable battery is installed, recharge as soon as possible (refer to section *4.1 Battery Installation*).

Manually check the condition of the battery power source at any time by pressing SHIFT BATT. The battery voltage is displayed in the large digits and a bar graph indication of the battery life is displayed

in the text section of the display. For example:



indicates a battery voltage of 8.0 volts and a battery life indication bar (running half the width of the 16-character section) indicates approximately half its charge remains. Although the voltage value displayed gives an actual measurement of the operating voltage, regardless of its source, the battery life indication applies only to a lead-acid rechargeable battery. The battery check display is momentary, and the display existing when the SHIFT, BATT keys were pressed is restored.

6.3 Warning Display (Flashing EEE in nm Field)

A flashing EEE in the wavelength field indicates conditions occurred to initiate one or more of the following messages:

OFFSET
ZERO
ERR# n (1-10)

When the flashing EEE display appears, determine which of the warning messages apply by pressing SHIFT, CONFIG, scrolling to RECALL WARNINGS, and pressing READ/ENTER. The appropriate message(s) is displayed. To correct the condition, select RESET WARNINGS and press READ/ENTER. The condition is corrected, and the display momentarily shows COMPLETED and then reverts to RESET WARNINGS. If warnings recur, please contact the Hach service center or distributor serving you.

SECTION 7 REPLACEMENT PARTS AND ACCESSORIES

Description	Unit	Cat.No.
Adapter, AccuVac Vial	each	43784-00
Adapter Kit, COD Vial	each	44799-00
Adapter Kit, test tube, 13-mm	each	44798-00
Battery Eliminator/Charger, 115/230 Vac, with North American 115 Vac power cord, UL/CSA approved (Cat. No. 18010-00)	each	47652-00
Battery Eliminator/Charger, 115/230 Vac, with Continental European 230 Vac power cord, VDE approved (Cat. No. 46836-00)	each	47651-00
Battery Holder, for 6 D cells	each	44866-00
Calibration Filter Assembly (includes 808-nm Filter Assembly and Instructions)	each	46646-00
Dust Cover, DR/2000	each	25624-00
Lamp Assembly (lamp only)	each	46647-00
Light Shield Cap	each	46878-00
Manual Set, includes: Instrument Manual Procedures Manual Three-Ring Binder	each	46643-88
Sample Cells, 1-inch, matched pair	each	20950-00
Zeroing Vial, AccuVac, w/cap	each	21228-00

OPTIONAL ACCESSORIES

Description	Unit	Cat.No.
Adapter, 1-cm cuvette	each	44895-00
Batteries, D size, pkg of 4	each	11494-54
Battery, rechargeable, 8V	each	45185-00
Cable Assembly, printer	each	45193-00
Lamp Replacement Kit, includes: Lamp Assembly Calibration Filter Assembly (46646-00)	each	46644-00
Power Cord, 18/3 SVT 7.5 ft. 10A-125Vac for North American 115Vac use	each	18010-00
Power Cord, .75mm SQx3 conductor, 8 ft, for Europeon 230 Vac use	each	46836-00
Power Supply, 115/230Vac UL CSA (includes 46876-00 & 18010-00)	each	47652-00
Power Supply, 115/230Vac TUV (includes 46876-00 & 46836-00)	each	47651-00
Power Supply Desk Top 115/230Vac	each	46876-00

OPTIONAL ACCESSORIES (continued)

Description	Unit	Cat.No.
Flow-Thru Sample Cell	each	45215-00
Recorder Output Phone Plug	each	45194-00
RS232 Interface Phone Plug	each	16084-00
Printer, 115 V,Citizen Model iDP562-RSL-UL	each	25933-00
Printer, 230 V,Citizen Model iDP562-RSL-UL	each	25933-02
Ribbon, Ink, Cassette, for Citizen Printer, Model iDP562-RSL-UL	each	25934-00
Sample Cell, 1-inch, unmatched pair	each	13537-02
Sample Cells, 1-cm, matched pair	each	20951-00
Sample Cells, disposable, 1-inch polystyrene, with caps	pkg/12	24102-12

SECTION 8 REPAIR SERVICE

For instrument service, please contact the Hach Factory Service Center serving your location.

In the United States:
HACH COMPANY
100 Dayton Ave.
P.O. Box 907
Ames, Iowa 50010
800-227-4224 (U.S.A. only)
FAX: (515) 232-1276

In Canada:
HACH SALES & SERVICE CANADA LTD.
1313 Border Street, Unit 34
Winnipeg, Manitoba
R3H 0X4
800-665-7635 (Canada only)
(204) 632-5598
FAX: (204) 694-5134

In Latin America, the Caribbean,the Far East, the Indian Subconcontinent, Africa (excluding Mediterranean Africa) or the Pacific Basin:
HACH COMPANY, WORLD HEADQUARTERS,
P.O. Box 389
Loveland, Colorado, 80539
U.S.A.
Telephone (303) 669-3050
(970) 669-3050 (*after April 1,1995*)
Telex 160840
FAX (303) 669-2932
(970) 669-2932 (*after April 1,1995*)

In Europe, the Middle East, or Mediterranean Africa:
HACH EUROPE, S.A./N.V.
Chaussée de Namur, 1
B-51150 Floriffoux (Namur), Belgium
Tel. 32-(0)81-44.71.71.

SECTION 9 WARRANTY

Seller warrants equipment of its manufacture against defective materials or workmanship for a period of one year from date of shipment.

The liability of Seller under this warranty is limited, at Seller's option, solely to (1) repair, (2) replacement with equivalent Hach products, or (3) an appropriate credit adjustment not to exceed the original sales price of products returned to the Seller, provided that:

a. Buyer promptly notifies Seller in writing on discovery of the defects, stating where applicable, the product type and serial numbers and fully describing the circumstances giving rise to the claim. Seller must receive such notification within the applicable warranty period in order for this warranty to apply.

b. On receipt of written instructions from Seller, Buyer returns the equipment as instructed with transportation charges prepaid by the Buyer; and

c. Seller's examination of such equipment discloses its satisfaction that the defects have not resulted from any negligence, misuse, improper installation, accident or unauthorized repair or alteration by the Buyer. Seller's determination of the cause and nature of the failure of the equipment shall be final.

This warranty does not include limited life electrical components which deteriorate with age such as batteries, lamps, photocells, electrodes, etc. In the case of equipment and accessories not manufactured by the Seller, but which are furnished with equipment of Seller's manufacture, Seller's liability is limited to whatever warranty is extended by the manufacturers thereof and transferable to the Buyer.

This warranty is applicable to the original Buyer only and shall be in lieu of and exclude all other warranties, expressed or implied, including, but not limited to, any implied warranty of merchantability or fitness. The foregoing shall constitute the sole and exclusive remedy of Buyer and the sole and exclusive liability of Seller, whether Buyer's claims shall be for breach of warranty or negligence. Seller neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of the equipment. In no event shall Seller be liable for special, incidental or consequential damages.

In no event shall Seller be liable for any damage resulting from improper handling or storage by Buyer.

If Seller finds that Buyer has returned the equipment without cause, Seller shall notify Buyer and return the equipment at Buyer's expense; in addition, Seller may, at its sole discretion, impose a charge for testing and examination of any equipment so returned.

APPENDIX A

USER-ENTERED CALIBRATIONS WORKSHEET

Test Name: VANADIUM, PENTAVALENT Test Method: PAR Date: 12-30-92 By: EXAMPLE

METHOD #?

BEGIN USER PROGRAM MODE
Press SHIFT PROG METH.
Record the number displayed by the DR/2000: → 8.8.8.8.

ENTER nm

ENTER THE WAVELENGTH
Key in the desired wavelength value and record it here: → 565
Make corrections by pressing SHIFT CLEAR and re-entering the wavelength.
When you have correctly keyed the wavelength, press READ/ENTER.

DECIMAL? ≤ 00.00

POSITION THE DECIMAL POINT
Use the arrow keys to position the decimal point; record it here. → 8.8.8.8.
Press READ/ENTER to accept the decimal position.

UNITS? ↕

SELECT THE UNIT OF MEASUREMENT
Use the arrow keys to select the desired unit, record it here: → mg/l
To construct a unit of measure - accept blank field; go to next step.
Press READ/ENTER to accept the unit or blank selection.

SYMBOL? ↕

CONSTRUCT THE CHEMICAL SYMBOL
Use the arrow keys to select the characters.
Press READ/ENTER to accept each character.
Make corrections with SHIFT LEFT ARROW or SHIFT CLEAR.
When completed, record both unit and symbol here: → mg/l V5+
Press READ/ENTER to record the entire construction.

TIMER?

SET THE TIMERS (OPTIONAL)
To bypass entry of the optional timers, press READ/ENTER at the timer prompt.
If you wish to set timers, press SHIFT TIMER.
Record each timer you have set in the spaces below:
Enter all four digits including leading zeroes

MM:SS TIMER 1 ?	30:00	MM:SS TIMER 3 ?	
MM:SS TIMER 2 ?		MM:SS TIMER 4 ?	

Press READ/ENTER when you have completed entering timer values.

ZERO SAMPLE

PERFORM A ZERO CALIBRATION
Insert a sample cell containing clear water and press ZERO.

 # 0 STANDARD

SET THE ZERO CONCENTRATION POINT
Insert a 0.0 concentration sample in the well and press READ/ENTER.
Begin calculation of the concentration - absorbance zero point by pressing READ/ENTER.

ENTER THE ABSORBANCE - CONCENTRATION DATA PAIRS.
Write the prepared sample values in order of increasing concentration in the table below.
Follow the steps outlined for entry and calculation of each point.
NOTE: You may repeat a measurement by pressing SHIFT/CLEAR when the data pair is displayed.

	Press	Enter & Record Concentration	Press	Record Displayed Absorbance	Press
# 1 STANDARD	READ/ENTER	0.200	READ/ENTER	0.188	READ/ENTER
# 2 STANDARD	READ/ENTER	0.400	READ/ENTER	0.372	READ/ENTER
# 3 STANDARD	READ/ENTER	0.600	READ/ENTER	0.554	READ/ENTER
# 4 STANDARD	READ/ENTER	0.800	READ/ENTER	0.715	READ/ENTER
# 5 STANDARD	READ/ENTER	1.000	READ/ENTER	0.906	READ/ENTER
# 6 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 7 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 8 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 9 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 10 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 11 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 12 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 13 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 14 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 15 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER

END USER PROGRAM MODE
When at least two but not more than sixteen data pairs (including the 0.0 concentration point) have been entered conclude the entry of data pairs by pressing SHIFT READ/ENTER.

USE THE NEW METHOD
Select the new method by pressing READ/ENTER and perform tests using the entered calibration

FIGURE A.1 SAMPLE USER-ENTERED CALIBRATIONS WORKSHEET

USER-ENTERED CALIBRATIONS WORKSHEET

Name: _____ Test Method: _____ Date: _____ By: _____

THOD #?

BEGIN USER PROGRAM MODE
Press SHIFT PROG METH.
Record the number displayed by the DR/2000: → 9

TER nm

ENTER THE WAVELENGTH
Key in the desired wavelength value and record it here: →
Make corrections by pressing SHIFT CLEAR and re-entering the wavelength.
When you have correctly keyed the wavelength, press READ/ENTER.

ECIMAL? = 00.00

POSITION THE DECIMAL POINT
Use the arrow keys to position the decimal point; record it here: → 0000
Press READ/ENTER to accept the decimal position.

NITS? :

SELECT THE UNIT OF MEASUREMENT
Use the arrow keys to select the desired unit, record it here: →
To construct a unit of measure - accept blank field; go to next step.
Press READ/ENTER to accept the unit or blank selection.

YMBOL? :

CONSTRUCT THE CHEMICAL SYMBOL
Use the arrow keys to select the characters.
Press READ/ENTER to accept each character.
Make corrections with SHIFT LEFT ARROW or SHIFT CLEAR.
When completed, record both unit and symbol here: →
Press READ/ENTER to record the entire construction.

IMER?

SET THE TIMERS (OPTIONAL)
To bypass entry of the optional timers, press READ/ENTER at the timer prompt.
If you wish to set timers, press SHIFT TIMER.
Record each timer you have set in the spaces below:
Enter all four digits including leading zeroes.

MM:SS TIMER 1 ?		MM:SS TIMER 3 ?	
MM:SS TIMER 2 ?		MM:SS TIMER 4 ?	

Press READ/ENTER when you have completed entering timer values.

ERO SAMPLE

0 STANDARD

PERFORM A ZERO CALIBRATION
Insert a sample cell containing clear water and press ZERO.

SET THE ZERO CONCENTRATION POINT
Insert a 0.0 concentration sample in the well and press READ/ENTER.
Begin calculation of the concentration - absorbance zero point by pressing READ/ENTER.

ENTER THE ABSORBANCE - CONCENTRATION DATA PAIRS.
Write the prepared sample values in order of increasing concentration in the table below.
Follow the steps outlined for entry and calculation of each point.
NOTE: You may repeat a measurement by pressing SHIFT/CLEAR when the data pair is displayed.

	Press	Enter & Record Concentration	Press	Record Displayed Absorbance	Press
# 1 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 2 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 3 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 4 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 5 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 6 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 7 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 8 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 9 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 10 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 11 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 12 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 13 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 14 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER
# 15 STANDARD	READ/ENTER		READ/ENTER		READ/ENTER

END USER PROGRAM MODE
When at least two, but not more than sixteen, data pairs (including the 0.0 concentration point) have been entered conclude the entry of data pairs by pressing SHIFT READ/ENTER.

USE THE NEW METHOD
Select the new method by pressing READ ENTER and perform tests using the entered calibration.

FIGURE A.2 USER-ENTERED CALIBRATIONS WORKSHEET