L.E. Capenter and Co.
1301 E.9th Street
Suite 3600
Cleveland, OH 44114

QUALITY ASSURANCE PROJECT PLAN L.E. CARPENTER FACILITY, WHARTON, MORRIS COUNTY, NEW JERSEY

JULY 13,1990

WSI
Weston Services, Inc.

346338

WSI
Weston Services, Inc.

QUALITY ASSURANCE PROJECT PLAN
L.E.CARPENTER FACILITY
WHARTON, NEW JERSEY

Prepared for:

L.E. Carpenter and Company
1301 E. 9th Street
Suite 3600
Cleveland, Ohio 44114

July 1990

W.O. No. 3600-04-51

Prepared by:

Roy F. Weston, Inc.
Raritan Center - Plaza I
Edison, New Jersey 08837

WSI
Weston Services, Inc.

QUALITY ASSURANCE PROJECT PLAN
L.E. CARPENTER FACILITY, WHARTON, NEW JERSEY

TABLE OF CONTENTS

Section	Title	Page
1	QUALITY ASSURANCE/QUALITY CONTROL	1
	SECTION 1	1
	1.1 Introduction	1
	1.2 Project Description	2
	1.2.1 General	2
	1.2.2 Background	2
	1.2.3 Project Objectives	6
	1.2.4 Project Scope	6
	1.2.5 Project Schedule	7
	1.4 Quality Assurance Objectives	13
	1.4.1 Accuracy	13
	1.4.2 Precision	14
	1.4.3 Completeness	16
	1.4.4 Representativeness	17
	1.4.5 Comparability	17
	1.4.6 Regulatory Requirements	17
	1.5 Sampling Procedures	17
	1.6 Sample Custody	19
	1.6.1 Chain of Custody	20
	1.6.1.1 Sample Labels	20
	1.6.1.2 Chain of Custody Record	20
	1.6.1.3 Transfer of Custody and Shipment	21
	1.6.1.4 Laboratory Custody Procedures	21
	1.6.2 Documentation	26
	1.6.2.1 Sample Identification	26
	1.6.2.2 Field Logs	28
	1.6.2.3 Corrections to Documentation	28
	1.6.2.4 Photographs	28

WSI
Weston Services, Inc.

QUALITY ASSURANCE PROJECT PLAN
L.E. CARPENTER FACILITY, WHARTON, NEW JERSEY

Section	Title	Page
	1.6.3 Sample Handling, Packaging, and Shipping	29
	1.6.3.1 Sample Handling and Packaging	29
	1.6.3.2 Procedures for Packing Low-Level Environmental Samples	30
	1.6.3.3 Procedures for Packing Medium-Level Environmental and Hazardous Samples	30
1.7	Calibration Procedures and Frequencies	33
	1.7.1 Field Equipment	33
	1.7.1.1 HNu Photoionization Analyzer	33
	1.7.1.2 Organic Vapor Analyzer (OVA)	34
	1.7.1.3 Specific Conductance Meter	35
	1.7.1.4 pH Meter	36
	1.7.2 Laboratory Equipment	37
1.8	Analytical Procedures	37
	1.8.1 pH Measurement	37
	1.8.2 Laboratory Methods	37
1.9	Data Reduction, Validation, and Reporting	38
	1.9.1 Field and Technical Data	38
	1.9.1.1 Field and Technical Data Reduction	38
	1.9.1.2 Field and Technical Data Validation	39
	1.9.2 Laboratory Data	39
	1.9.2.1 Laboratory Data Reduction	39
	1.9.2.2 Laboratory Data Validation	40
	1.9.2.3 Laboratory Data Reporting	41
1.10	Internal Quality Control Checks	41
	1.10.1 Internal Quality Control Checks - Field	41
	1.10.2 Internal Quality Control Checks - Laboratory	43
1.11	Performance and Systems Audits	45
	1.11.1 Project Systems Audits	45
	1.11.2 Technical Performance Audits	45
	1.11.3 Field Performance Audits	45
	1.11.4 Laboratory System Audits	46
	1.11.5 Laboratory Performance Audits	46

QUALITY ASSURANCE PROJECT PLAN
L.E. CARPENTER FACILITY, WHARTON, NEW JERSEY

Section	Title	Page
	1.12 Preventive Maintenance of Equipment	48
	1.12.1 Field Equipment	48
	1.12.2 Laboratory Equipment	48
	1.12.2.1 Instrument Maintenance Log Books	48
	1.12.2.2 Instrument Calibration and Maintenance	49
	1.12.2.3 Spare Parts	51
	1.13 Data Assessment Procedures	51
	1.13.1 Field Data	51
	1.13.1.1 Precision	51
	1.13.1.2 Accuracy	51
	1.13.1.3 Completeness	51
	1.13.2 Laboratory Data	51
	1.13.2.1 Precision	52
	1.13.2.2 Accuracy	52
	1.13.2.3 Completeness	54
	1.14 Corrective Action	54
	1.14.1 Field Corrective Action	54
	1.14.2 Laboratory Corrective Action	56
	1.15 Quality Assurance Reports	54
	1.15.1 Field QA Reports	54
	1.15.2 Laboratory QA Reports	56
2	SECTION 2	57
	METHODS PROTOCOLS	57
	2.1 Site Specific Field Procedures	57
	2.1.1 Soil Borings and Sampling Backhoe Pit Excavation	57
	2.1.2 Surface Water Sampling	58
	2.2 General Sampling Procedures	58
	2.2.1 Sample Handling Procedures	58
	2.3 Sampling Equipment	61

WSI
Weston Services, Inc.

QUALITY ASSURANCE PROJECT PLAN
L.E. CARPENTER FACILITY, WHARTON, NEW JERSEY

Number	Title	Page
2.4	Sampling Equipment Decontamination	61
	2.4.1 Required Containers, Preservation Techniques Holding Times, and Sample Volumes	62
	2.4.1.1 Sample Containers	62
	2.4.1.2 Sample Preservation	63
	2.4.1.3 Holding Times	63
	2.4.2 Sampling QA/QC Protocols	63
2.5	Site Management	67
	2.5.1 General Operations and Coordination with L.E. Carpenter	67
	2.5.2 On-Site Project Facilities	68
	2.5.2.1 Site Access and Security	68
	2.5.2.2 Site Logistics	68
	2.5.3 Contingencies	69

WSI
Weston Services, Inc.

QUALITY ASSURANCE PROJECT PLAN
L.E. CARPENTER FACILITY, WHARTON, NEW JERSEY

LIST OF FIGURES

Number	Title	Page
1-1	Topographical Map	3
1-2	Remedial Investigations Sampling	8
1-3	Remedial Investigation Project Work Plan Task Schedule	9
1-4	Project Organizational Chart	10
1-5	Custody Transfer Record/Lab Work Request	22
1-6	Sample Extraction Record	23
1-7	Sample Digestion Record	25
1-8	Sample Packaging, Medium Level Environmental and Hazardous Level Samples	31
1-9	Shipping Container, Medium Level Environmental and Hazardous Level Samples	32
1-10	Corrective Action Documentation Form	55

WSI
Weston Services, Inc.

QUALITY ASSURANCE PROJECT PLAN
L.E. CARPENTER FACILITY, WHARTON, NEW JERSEY

LIST OF TABLES

Number	Title	Page
1-1	Summary of Analytical Methods	11
1-2	QA Objectives for Accuracy and Precision of Laboratory Organic Priority Pollutant Compound Analysis	15
1-3	Summary of External Performance and Systems Audits, Weston Analytical Laboratories	47
1-4	Instrument Maintenance Schedule Weston Analytical Laboratories	50
1-5	QA Objectives for Accuracy (%) of Laboratory Organic Surrogate Analyses	53
2-1	Sample Summary and Analytes	59
2-2	Methods of Chemical Analysis L.E. Carpenter Wharton Facility Samples	60
2-3	Sample Container/ Sample Volume Requirements	64
2-4	Preservation Holding Times	65
2-5	Summary of QA Sampling	66

WSI
Weston Services, Inc.

SECTION 1

QUALITY ASSURANCE/QUALITY CONTROL

1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) is one of two planning documents that describes activities to be undertaken as part of the Administrative Order on Consent between L.E. Carpenter and Co. the New Jersey Department of Environmental Protection (NJDEP) at the L.E. Carpenter and Co. Wharton Facility, Wharton (Morris County), New Jersey. The second planning document is the Supplemental Sampling Plan. The Supplemental Sampling Plan presents the proposed activities to refine the knowledge of the nature and extent of contaminants on the site and aid in the selection of remedial action alternatives. The Health and Safety Plan (HASP) is included as part of the Supplemental Sampling Plan. It presents site-specific information concerning types of facilities, waste types and characteristics, types of hazards, levels of protection, surveillance equipment to be used, and emergency precautions.

The other documents associated with this Remedial Investigation Feasibility Study currently include:

- Work Plan - presents the available information concerning the site's history and potential hazards, and proposed activates to assess the nature and extent of contaminates thereon.

- Report of Remedial Investigation - presents the information collected during the previous efforts of the Remedial Investigation. The original work was performed by Geoengineering, Dover, N.J. for L.E. Carpenter . This document was revised for L.E. Carpenter by Weston Services.

The purpose of the QAPP is to describe the following items:

- Quality assurance objectives.
- Sampling and laboratory procedures.
- Protocols for field activities.

- Sample custody procedures.
- Calibration procedures, references, and frequencies.
- Internal Quality Control (QC) checks.
- QA performance and system audits.
- QA reports to management.
- Preventive maintenance procedures and schedules.
- Data assessment procedures.
- Corrective actions.

1.2 PROJECT DESCRIPTION

1.2.1 General

The L.E. Carpenter and Co. facility is located at 170 North Main Street, Borough of Wharton, Morris County, New Jersey. The regional location of the facility is shown on Figure 1-1, Topographic Map of the L.E. Carpenter Facility, Wharton, New Jersey. The facility comprises Block 301, Lot 1 and Block 703 Lot 30 on the tax map of the Borough of Wharton.

L.E. Carpenter has owned and operated this facility from 1943 through the present. The facility was designed and has operated as a manufacturing facility for vinyl wall coverings.

1.2.2 Background

Figure 1-2 depicts the location of the site and illustrates the general environmental setting. The site (property boundary) occupies approximately 14.6 acres northwest of the intersection of the Rockaway River and North Main Street. The site is situated within a heavily industrialized area. The Rockaway River borders the site to the south, a vacant lot lies to the east, a large compressed gas facility (Air Products Inc), borders the site to the northeast, and a residential area borders the site to the northwest. Additional industrial sites are located to the south of the site. The residential portion of the Borough of Wharton is separated by Ross Street which is located on the northwest side of the site.

Buildings occupy approximately 15%, of the 636,000 square foot (14.6 acre) property. The Rockaway River occupies approximately 13% of the property. Pavement associated with the buildings and access roads occupy approximately 22% of the site. A historical profile of the site and buildings is provided in Sections 3 and 4 of the Draft Report of Remedial Investigation Findings.

N

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET

QUADRANGLE LOCATION

Approximate area of L.E. Carpenter Site

WESTON
MANAGERS DESIGNERS/CONSULTANTS

FIGURE 1-1 SITE LOCATION AND TOPOGRAPHIC MAP

All vehicles enter the site either along North Main Street which crosses the site or at the northwest property entrance along Ross Street. The site is enclosed by a security fence except along the Rockaway River. In addition, the small section of the property between Washington Forge Pond and North Main Street which is used as a parking lot for building 2 is not fenced. Security gates are present at the fenced entrances to the majority of the property.

The site has been active since the 1800's as an iron ore mine and subsequently manufacturing site. Prior to manufacturing the site contained the Washington Forge and West Mount Pleasant mines. Tailings from these mines are thought to have been disposed of on site. In conjunction with the mines, a forge was operated on the site concurrent with mining. Additional details concerning past site use can be found in the Site Evaluation Submission Appendix H, ECRA Sampling Plan and the Draft Report of Remedial Investigation Findings. From approximately 1963 until 1970, L.E. Carpenter disposed its wastes, including a polyvinyl chloride (PVC) waste material, into an on site impoundment. In addition, L.E. Carpenter used a subsurface waste disposal system in 1967 to discharge industrial waste.

L.E. Carpenter submitted to NJDEP a report dated October 2, 1979, concerning the characterization of the PVC waste material disposed in the impoundment and an evaluation of remedial alternatives for the impoundment. The report indicated that a chemical analysis of the PVC waste material collected from the impoundment on July 25, 1979, showed the presence of the following pollutants: di-n-butyl phthalate, diethyl phthalate, phenol, antimony, barium, cadmium, copper, magnesium, lead and zinc.

On August 18, 1980, NJDEP sampled the PVC waste material in the impoundment. The analytical results indicated the presence of the following pollutants: antimony, barium, nickel, copper, lead, xylene, styrene, nonane, cumene, heptane, dibromomethane, mesitylene, p-cymene, butyl benzene, toluene, trichloroethylene, chloroform and benzene.

On August 18, 1980, NJDPE collected samples of groundwater and immiscible chemical compounds floating upon the groundwater from groundwater monitor wells installed at the site. The analytical results of these samples indicated that the groundwater at the site was contaminated with immiscible (free floating) and dissolved pollutants including: 1,2 dichloroethane, trichloroethylene, toluene, ethylbenzene, styrene, dibromoethane, propyl benzene, xylene, cumene, mesitylene, cymene, tetrachloroethylene, tetrachloroethane, chlorobenzene, copper, lead, arsenic, zinc, antimony, barium and nickel.

On March 3, 1981 and December 7, 1981, NJDEP collected groundwater samples from a monitoring well installed at the site. Analytical results of the samples indicated the presence of 16.8 parts per million (ppm) and 135 ppm, respectively, of polychlorinated biphenyls. Subsequent testing in other areas of the site did not show the presence of PCB's.

On January 29, 1982, L.E.Carpenter and NJDEP entered into an Administrative Consent Order (1982 Administrative Consent Order), which required L.E. Carpenter to:

a. Remove the waste sludge from the impoundment

b. Define the full extent of chemical compounds floating upon the groundwater;

c. Decontaminate the groundwater beneath the site as follows:

   i. Remove the immiscible chemical compounds from the groundwater; and

   ii. Remove dissolved volatile organic compounds, including hazardous substances, from the groundwater beneath the site,; and

d. Monitor groundwater quality according to the following schedule:

   i. Collect samples to be analyzed for specific volatile organic compounds every two months for a six month period beginning on or about June 1982 and quarterly thereafter; and

   ii. Take measurements every month to determine groundwater flow direction(s) and the thickness of the free floating organic compounds floating upon the groundwater.

On February 24, 1983, an Addendum (1983 Addendum) was added to the 1982 Administrative Consent Order to clarify its provisions.

Pursuant to the requirements of the 1982 Administrative Consent Order and the 1983 Addendum, referenced in paragraph 7 of this Administrative Consent Order, L.E. Carpenter took the following actions: In April 1982 and May 1982 L.E. Carpenter removed over 4,000 cubic yards of waste from the impoundment; thereafter L.E. Carpenter implemented a groundwater quality monitoring program.

On May 11, 1984, L.E. Carpenter also began removing the immiscible chemical compounds from the top of the water table beneath the site.

On September 26, 1986 an additional Administrative Consent Order was entered into which superseded the January 29, 1982 Administrative Consent Order and the Addendum of February 24, 1983 except that all requirements for L.E. Carpenter contained in L.E. Carpenter's proposal entitled, "Groundwater Decontamination Plan" dated October 31, 1983, as approved with conditions by NJDEP on January 26, 1984 were incorporated. This Remedial Investigation / Feasibility was directed to be undertaken by this Administrative Consent Order.

Under the terms of the Amended Administrative Consent Order, effective 26 September 1986, L.E. Carpenter would undertake a Remedial Investigation/ Feasibility Study of its Wharton New Jersey facility. The initial phase of the RI/FS completed in November 1989 has identified several areas that need additional clarification by sampling.

1.2.3 Project Objectives

The primary objective of this effort is to sample at specific locations and analyze soil, groundwater, and surface water for specific analytes at the Wharton facility. The objective of this sampling event is to refine the assessment of the nature and extent of contamination and determine the threat posed by any contamination.

1.2.4 Project Scope

The scope of work for the Wharton facility includes site-specific activities. Site-specific field activities include test borings or test pit digging, sampling and analysis of soils, sediment and surface water. Specific protocols for each activity are addressed in Section 2.

Three surface water samples will be collected from the Air Products drainage ditch which receives surface runoff from areas of the Wharton facility. Three sediment samples will be collected from these same locations. One surface water smaple and one sediment sample will be collected from the Rockaway River. Three surface soil samples will be obtained from the bank of the Washington Forge Pond on the facility. Twenty-seven additional soil samples will be collected.

All proposed sample locations are shown in Figure 1-2. The final location of the sampling locations or soil borings will be contingent upon the actual site conditions and access. In no event will the sampling locations or soil borings be more than 20' from the proposed location.

All analytical parameters are summarized in the Table 1-1.

1.2.5 Project Schedule

The schedule to complete the Scope of Work is summarized in Figure 1-3. In order to achieve the target schedule, individual activities can be scheduled to overlap or occur simultaneously as much as possible. The planned schedule for execution of field work related to this project will be as follows:

- Background data acquisition
- Initial subsurface investigations (test borings, and soil sampling), associated investigations and surveying.

One draft report and a final report are planned to document the results of field work. The actual Scope of Work and schedule may be revised by L.E. Carpenter, after consultation with the New Jersey Department of Environmental Protection, based on recommendations contained in the Draft Report.

1.3 PROJECT ORGANIZATION AND RESPONSIBILITY

The organization for this project is illustrated diagrammatically in the chart in Figure 1-4. The following is a brief description of project responsibilities.

WESTON
MANAGERS DESIGNERS/CONSULTANTS

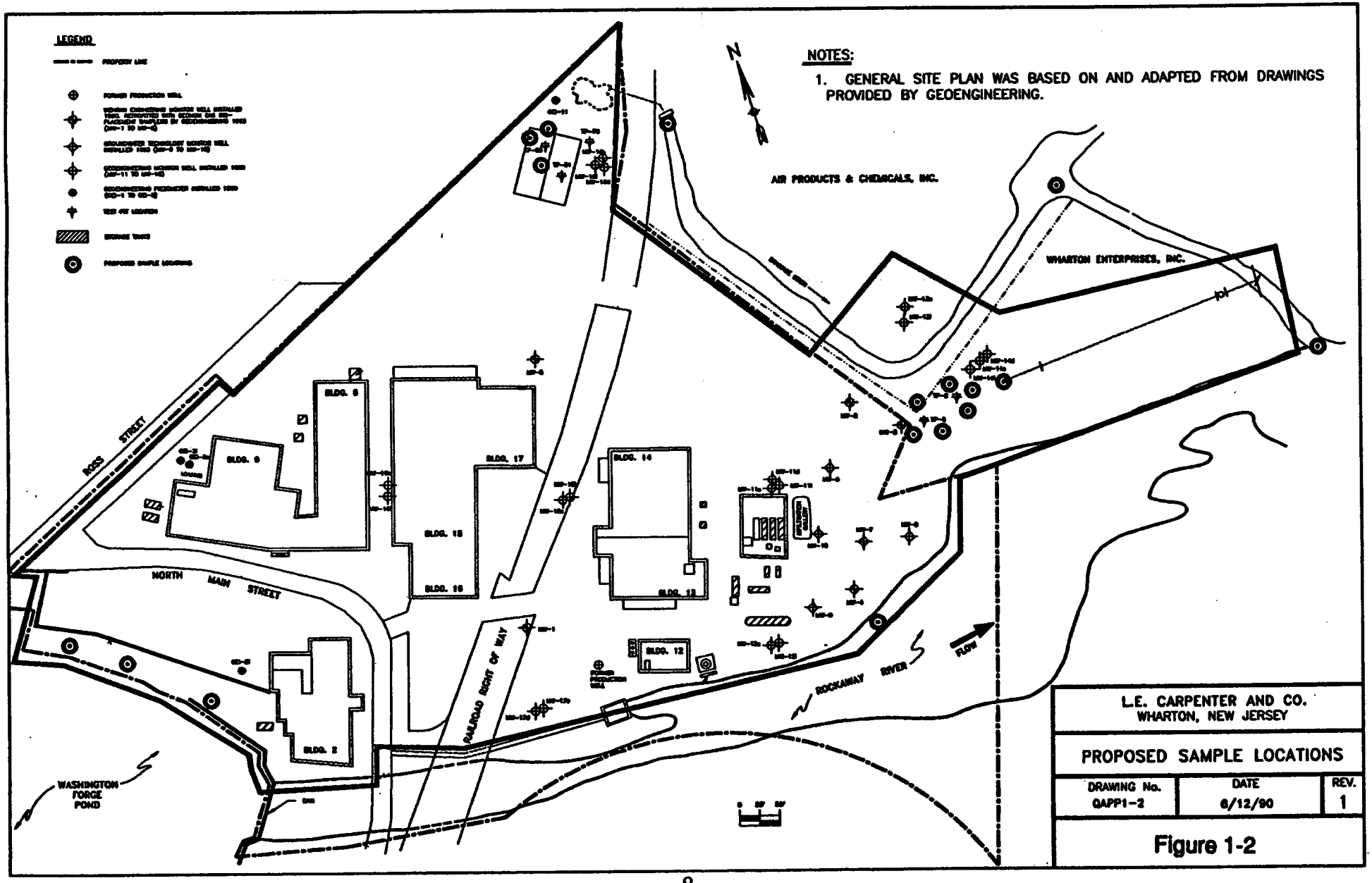
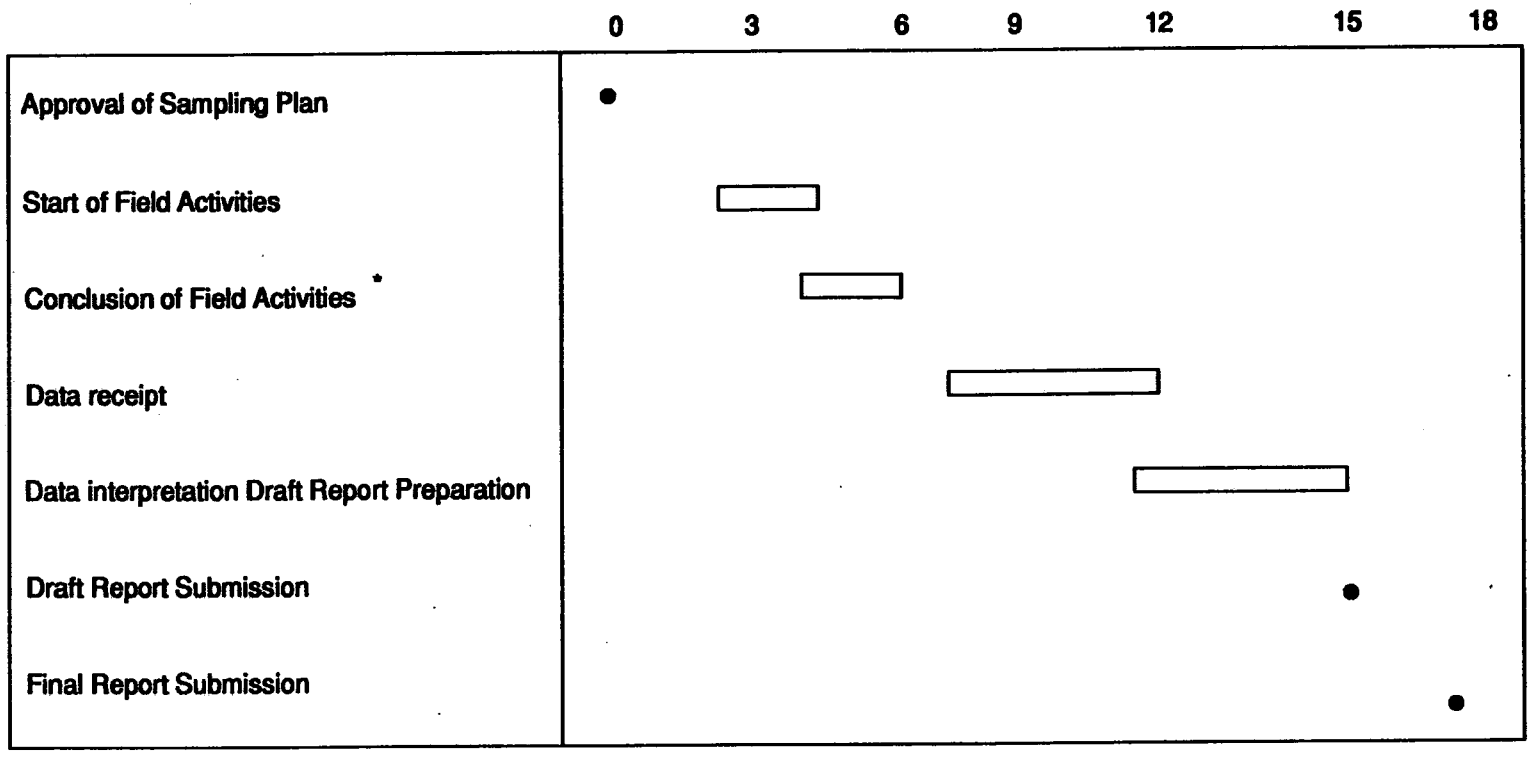


Figure 1-3

Project Work Plan Task Schedule

L.E. Carpenter, Wharton N.J. Facility

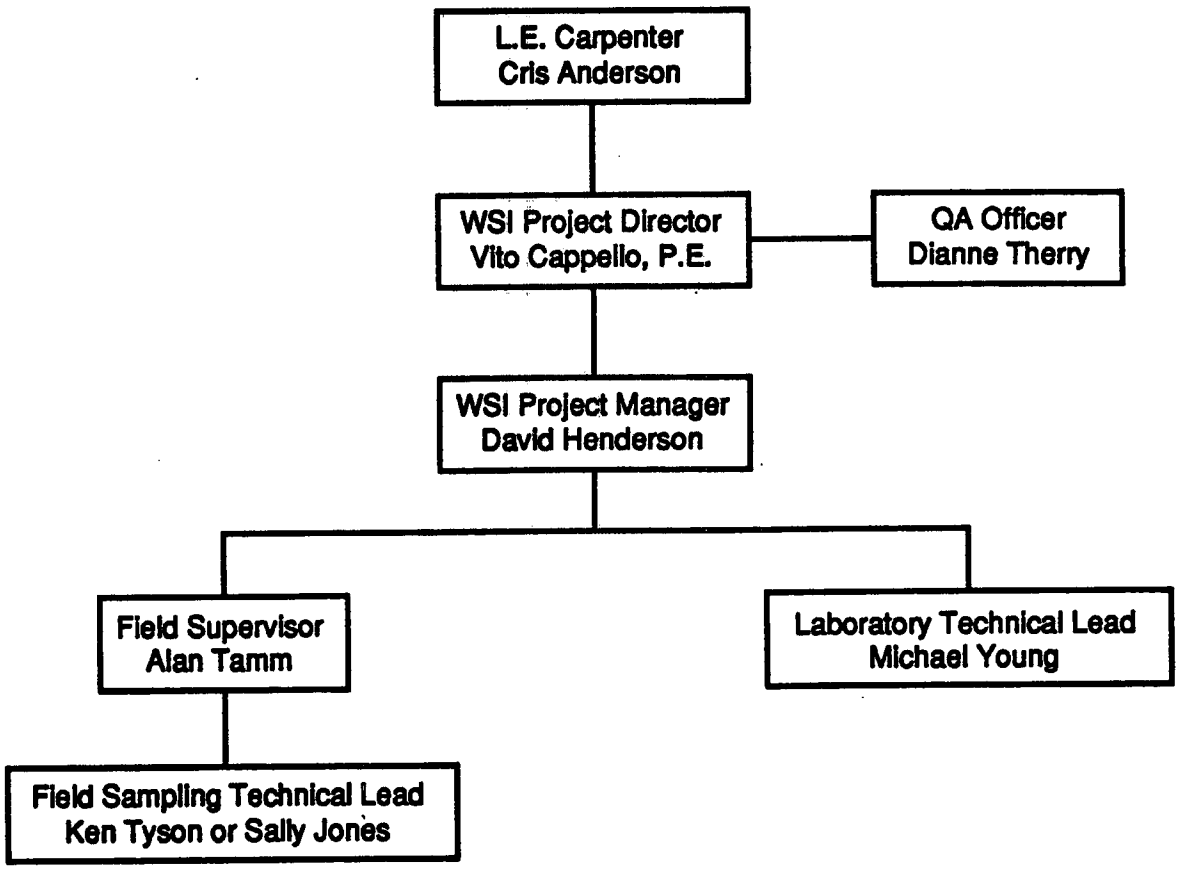


* Sample acquistion presumes a court order will not be required for access to Wharton Enterprises property

carpshed.drw

FIGURE 1-4

Project Organization Chart



WSI
Weston Services, Inc.

Table 1-1

Summary of Analytical Methods

Parameter	Method	Matrix	Reporting Limit	% RPD
VO+10	CLP SOW-0	S+W	See Appendix B	See Appendix A
VO+15	CLP SOW-0	S+W	"	"
BN+15	CLP SOW-0	S+W	"	"
PCB	CLP SOW-0	S+W	"	"
PP Metals	CLP SOW-I	S	"	75-125≤ 20%
TAL Metals	CLP SOW-I	S+W	"	75-125≤ 20%

CLP-SOW-O-EPA CLP Statement of Work for Organic Analysis Multi Media, Multi Concentration 2/88 with Revisions (No diskette deliverable).

CIL-SOW-I-EPA CLP Statement of Work for Inorganic Analysis Multi Media, Multi Concentration 2/88 with Revisions (No diskette deliverable).

Mr. Cris Anderson, Manager Environmental Projects, will serve as L.E. Carpenter and Co.'s Designated Project Coordinator for the Wharton Remedial Investigation. Mr. Anderson will be responsible for oversight of the implementation of the NJDEP Consent Order and will be L.E. Carpenter's primary point of contact with the NJDEP.

The Project Director, Vito Cappello, P.E., is responsible for overall management and quality assurance for this L.E. Carpenter project. His responsibility includes ensuring that all WESTON corporate resources necessary for the successful completion of the project are provided. The Project Director is the senior point of contact between L.E. Carpenter and WESTON.

The Project Manager David Henderson, along with the Project Director, is responsible for technical and financial management of this project and is the direct contact individual between L.E. Carpenter and WESTON. His responsibilities include allocation of resources to ensure that the project schedule is maintained, including subcontractor management.

The Field Supervisor, Alan Tamm, CPGS, P.G., is responsible for coordinating the activities of the field teams and directing the work of subcontractors in the field. The Field Supervisor is directly responsible for implementation of the Work Plan and the QAPP as they apply to the field effort, for keeping the field teams supplied, and for coordination of logistical issues. The Field Supervisor may prepare daily field reports during all field activities and communicates progress and problem areas to the Project Manager on a daily basis. The Field Supervisor also is responsible for coordination and day-to-day contact with L.E. Carpenter and Co. Wharton facility personnel.

The Technical Leads are responsible for tracking technical progress within the project scope relating to each of their disciplines (geosciences; geology, hydrology, and soil science and chemistry; including laboratory analysis) and ensuring that the technical objectives of the Work Plan are being met. The Technical Leads work with the Field Supervisor to plan data collection efforts. In addition, Technical Leads track and constantly evaluate new technical data as they are generated and notify the Field Supervisor or Project Manager of any anomalies, data gaps, and/or adjustments to the planned data collection effort which might be required to meet the technical objectives of the project.

The Data Administrator is responsible for entering all data collected in the field into the database for the project. The intent is to check all data and to enter it into the data base as it is generated. The data to be entered will include: boring

logs, geophysical data, water level measurements, field water quality data, and sample point coordinate locations. In addition, the Data Administrator will assist the Field Supervisor in keeping the field teams supplied and in maintaining daily progress reports. The field supervisor Data Administrator and Technical lead position responsibilities may be shared by one or more people due to the limited scope of the Supplemental Sampling Plan.

The Quality Assurance Officer for the project will report directly to the Project Director. The QA Officer is responsible for review of data generated. The Data Administrator or Technical Lead may request assistance from the project QA Officer in validating a data set or data analysis technique. The QA Officer is responsible for review of project laboratory deliverables.

1.4 QUALITY ASSURANCE OBJECTIVES

The overall quality assurance objective for field activities, data analyses, and laboratory analyses is to produce data of sufficient and known quality to support evaluation of environmental effects and preliminary selection of preliminary remedial alternatives. Specifically, all data will be gathered or developed using procedures appropriate for the intended use. Standard procedures will be used so that known and acceptable levels of accuracy, precision, representativeness, completeness, and compatibility are maintained for each data set. Descriptions of these criteria are presented in the following subsections. The analytical quality control level that will be used is Level IV for routine CLP procedures (EPA 540/G-87/0003A). Further discussions on quality assurance objectives are found in Section 1.13.

1.4.1 Accuracy

Accuracy is the degree of agreement of a measurement, X, with an accepted reference or true value, T, usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100(X-T)/T, and sometimes expressed as a percentage of the reference. For this project accuracy will be expressed as the percentage of the reference. Accuracy is a measure of the bias in a system.

The accuracy of data collected using field instruments is difficult to quantify. It can be qualitatively maximized, however, by strict adherence to standard protocols and, where applicable, manufacturers' operating and calibration procedures. This will ensure that the data are accurate and within the manufacturers' reported accuracy limits. Specific procedures for instrument calibrations and field protocols

are presented in Subsection 1.7.2 and Section 2, respectively.

Analytical accuracy is expressed as the percentage recovery of an analyte (or a surrogate in the case of organic analytes) which has been added to the sample (or standard matrix, e.g. a blank) at a known concentration before analysis and is expressed by the following formula:

$$\text{Accuracy} = \text{Percent recovery} = \frac{A_T - A_O}{A_F} \times 100 \text{ percent}$$

where:

A_T = Total amount found in fortified sample

A_O = Amount found in unfortified sample

A_F = Amount added to sample

A comprehensive summary of the specific precision and accuracy goals for the matrices and analysis specific to this project are shown on Table 1-2.

1.4.2 Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions".

During collection of data using field methods and/or instruments, precision is checked by reporting measurements at one location and comparing results. For example, water level measurements would be taken three times at a well and the values compared. Only if the values are within a specified percentage of each other are the measurements sufficiently precise. Specific precision goals are presented in Subsection 1.13 and Section 2.

Analytical precision is calculated by expressing as a percentage the difference between results of analyses of duplicate samples for a given analyte. Precision can be expressed by the formula:

Table 1-2

QA Objectives for Accuracy and Precision of Laboratory Organic Priority Pollutant Analyses

Fraction	Matrix Spike Compound*	Recovery Limits (%) Water	Recovery Limits (%) Soil/Sed	RPD Limits (%) Water	RPD Limits (%) Soil/Sed
VOA	1,1-Dichloroethene	61-145	59-172	14	22
VOA	Trichloroethene	71-120	62-137	14	24
VOA	Chlorobenzene	75-130	60-133	13	21
VOA	Toluene	76-125	59-139	13	21
VOA	Benzene	76-127	66-142	11	21
BNA	1,2,4-Trichloro-benzene	39- 98	38-107	28	23
BNA	Acenaphthene	46-118	31-137	31	19
BNA	2,4-Dinitrotoluene	24- 96	28- 89	38	47
BNA	Pyrene	26-127	35-142	31	36
BNA	N-Nitroso-di-n-propylamine	41-116	41-126	38	38
BNA	1,4-Dichlorobenzene	36- 97	28-104	28	27
Acid	Pentachlorophenol	9-103	17-109	50	47
Acid	Phenol	12- 89	26- 90	42	35
Acid	2-Chlorophenol	27-123	25-102	40	50
Acid	4-Chloro-3-methyl-phenol	23- 97	26-103	42	33
Acid	4-Nitrophenol	10- 80	11-114	50	50
Pest.	Lindane	56-123	46-127	15	50
Pest.	Heptachlor	40-131	35-130	20	31
Pest.	Aldrin	40-120	34-132	22	43
Pest.	Dieldrin	52-126	31-134	18	38
Pest.	Endrin	56-121	42-139	21	45
Pest.	4,4'-DDT	38-127	23-134	27	50
PCB	Arochlor 1254	Not Established		30	50

* The list provided includes those compounds most commonly used for QA/QC accuracy and precision control in the groups of analytes shown based on current U.S. EPA Contract Laboratory Program requirements.

$$RPD = \frac{C_1 - C_2}{(C_1 + C_2)/2} \times 100 \text{ percent}$$

where:

RPD	= Relative Percentage Difference
C_1	= Concentration of analyte in sample
C_2	= Concentration of analyte in replicate

1.4.3 Completeness

Data completeness for this project is defined as the percent of acceptable data obtained compared to those planned for the project. Unless recommended for rejection as the result of data validation, qualified data is considered valid, useable data and therefore acceptable. The level of completeness can be affected by field conditions as well as laboratory factors.

Field data completeness can be affected by inaccessibility to various areas and/or media, along with unanticipated difficulties with sample collection. For example, poor sample recovery in a split-spoon sample reduces the number of soil samples that can be collected. A seasonally low water table at a groundwater monitoring well may prevent collection of the required sample volume needed for full sample analysis.

Laboratory data completeness can be affected by difficulties encountered during sample handling, as well as, unforeseen complications with respect to sample extraction or analysis. For example, the analytical methods proposed for use (particularly for the organics analyses) are intended for environmental samples of low and medium level concentrations, which is in keeping with historical knowledge of the site. However, the applicability of these methods to unknown or hazardous level samples often result in poor method performance and, therefore, can adversely affect achieving the data completeness goal.

It is reasonable to plan for some loss of samples due to the common occurrences described above. Therefore, the overall completeness goal for investigations at the Wharton Facility, encompassing potential difficulties from both field and analytical sources, is 85 percent. A subset of key sampling points will be defined as critical to the investigation to ensure sampling is sufficient enough to meet project objectives. Critical data points are sample locations for which valid data must be obtained in order that the sampling be considered complete. An example of a critical data point is the surface water sample taken at the confluence of the

Rockaway River and the Drainage ditch, as only one sample is planned. Another example of a critical data point may be an upgradient well, or any other data point considered vital to the decision making process. Critical data points for the Wharton Facility investigation will be determined in the field by the Project Manager and the Field Supervisor prior to the initiation of each applicable field activity, and this information will be forwarded to the data validation team. Because of the importance of these critical data points, the completeness goal for these points is 100 percent. Resampling/reanalysis will be required if critical data points are not 100 percent complete.

1.4.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter, variation at a sampling point, a process condition, or an environmental condition. The methods used to select samples that are representative of the site or source will be described in the sampling protocols in Section 2.

The sampling plan that has been agreed upon by the NJDEP, and L.E. Carpenter has been designed to collect a biased distribution of data on the facility. This bias was intended to determine the "worst case" for the presence of contaminants. Samples will be taken immediately in the vicinity of the potential contaminant source, immediately downgradient and upgradient for comparison purposes,

1.4.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. The comparability of the data is influenced by sampling and analytical procedures. By providing specific standard protocols to be used for obtaining and analyzing samples, reviewing and validation of data, data will be comparable to results from other studies which employ standard methods.

1.4.6 Regulatory Requirements

Wherever possible given the analytical method specified, the limit of detection (LOD) of any chemical analysis should be less than the established Federal or state standard for the compound in the matrix analyzed in order to allow comparison of the result with that standard.

1.5 SAMPLING PROCEDURES

Sampling and analysis procedures, including sample preservation and holding times for the relevant chemical analyses and matrices and the CLP SOW, are in conformance with applicable techniques contained in the following documents:
Regulations

CODE OF FEDERAL REGULATIONS

40 CFR 136.3e, Table II	Required Containers, Preservation Techniques, and Holding Times
40 CFR 300.61 - 300.71(Subpart F)	National Contingency Plan

Manuals/Analysis Protocols

ENVIRONMENTAL PROTECTION AGENCY

EPA-330/9-S1-002	NEIC Manual for Groundwater/Subsurface Investigations at Hazardous Wastes Sites
	Superfund Exposure Assessment Manual (January 1986)
EPA-540/1-86-060	Superfund Public Health Evaluation Manual (October 1986)
EPA-600/4-79-020	Methods for Chemical Analysis of Water and Wastes (1983)
EPA-60/4-88/039	Method for the Determination of Organic Compounds in Drinking Water (1988)
SW-846	Test Methods for Evaluating Solid Waste, Third Edition (1986)
USEPA	Region II CERCLA Quality Assurance Manual, Final Copy, Revision 0, (March 1988)

AMERICAN PUBLIC HEALTH ASSOCIATION (APHA,AWWA,&WPCF)

16th Edition	Standard Methods for the Examination of Water and Wastes

AMERICAN SOCIETY FOR TESTING AND MATERIALS

D-1452	Soil Investigation and Sampling by Auger Boring
D-1586	Penetration Test and Split Barrel Sampling of Soils
D-2488	Recommended Practices for the Visual-Manual Description of Soils

Handbooks

ENVIRONMENTAL PROTECTION AGENCY

EPA-600/4-82-029	Handbook for Sampling and Sample Preservation of Water and Wastewater (1982)

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

Hazardous Waste Programs Field Sampling Manual (February 1988)

Guidance Documents

ENVIRONMENTAL PROTECTION AGENCY

EPA-540/G-89-004	Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA
EPA-540/G-88-003	Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites
EPA-540/G-87-003	Data Quality Objectives for Remedial Response Activities, Vol 1, Developmental Process

Specific methodologies to be followed, including any revisions to techniques in the above listed documents which are required by the L.E. Carpenter or are necessary to meet the objectives of the Scope of Work are detailed in Section 2 of this Plan.

1.6 SAMPLE CUSTODY

The purpose of sample custody procedures is to document the history of sample

containers and samples (and sample extracts or digestates) from the time of sample collection, shipment, and analysis. An item is considered to be in one's custody if one or more of the following conditions apply:

- it is in the physical possession of the responsible party;
- it is in the view of the responsible party;
- it is secured by the responsible party to prevent tampering; or
- it is secured by the responsible party in a restricted area.

1.6.1 Chain-of-Custody

1.6.1.1 Sample Labels

All samples will be identified with a label which will be attached directly to the container. Sample labels will be completed using waterproof ink. The labels will contain the following information:

- Sample number.
- Time and date of collection.
- Project name.
- Parameters to be analyzed.
- Preservative, to include pH (<2 or > 12), e.g., HNO_3 to pH <2.
- Sample source/location.
- Sampler's initials.

As each sample is collected it will be placed in a labeled container. Sample numbers will have been determined before the field investigation begins. See Subsection 1.6.2.1 for a description of the sample numbering system.

1.6.1.2 Chain-of-Custody Record

To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, a chain-of-custody record will be filled out for each sample at each sampling location. Each time the samples are transferred, the signatures of the persons relinquishing and receiving the samples as well as the date and time will be documented. A sample chain-of-custody record is included as Figure 1-5. An adhesive seal will be affixed to the exterior of the bottle such that opening of the bottle will tear the seal.

1.6.1.3 Transfer of Custody and Shipment

Prior to shipment of samples, the chain-of-custody record will be signed and dated by a member of the WESTON field team who has verified that those samples indicated on the record are indeed being shipped. After packaging has been completed, custody seals, signed and dated by a member of the WESTON field team, will be placed on the cooler.

All samples will be shipped via courier such as Federal Express, Emery, or other overnight delivery service to the appropriate laboratory. Hazardous or environmental-level samples may be transported by WESTON personnel in private vehicles if the samples are properly packaged and labeled. Upon receipt of the samples at the laboratory, the receiver will complete the transfer by dating and signing the chain-of-custody record.

1.6.1.4 Laboratory Custody Procedures

When sample containers are provided by WESTON, chain-of-custody documentation (see Figure 1-5) will be shipped with the sample containers. These forms should be completed by field personnel with acknowledgment of time and date of transfer and placed in the shipping container in the plastic cover provided. The following subsections describe laboratory custody procedures associated with sample receipt, storage, preparation, analysis, and general security procedures.

Sample Receipt

- Upon receipt, the sample custodian will inspect sample containers for integrity. The presence of leaking or broken containers will be noted on the chain-of-custody record (see Figure 1-5). The sample custodian will sign (with date and time of receipt) the chain-of-custody record, thus assuming custody of the samples.

- The information on the chain-of-custody record will be compared with that on sample tags and labels to verify sample identity. Any inconsistencies will be resolved with the field sampling representative before sample analysis proceeds.

- Samples will be moved to one of the locked sample storage refrigerators for storage prior to analysis. The storage location will be recorded on the chain-of-custody record.

FIGURE 1-5

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

Client _____

Work Order _____

Date Rec'd. _____ Date Due _____

RFW Contact _____

Client Contact/Phone _____

Refrigerator#											
#/Type Container											
Volume											
Preservative											
ANALYSES REQUESTED →											

WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected										

Matrix:
S - Soil
SE - Sediment
SO - Solid
W - Water
O - Oil
A - Air
WI - Wipe
DS - Drum Solids
DL - Drum Liquids
F - Fish
L - EP/TCLP Leachate
X - Other

Special Instructions:

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y N
NOTES:

4 Properly Preserved
Y N
NOTES:

5 Received Within Holding Times
Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Unbroken on Outer Package Y N
3 Present on Sample Y N
4 Unbroken on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

RFW 21-21-001/A-12/88

7-115

- The sample custodian will return the original chain-of-custody record to the Laboratory Data Manager and provide carbon copies to each laboratory Section Manager and one to the main sample log kept in the laboratory.

- The sample custodian will alert the appropriate Section Managers and Analysts of any analyses requiring immediate attention because of short holding times.

Sample Storage

Samples will be maintained in storage in one of the locked storage refrigerators prior to sample preparation and analysis.

The storage refrigerators are maintained at 4°C +/- 2°C. The temperature is monitored by the laboratory security system and recorded daily in a bound log. If during working hours equipment failure (compressor failure, door left open, etc.) results in the storage refrigerator temperature exceeding the upper or lower control limits, an audible alarm will sound, and the samples will be moved to suitably controlled storage until the problem has been corrected. During off hours, the alarm is automatically transferred to security agency personnel who alert laboratory and maintenance personnel (via beeper call) so that prompt corrective action can be taken.

Analysts request samples for analysis from the sample custodian. Both sign the chain-of-custody record to acknowledge transfer of custody to the analyst.

Sample Tracking - Organic Analysis

For samples which require extraction prior to analysis, a sample extraction form is completed during the time of extraction. A copy of this form is shown as Figure 1-6.

When samples are extracted for analysis by gas chromatography, GC/MS, or liquid chromatography, all pertinent data are recorded in a bound laboratory notebook. Data are entered onto the Laboratory Information Management system (LIMS). A hard copy of the extraction record is printed out and is used as the vehicle for custody transfer to the analyst. This signed copy is attached to the bound record book. Copies are provided to the Analysts to inform them that extracts are ready for analysis. The bound laboratory notebook is kept in the laboratory. Extracts are maintained in refrigerated storage by the sample preparation section until transferred to the Analysts.

Sample Tracking - Metals Analysis

Samples are received by the sample preparation section for digestion prior to

SAMPLE EXTRACTION RECORD

Sheet No.:

Extract. Date: Extraction Batch No.: Analyst: Method:

Test: Cleanup Date: Analyst: Client:

Solvent: Adsorbent:

Sample No.:	Client ID	pH	Initial WT/VOL	Surr. Mult. 500 ul	Spike Mult. 500 ul	Final VOL ACID	Final VOL BN	Split Mult.	% Solids	C/D Factor

Comments:
Surrogate:
Spike:

Extracts Transferred	Relinquished By	Date Time	Received By	Date Time	Reason for Transfer

FIGURE 1-6 SAMPLE EXTRACTION RECORD

WESTON

analysis for metals by atomic absorption/inductively coupled plasma spectroscopy. When samples are prepared for digestion, the Preparation Technician fills out the sample digestion notebook. The type of information recorded is shown in Figure 1-7.

All information regarding sample digestion is entered onto the laboratory computer and a hard copy of the resultant digestion record is generated. The computer generated digestion record is maintained to acknowledge custody transfer of digestates to the metals analysis section. Upon completion of sample digestion, a copy of the sample digestion record is provided to the metals analysis section to alert them that digestates are ready for analysis.

The bound sample digestion notebook is retained by the sample preparation section.

Recordkeeping

Data related to all sample preparation and analysis procedures and observations by Laboratory Analysts are recorded in bound laboratory notebooks which are issued by the Laboratory Quality Assurance fig 1-6. Laboratory notebook pages are signed and dated daily by Laboratory Analysts. Corrections to notebook entries are made by drawing a single line through the erroneous entry and writing the correct entry next to the one crossed out. All corrections are initialed and dated by the Analyst.

Building Security

The WESTON laboratory maintains controlled building access at all times. During working hours, all non-WESTON laboratory personnel are required to sign in with the receptionist and are escorted by laboratory personnel while in the building.

The laboratory is locked by an ADT Security System between the hours of 5:00 P.M. and 8:00 A.M. Monday through Friday and during non-working hours. This security system not only monitors building access, but also monitors the temperature in the sample storage refrigerators. If the control temperature range is exceeded during working hours, an audible alarm sounds, and during non-working hours, a silent alarm alerts ADT personnel. Response by laboratory personnel is described above.

The building is accessed by laboratory employees during nonworking hours by using a key and the pass code for the building security system.

WESTON

SAMPLE DIGESTION RECORD

Digestion Date _____ Digestion Batch No. _____ Analyst _____

Completion Date _____ Type of Prep. _____ Method _____

Parameters _____ Client _____

Type of Analysis _____ Matrix _____

RFWs	Customer ID/ Spike Info	Initial Wt./Vol. g/mL	Final Vol (mL)	pH <2>	DESCRIPTION WATER - Color, Clarity SOIL - Color, Texture, Artifacts	Soil Prep Pan Wt. (g)	Wet Wt. (g)	Dry Wt. (g)

Comments:

FIGURE 1-7 SAMPLE DIGESTION RECORD

Any breach of security during nonworking hours sounds a silent alarm to security agency personnel who alert the local law enforcement agency and one of three laboratory personnel via beeper call. Police response to security alarms takes place within 5 minutes, and laboratory personnel are on-site within 20 minutes.

1.6.2 Documentation

1.6.2.1 Sample Identification

A numbering system has been developed to identify each well, boring location, and sample taken during water and soil sampling programs. This numbering system provides a tracking procedure to allow retrieval of information concerning a particular sample.

Each sample number will consist of three components which will consist of site, location, and depth identifiers as described below.

- Site Identifier - A two-digit designation will be used to identify the particular site where the sample is being collected. The site number will be cross-referenced to the actual site name in the Work Plan and also to the sampler's field notebook. The site identifiers to be used for the investigation are based on the site numbering system used in earlier investigations by WESTON. For this project the Site identification number for the L.E. Carpenter and Co. Wharton Facility is 02.

- Sample Identifier - A four-character alphanumeric designation will be used to identify samples according to sample type. The first character will be a letter to identify the sample type as follows:

  M - Monitor wells
  B - Soil borings
  R - Surface water and seeps
  P - Test Pit
  S - Sediment

- Depth Location Identifier - A two character designation will be used to identify the sample depth location within each site.

The sample number will not be related to date of collection; however, the date will be documented in the sampler's field log and on the chain-of-custody record. Provision will be made where circumstances require a slight modification to the

numbering sequence for a specific sample. A typical sample number follows:

- 02-B156-B - Soil sample taken from boring 156 at the L.E. Carpenter and Co. Wharton facility at the depth "B". (Cross referenced in the field notebook for depth).

The last character of the numbering system may be used to denote that a sample is the one collected for quality control purposes (see Subsection 1.10.1). The site and location identifier will not change. The numbering system for quality control samples is explained below.

Field Duplicates/Field Replicates

The first character of the sample depth identifier will be a letter to identify the sample type as discussed above. For duplicate or replicate samples, the second character will always be the number 1 which will indicate that the sample is a duplicate of the sample denoted in the location identifier.

- 02-B156-B1 - Field duplicate soil sample taken from boring 156 at L.E. Carpenter and Co. Wharton facility, at depth "B".

Field Blanks

The first character of the sample depth identifier will denote the sample type as described above The second will always be a 2 to indicate a field blank. The site and location identifiers for the field blank will be the numbers of the location and corresponding site which was sampled immediately prior to collecting the equipment blank.

- 02-B156-B2 - Field blank collected immediately after sampling boring 156 at depth "B" on the L.E. Carpenter and Co. Wharton facility.

Trip Blanks

The first character of the sample depth identifier will denote the sample type. The second character will be a digit, the first of which will always be a 3 to denote a trip blank. The site and location identifiers will be the numbers of the location and corresponding site of the last sample on the chain-of-custody record.

- 02-B156-B3 - Trip blank collected during the sampling event; 02-B156 are the site and location identifiers of the last sample on the

chain-of-custody record for each batch of samples taken for VOAs analysis.

1.6.2.2 Field Logs

All data collection activities performed at a site will be documented either in a field notebook or on appropriate forms. Entries will be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. All field log entries should be dated. Field notebooks will be bound books and will be assigned to individual field personnel for the duration of their stay in the field. All field log forms will be kept in ring binders assigned to individual field personnel.
The cover of each notebook or ring binder will contain the following information:

- Person to whom the book is assigned.
- Project name.
- Start date.
- End date.

It will be the responsibility of all field personnel to photocopy all field logs (including notebook pages and field forms) generated during a field day at the end of that day.

1.6.2.3 Corrections to Documentation

All measurements made and samples collected will be recorded. Each field geologist/scientist will initial each page as it is completed.

If an incorrect entry is made, the data will be crossed out with a single strike mark and the mark initialed.

Any revisions to field notes will be made on the field log and will be dated and initialed by the person revising the log. There will be no erasures or deletions from the field logs.

1.6.2.4 Photographs

To the extent practicable, sampling locations will be photographed to provide a visual record of the conditions of the sampling area. All rolls of film will be numbered with roll number and picture number recorded in the field log book. Pictures of the sampling locations will be taken with 35-mm slide or print film.

Sampling locations will be identified in the photographs by placing an 8-1/2 x 11-in. (or larger) sheet of paper with the sample and/or well number written on it next to the well or sampling point when the photograph is taken.

1.6.3 Sample Handling, Packaging, and Shipping

1.6.3.1 Sample Handling and Packaging

Samples obtained at potentially hazardous waste sites are classified as either environmental or hazardous samples. Within the environmental sample category, a distinction is made between low- and medium-concentration samples for determining both shipping procedures and appropriate analytical protocols such as dilution. These categories apply to both solid and liquid samples. Low-level samples are considered to be those collected off-site, around the perimeter of a waste site, or in areas where hazards are thought to be significantly reduced by normal environmental processes. Medium-level samples are most often those collected on-site in areas of moderate dilution by normal environmental processes. Hazardous-level samples include samples collected from drums, surface impoundments, direct discharges, and chemical spills where there is little or no evidence of environment dilution. Hazardous-level samples are suspected to contain greater than a 15 percent concentration of any individual chemical contaminant.

Determination of the suspected concentration level of a sample is made in the field based on the point of origin of the sample, visual evidence, and evidence from OVA field screening.

In general, all groundwater and surface water samples at the Wharton facility are expected to be low-level environmental samples. Selected soil samples from source areas may be medium-level environmental or hazardous-level samples. As a conservative approach, all samples suspected of being either medium-level environmental or hazardous-level samples will be handled and shipped in the same manner as described in Subsection 1.6.3.3 below. However, whenever possible based on field data, a distinction between sample-level categories will be noted on the chain-of-custody record.

Whatever the suspected level category of a sample, the sample container will be handled with gloves and will be decontaminated in the field by rinsing off any water, preservatives, or soil residue with potable water prior to shipping.

1.6.3.2 Procedures for Packing Low-Level Environmental Samples

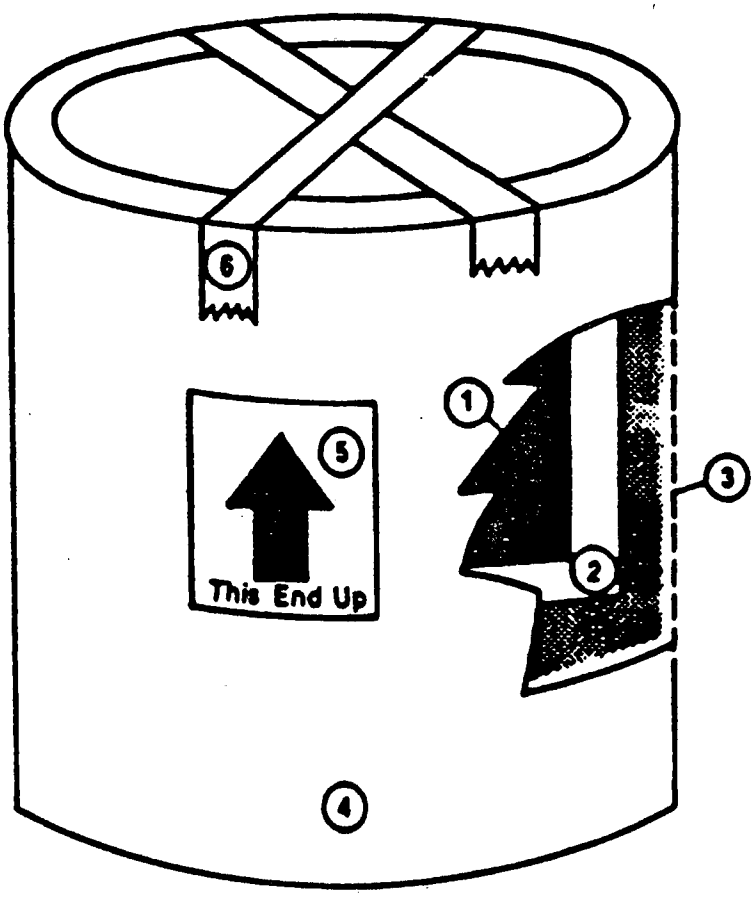
Samples assumed to have no to low-concentrations of contaminants (low-level samples) will be collected in an appropriate container. The sealed and labeled container will then be placed inside a watertight polyethylene bag. The sealed packages will then be placed inside an ice chest and packed with an absorbent packaging material such as vermiculite so as to prevent breakage. An internal temperature of 4°C is to be maintained during shipment of the sample cooler. Sufficient amounts of ice are to be used when packing samples. Ice will be placed on top of the samples to keep them cool during shipment. The ice chests will be sealed with a custody seal and strapping tape.

1.6.3.3 Procedures for Packing Medium-Level Environmental and Hazardous-Level Samples

Samples suspected of having medium- or hazardous-levels of contaminants will be packed according to the following procedure:

- The sample container will be placed in a separate 2-mil thick (or heavier) watertight polyethylene bag. Each sealed bag will be placed inside an appropriately sized metal can with enough noncombustible absorbent packaging material (e.g., bentonite, vermiculite, or diatomaceous earth) to prevent breakage and provide for absorption of liquid with one bag per can. The can will be pressure-closed, and clips or tape will be used to hold the lid securely. An example of this packaging is shown in Figure 1-8.

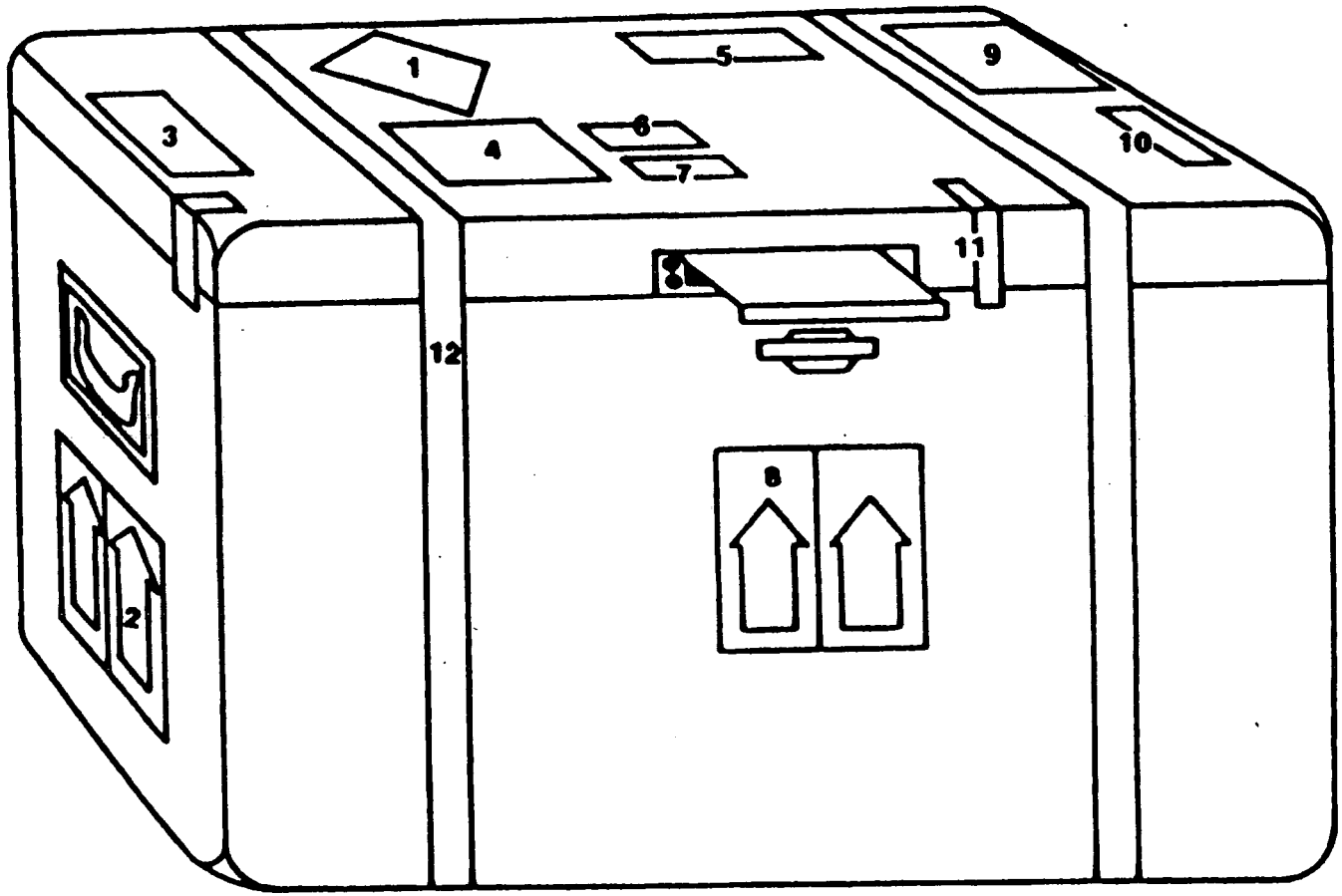
- The metal cans will be placed in a strong outside container such as an ice chest and surrounded with vermiculite or similar substitute for stability during transport. Ice will be placed on top of the samples to keep them cool (maintained at 4°C) during shipment. The ice chest will be sealed with a custody seal and strapping tape. The appropriate stickers, as specified by the U.S. DOT or the state DOT whichever is more stringent, will be placed on the ice chest to indicate that its contents may be hazardous. An example of the cooler labeling for medium-concentration samples is shown in Figure 1-9.



Legend

1 Sample Container
2 Ziplock Bag (2 Mil Minimum)
3 Vermiculite (or Equivalent) Packing
4 Metal Paint Can With Lid
5 This End Up Sticker
6 Strapping Tape

FIGURE 1-8 SAMPLING PACKAGING, MEDIUM - LEVEL ENVIRONMENTAL AND HAZARDOUS - LEVEL SAMPLES



Legend

1 Flammable Liquid, N.O.S. (DOT Label)
2 Arrows Pointing Cooler In Upright Position
3 This Side Up
4 Laboratory Address
5 Return, or Local Address
6 Flammable Liquid N.O.S.
7 UN 1993
8 Same as #2
9 Danger Cargo Aircraft Only (DOT Label)
10 Limited Quantity
11 Custody Seal (Optional)
12 Tape to Seal Cooler

FIGURE 1-9 SHIPPING CONTAINER, MEDIUM - LEVEL ENVIRONMENTAL AND HAZARDOUS - LEVEL SAMPLES

1.7 CALIBRATION PROCEDURES AND FREQUENCIES

This subsection reviews calibration procedures and frequencies for the following types of equipment:

- Field equipment (including water level recorders, field water quality and field air quality screening equipment, and geophysical equipment, if used).
- Laboratory equipment (including both inorganic and organic analytical equipment).

1.7.1 Field Equipment

The in-field analytical instruments to be used during the Wharton Facility investigation are listed below:

- HNu Photoionization Analyzer
- Organic Vapor Analyzer (OVA)
- pH Meter

The instruments will be calibrated before and after each field use or as otherwise described below. Instruments will be calibrated each day during field use.

1.7.1.1 HNu Photoionization Analyzer

The HNu photoionization analyzer is designed to measure the concentration of trace gases in many industrial or plant atmospheres. The analyzer employs the principle of photoionization for detection. A sensor, consisting of a sealed ultraviolet light source, emits photons which are energetic enough to ionize many trace species, particularly organics. In general, the instrument will be calibrated by following the listed procedures:

1. Turn instrument switch to the standby position and check the electronic zero. Reset zero potentiometer as necessary.

2. Insert one end of T tube into probe. Insert second end of probe into calibration gas in the 20-200 ppm range. The third end of probe should have the rotometer (bubble meter) attached.

3. Set the function switch in the 0-200 ppm range.

4. Crack the valve on the pressured calibration gas container until a slight flow is indicated on the rotometer. The instrument will draw in the volume required for detection with the rotometer indicating excess flow.

5. Adjust the span potentiometer so that the instrument is reading the exact value of the calibration gas. (Calibration gas value is labeled on the cylinder.)

6. Next, set the function switch to the 0-20 ppm. Remove the mid-range (20-200 ppm) calibration gas cylinder and attach the low-range (0-20 ppm) calibration gas cylinder as described above.

7. The observed reading should be a 3 ppm of the concentration specified for the low-range calibration gas. If this is not the case, recalibrate the mid-range scale repeating procedures 1 to 7 above. If the low-range reading consistently falls outside the recommended tolerance range, the probe light source window likely needs cleaning. When the observed reading is within the required tolerances, the instrument is fully calibrated.

8. Record on the form provided all original and readjusted settings as specified by the form.

The HNu instrument will be calibrated once per day at minimum. Calibration standard gases provided by the manufacturer or authorized vendor will be utilized.

1.7.1.2 Organic Vapor Analyzer (OVA)

The Century portable organic vapor analyzer (OVA) is designed to detect and measure gases and organic vapors in the atmosphere. The instrument utilizes the principle of hydrogen flame ionization for detection. The organic vapor analyzer measures gases and vapors by producing a response to an unknown sample which can be related to a gas of known composition to which the instrument has been previously calibrated. The instrument is normally calibrated to methane gas. To calibrate the instrument, a step-by-step procedure is followed as listed below:

1. Set CALIBRATE switch to 10.

2. Adjust meter reading to zero by rotating the CALIBRATE ADJUST (zero) knob.

3. Attach one end of T assembly to calibration gas cylinder and the other to the probe.

4. Crack open calibration gas cylinder until a slight flow of gas can be detected exiting the open end of the T assembly. (Caution: if the calibration gas is toxic or highly flammable, calibration should occur inside a hood.)

5. Adjust GAS SELECT knob on instrument until the meter reads the same level as that of the calibration gas.

6. Turn off calibration cylinder and remove T assembly.

7. The instrument is now calibrated for the specialty gas/vapor. All responses of the instrument should be recorded relative to the specialty gas.

8. Calibration in the x10 range by adjusting the GAS SELECT knob automatically calibrates the instrument for the x1 and x100 ranges. No further adjustments are necessary.

9. Shut instrument down by closing the SUPPLY VALVE and TANK VALVE and putting the INSTR and PUMP switches in the OFF position.

10. Record the following on the instrument calibration label: calibration date, span gas and concentration, span setting, and initials of person performing calibration.

Calibration will be performed using manufacturer's approved calibration gases on a weekly basis in a well ventilated area. A daily internal calibration check will be made prior to use.

1.7.1.3 Specific Conductance Meter

The YSI Model 33, or equivalent, is a portable battery-operated transistorized instrument used to measure salinity, specific conductance, and temperature in surface water, groundwater, and wastewater systems. The meter is calibrated daily or each time the meter is turned on (if more than once per day) by turning the MODE control to REDLINE and adjusting the REDLINE control so that the indicator lines up with the redline on the meter face. A manufacturer recommended calibration solution commercially prepared from water and KCl will be used to ensure standardized instrument response. At a minimum the KCl standard solution will be used for calibration after every 15 samples.

1.7.1.4 pH Meter

The Fisher Model No. 107 pH Meter, or equivalent, is a portable pH monitoring instrument for determining pH in surface and groundwaters, waste systems, and other water quality applications.

The instrument requires field calibration daily or each time the meter is turned on (if more than once per day). Distilled water and buffer solutions (pH 7 and pH 4) are required for field calibration. These solutions will be obtained from the WESTON Laboratory. All solutions must be at the same temperature to reduce meter stabilization time and to maintain accuracy. The instrument will be calibrated as follows:

1. Rinse the electrode in distilled water.

2. Place the electrode in the pH 7 buffer solution and allow the meter reading to stabilize.

3. Adjust the control using the knob on the front panel of the instrument until the meter reads pH 7.

4. Rinse the electrode in distilled water.

5. Place the electrode in pH 4 (or pH 10) solution and allow the meter readout to stabilize.

6. Adjust the control knob until the meter reads the correct value of the pH 4 (or pH 10) solution.

7. Rinse probe in distilled water.

8. Repeat steps 2 through 7.

9. If the meter reading indicates that the pH is outside the 4 to 7 range then an appropriate pH buffer solutions will be selected that brackets the anticipated reading. A pH 10 buffer solution will be available for calibration in the event that alkaline materials will be measured. Steps 1 through 9 will be repeated until an environmental measurement is made that falls between the selected buffer pHs.

10. Record results in logbook.

1.7.2 Laboratory Equipment

Before any instrument is used as a measuring device, the instrumental response to known reference materials must be determined. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. All sample measurements are made within the calibrated range of the instrument. Preparation of all reference materials used for calibration will be documented in a standard preparation notebook.

Laboratory instrument calibration typically consists of two types: initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Procedures for the calibration of the instruments utilized by the laboratory are detailed in the Laboratory Quality Assurance Plan found in Appendix A.

1.8 ANALYTICAL PROCEDURES

1.8.1 Field Testing and Screening

As part of the analytical protocol, all liquid samples will be tested for pH.

1.8.1.1 pH Measurement

The pH of all liquid samples will be measured using a Fisher Model No. 107 portable water pH meter (or equivalent). Before analyzing a sample, the pH meter will be calibrated and checked against the provided buffer solutions. The probe is then rinsed with distilled water and placed in the sample to be tested. One minute should be allowed for the meter to stabilize and the reading then recorded in the field log book. After the reading is taken, the probe will be rinsed with distilled water and placed in 7.0 buffer solution until its next use.

1.8.2 Laboratory Methods

Laboratory analytical methods proposed for use in this project to analyze soil, sediment, and water samples are listed in Table 1-1. Table 2 through 4 of Appendix B contains, for each analytical method, a list of parameters to be determined and the limits of detection (LODs) for each parameter. The limits of detection listed in Appendix B are based on clean water (with no interference). Reporting for both organic and inorganic analyses parameters will be based on the specified LODs listed in Appendix B.

Elevated levels of target and/or non-target compounds, moisture correction, available sample quantity, sample cleanup techniques, etc. may affect actual reported limits of detection.

For organics, values below the stated LODs will be qualified with a "J" to indicate the presence of a compound that meets the identification criteria but for which the concentration is less than the sample LOD which is, therefore, estimated rather than accurately quantified.

1.9 DATA REDUCTION, VALIDATION, AND REPORTING

1.9.1 Field and Technical Data

The field and technical (non-laboratory) data which will be collected during the Wharton Facility effort can generally be characterized as either "objective" or "subjective" data.

Objective data include all direct measurements of field data such as field screening/analytical parameters, water level measurements, and geophysical data. Subjective data include descriptions and observations such as lithologic descriptions of well cuttings and soil borings.

1.9.1.1 Field and Technical Data Reduction

As described in Subsection 1.6.2.2, all field data will be recorded by field personnel in bound field notebooks and on the appropriate field forms in ring binders. For example, during drilling activities, the field team member supervising a rig will keep a chronologic log of drilling activities, a vertical descriptive log of lithologies encountered, (following the Unified Soil Classification System in Appendix C), other pertinent drilling information (staining, odors, field screening, atmospheric measurements, water levels, geotechnical data), and a labor and materials accounting in his/her bound notebook.

After checking the data in the field notebooks and forms (see Data Validation in Subsection 1.9.1.2 below), the data will be reduced to tabular form, wherever possible, by entering it in data files. Objective data may be set up in spreadsheet type tabular files (e.g., water level data). Subjective data such as soil boring and well logs will be filed as hard copies for later review and for incorporation into technical reports as appropriate.

1.9.1.2 Field and Technical Data Validation

Validation of objective field and technical data will be performed at two different levels. On the first level, data will be validated at the time of collection by following standard procedures and QC checks (e.g., triplicate measurements) specified in Section 2. At the second level, after data reduction into tables, the data will be reviewed for anomalous values. Any inconsistencies or anomalies discovered by this review will be resolved immediately, if possible, by seeking clarification from the field personnel responsible for collecting the data.

Subjective field and technical data will be validated by the review of field reports for reasonableness and completeness. In addition, random checks of sampling and field conditions will be made to check recorded data at that time to confirm the recorded observations. Whenever possible, peer review also will be incorporated into the data validation process, particularly for subjective data, in order to maximize consistency between field personnel. For example, during drilling activities, scheduled periodic reviews of archived lithologic samples will be performed to ensure that the appropriate lithologic descriptions and codes are being consistently applied by all field personnel.

1.9.2 Laboratory Data

All analytical data are recorded into bound laboratory notebooks issued by the Laboratory QA Section. Data are recorded and associated with the unique WESTON laboratory sample identification number which can be matched to the field sample identifier via the chain of custody record.
The Laboratory Analysts sign and date all notebook entries daily. The notebook pages are reviewed periodically by the Section Manager prior to final data assembly. Copies of strip chart outputs (chromatograms, etc.) are maintained on file.

1.9.2.1 Laboratory Data Reduction

All analyses performed by the laboratory must meet the minimum calibration and performance QC criteria defined in the laboratory's standard SOPs. These requirements encompass instrument performance checks, such as GC/MS tuning and mass calibration, target compound calibration to determine instrument response to compounds of interest, interference check compounds, etc; as well as, method performance checks such as lab control samples and preparation blanks. A summary of these instrument and method performance checks is included in subsections 3, 7 and 11 of the Laboratory QA Plan (see Appendix A, pages A12A17, A34-A47, A59). Detailed procedures are included in the respective

analytical SOP. Additionally, project specific sample QC is analyzed, as required. This includes matrix spikes, matrix spikes duplicates, sample duplicates, etc. tailored to meet specific project goals. A summary of the types of QC samples analyzed is given in the Laboratory QA Plan, subsection 9 (see Appendix A, page A53). For data which do not meet specified criteria, appropriate corrective action is initiated, as outlined in subsection 11 of the Laboratory QA Plan (see Appendix A, pages A63-A64).

At the completion of a set of analyses, data reduction is performed by the individual Analysts as described in subsection 8.2 of the Laboratory QA Plan (Appendix A, page A49). The associated quality control data are verified to be within project control limits. If all data are acceptable, the data are submitted to the appropriate Unit Leader or Section Manager for review. This is the procedure for all inorganic analytical data. If QC samples do not meet acceptance criteria corrective action is taken as described in subsection 1.14.2.

Data reduction is performed by the individual Analysts and consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. The complexity of the data reduction will be dependent on the specific analytical method and the number of discrete operations (extractions, dilutions, and concentrations) involved in obtaining a sample that can be measured.

For those methods utilizing a calibration curve, sample response will be applied to the linear regression line to obtain an initial raw result which is then factored into equations to obtain the estimate of the concentration in the original sample. Rounding will not be performed until after the final result is obtained to minimize rounding errors, and results will not normally be expressed in more than two (2) significant figures.

Copies of all raw data and the calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date.

1.9.2.2 Laboratory Data Validation

System reviews are performed at all levels. The individual Analyst constantly reviews the quality of data through calibration checks, quality control sample results, and performance evaluation samples. These reviews are performed prior to submission to the Section Managers or the Analytical Project Manager.

The Section Manager and/or the Analytical Project Manager review data for consistency and reasonableness with other generated data and determine if program requirements have been satisfied. Selected hard copy output of data (chromatograms, spectra, etc.) will be reviewed to ensure that results are interpreted correctly. Unusual or unexpected results will be reviewed, and a resolution will be made as to whether the analysis should be repeated. In addition, the Analytical Project Manager or Section Manager will recalculate selected results to verify the calculation procedure.

The Quality Assurance Section independently conducts a complete review of selected projects to determine if laboratory and client quality assurance/quality control requirements have been met. Discrepancies will be reported to the appropriate Section Manager and/or Analytical Project Manager for resolution.

The final routine review is performed by the Laboratory Manager prior to reporting the results to the client. Non-routine audits are performed by regulatory agencies and client representatives. The level of detail and the areas of concern during these reviews are dependent on the specific program requirements.

1.9.2.3 Laboratory Data Reporting

Laboratory data reporting will be performed using the tabular outputting capabilities of the LIMS system and other standard software formats. The laboratory data reports will include sample analytical results, second column confirmation results, reportable field and laboratory QA/QC sample analytical results (as specified in Subsection 1.10), and sample limits of detection (LODs) assembled in a New Jersey Tier I format.

1.10 INTERNAL QUALITY CONTROL CHECKS

1.10.1 Internal Quality Control Checks - Field

The quality assurance effort for a field investigation program is developed to ensure and validate that inconsistencies in protocols or the field protocols themselves do not introduce error into the data collection process. To achieve this goal, standard operating procedures (SOPs) have been developed, as described in Section 2, and will be followed as consistently as possible by all field personnel given the variability of natural conditions encountered in the field. Any deviation from SOPs necessitated by unanticipated field conditions will be fully documented as they occur. An integral part of SOPs are the quality control checks which are described individually in Section 2 for each type of field method. Specifically,

field quality control checks have been introduced into the sample collection procedures in order to minimize (and identify if it occurs) the potential for interference or introduction of non-environmental contaminants during sample collection, storage, transport, and/or equipment decontamination. These checks are provided through collection of field quality control samples. The following types of quality control samples will be included in the sampling quality assurance program:

- One trip blank with every cooler of VOA samples (water samples only) sent to the laboratory. Definition of Trip Blank: a sample bottle is filled with ASTM Type II Reagent water (demonstrated to be analyte free), acidified with 1:1 HCL to pH <2 prior to transport to the site, is transported to the site, is handled like a sample, and is returned to the laboratory unopened from receipt for analysis (trip blanks are not to be opened in the field, they will remain unopened until analysis).

- The ASTM Type II Reagent water will be demonstrated analyte free. The criteria for analyte free water is as follows:

Purgeable Organics	<10ppb
Semivolatile Organics	<CRDL
Pesticides	<CRDL
PCBs	<CRDL
Inorganics	<CRDL

  The TCL/TAL compound list will be used.

  The assigned values for the Contract Required Detection Limits (CRDLs) are found in the most recent CLP SOWs.
  Documentation to support acceptability of reagent water will be completed prior to sampling and analysis. Copies of the analytical results will be provided to the NJDEP Project Manager as requested. These analysis results will be kept at Weston's Analytics Division office in Lionville, PA. Copies of the analytical results will be included with the data report and thereby provided to EPA's Project Manager as well as the EPA Project Quality Assurance Officer.

- One set of field blanks for every day of aqueous and non-aqueous sampling (all parameters analyzed). Definition of Field Blank: Type II Reagent water (demonstrated analyte free) is poured into the decontaminated sampling device (or pumped through it in the case of

sampling pumps), is transferred to the sample bottle, preserved in the same method as the aqueous investigative samples, and is then transported to the laboratory for analysis along with the samples taken that day. Sampling devices shall include bowls and pans used for homogenization. For VOA field blanks taken from soil sampling equipment, do not use the homogenization pan. Field blanks must be clearly labeled so the laboratory does not inadvertently select them for project QC (i.e., field blanks are exempt from matrix spike/duplicate requirements).

- Ten-fifteen percent field duplicates (all parameters analyzed) for water samples. Definition of Duplicate: two samples collected independently at a sampling locating during a single act of sampling. Field duplicates shall be indistinguishable from other analytical samples so that personnel performing the analyses are not able to determine which samples are duplicates. Duplicate soil/sediment samples will be homogenized by mixing individual grab samples to minimize any bias of the sample representativeness. Soils will not be homogenized before taking duplicate samples for VOA analysis.

1.10.2 Internal Quality Control Checks - Laboratory

The daily quality of analytical data generated in the WESTON laboratories is controlled by the implementation of WESTON's Standard Analytical Laboratory Quality Assurance Plan (Appendix A). As specified in the plan under "Method Performance", types and frequencies of internal quality control checks have been developed for each analysis type. Frequency of these routine QC checks may be superseded by project specific QA plans. In general, internal laboratory QC checks will consist of the following:

- Method Blanks. Method blanks usually consist of laboratory reagent grade water (ASTM Type II water that is demonstrated analyte free) treated in the same manner as the sample (i.e., digested, extracted, distilled, etc.) which is then analyzed and reported as a standard sample would be.

- Method Blank Spike. A method blank spike is a sample of laboratory reagent grade water fortified (spiked) with the analytes of interest which is prepared and analyzed with the associated sample batch. Method blank spikes are not included with VOA analyses since the same function is served by the calibration standard analysis.

- Matrix Spikes. A matrix spike is an aliquot of a field sample which is fortified (spiked) with the analytes of interest and analyzed with an associated sample batch to monitor the effects of the field sample matrix (matrix effects) on the analytical method. Matrix spikes are performed only in association with selected protocols, as specified in Appendix A. For each sample round, at the L.E. Carpenter and Co. Wharton facility, one matrix spike and one matrix spike duplicate will be analyzed for every 20 samples of similar matrix and concentration as summarized in Tables 2-1, 2-2 and 2-3.

- Laboratory Duplicate Samples. Duplicate samples are obtained by splitting a field sample into two separate aliquots and performing two separate analyses on the aliquots. The analysis of laboratory duplicate monitors sample precision; however, it may be affected by sample inhomogeneity, particularly in the case of nonaqueous samples. Laboratory duplicates will be run and reported for specific analyses only, as specified in Appendix A. For each sample round at the L.E. Carpenter's Wharton facility, a laboratory duplicate will be run with every 20 field samples, as summarized in Tables 2-1, 2-2 and 2-3.

In addition to the quality control samples described above, three additional types of independent quality control checks (not associated with field sample batches) are routinely analyzed in the laboratory. These are the following:

- Laboratory Control Standard for Inorganics This is a standard solution with a certified concentration which is analyzed as a sample and is used to monitor analytical accuracy.

- Blind Performance Sample This is a QC sample of known concentration obtained from the U.S. EPA, the National Bureau of Standards (NBS), or a commercial source. The blind performance sample is not recognizable to the analyst as a performance sample and is used to monitor analytical accuracy.

- Known Performance Sample A known performance sample is the same as a blind performance sample, but is identified to the analyst so that he/she may use it to check the accuracy of an analytical procedure. It is particularly applicable when a minor revision or adjustment has been made to an analytical procedure or instrument.

1.11 PERFORMANCE AND SYSTEM AUDITS

Audits may consist of two types - system audits and performance audits. The purpose of the systems audit is to determine whether appropriate corporate, division, and project systems are in place. The performance audit is used to indicate whether those systems are functioning properly.

1.11.1 Project System Audits

WESTON's Corporate Quality Assurance auditors will periodically, on an unannounced basis, call for a corporate project audit (system audit). The Project Manager must respond by submitting the Project Quality Control Plan (in this case, the project QAPP and the auditor will then determine whether the QAPP is inplace. The auditor also will determine whether the reviews called for in the Quality Control Plan have been and are being conducted. On a scheduled basis, certain projects are identified by Corporate Quality Assurance for a more formal audit. These audits evaluate in depth the implementation of the QA Program in the project as they apply to field and data analysis and reduction procedures. The Division Operations Manager, in his role as Division Quality Assurance Officer, may request the Corporate Quality Assurance Department to perform an audit or may conduct the audit himself.

1.11.2 Technical Performance Audits

Technical performance audits will be performed on an ongoing basis during the project as field data are generated, reduced, and analyzed. All numerical analyses, including manual calculations, mapping, and computer modeling, will be documented and will be the subject of performance audits in the form of quality control review, numerical analysis, and peer review. All records of numerical analyses will be legible, reproduction quality, and complete enough to permit logical reconstruction by a qualified individual other than the originator.

1.11.3 Field Performance Audits

Periodic performance audits may be conducted in the field by the appropriate technical QA Officers for the particular discipline of field activities (e.g., geoscientist to audit well drilling activities). The purpose of the field audits will be to ensure that the methods and protocols detailed in this QAPP are being consistently adhered to in the field.

Checklists will be prepared by the auditing QA Officer prior to the audit and used to ensure completeness of the review, and as a means of documenting the results of the audit. Items to be examined may, as appropriate, include the availability and implementation of approved work procedures; calibration and operation of equipment; packaging, storage, and shipping of samples obtained; and documentation procedures.

The records of field operations will be reviewed to verify that field-related activities were performed in accordance with appropriate project procedures. Items reviewed will include, but not be limited to, the calibration records of field equipment, daily field activity logs, chain-of-custody documentation, and field logs.

During an audit and upon its completion, the auditors will discuss the findings with the individuals audited and cite corrective actions to be initiated. Minor administrative findings which can be resolved to the satisfaction of the auditors during an audit are not required to be cited as items requiring corrective action. Findings that are not resolved during the course of the audit and findings affecting the overall quality of the project, regardless of when they are resolved, will be noted on the audit checklist and the results immediately provided to the Project Manager, who will insure that the corrective actions are implemented. The results will be simultaneously provided to the Project Director.

1.11.4 Laboratory System Audits

WESTON participates in several external system audits sponsored by state regulatory agencies and the U.S. EPA. These system audits involve on-site evaluation of the WESTON laboratory systems. An example of the type of audit, auditing agency, and frequency of these audits for the WESTON Analytical Laboratory are summarized in Table 1-3.

The WESTON Laboratory QA Section audits systems at least once annually. The internal audit consists of a review of systems, procedures, and documentation. Any deficiencies/ deviations are documented, and a summary report is prepared.

1.11.5 Laboratory Performance Audits

WESTON participates in several external performance audits sponsored by those agencies listed in Table 1-2. These performance audits are in the form of blind performance samples submitted by the auditing agency.

The Laboratory QA Section has overall responsibility for monitoring the internal Quality Assurance/Quality Control program. The QA Section has a staff to provide in-house audits and to review and validate analytical data packages. The QA Section is also responsible for scheduling and coordinating external systems audits and for reviewing data for performance samples received. The QA Section supplies blind performance samples to the laboratory at least semi-annually.

Table 1-3

Summary of External Performance and Systems Audits, WESTON Analytical Laboratories

Agency	Parameters	Type	Frequency	Purpose
Illinois EPA	WS/WP	Performance	Semiannually*	Water/Wastewater Cert. Requirement
NY Department of Health	WS/WP	Performance	Semiannually	Water/Wastewater Cert. Requirement
NY State Dapartment of Energy Conservation	Inorganic/ Organic HSL	Performance System	Semiannually Annually	Required for State Analytical Contract
NJ Department of Environmental Protection	WS/WP	Performance System	Annually Every 2 Yrs.	Water/Wastewater Cert. Requirement
PA Department of Environmental Resources	WS/WP	Performance System	Annually Every 2 Yrs.*	Water/Waste-Water Cert. Requirement
U.S. EPA	Inorganic/ Organic HSL	Performance System	Quarterly Every 2 Yrs.*	Superfund Related Analytical Work
U.S. Army Corps of Engineers (DERA)	Inorganic/ Organic	Performance System	As contract requires	Water/ Wastewater Superfund Analytical Work
U.S. Navy	Inorganic/ Organic	Performance	As required by U.S. Navy	Laboratory Qualification and Approval for Analytical Work

Last on-site EPA should be Nov. 1989, last PADER on-site was performed in Sept. 1989, and last IEPA on-site was performed in June, 1987.

WS = Waste supply (drinking water)
WP = Water pollution (wastewater)

1.12 PREVENTIVE MAINTENANCE OF EQUIPMENT

1.12.1 Field Equipment

As discussed in Subsection 1.7, the field equipment will be properly calibrated, charged, and in good general working condition prior to the beginning of each working day.

All field instruments will be properly protected against inclement weather conditions during the field investigation. Each instrument is specially designed to maintain its operating integrity during variable temperature ranges that are representative of ranges that will be encountered during cold weather working conditions. At the end of each working day, all field equipment will be taken out of the field and placed in a cool dry room for overnight storage.

All subcontractor equipment (e.g., drill rigs, water trucks, etc.) will arrive at the site each day in proper working condition. All lubrication, hydraulic, and motor oils will be checked by the subcontractors prior to the start of each work day to make certain all fluid reservoirs are full and there are no leaks.

Prior to the start of work each day, the WESTON Field Supervisor will also inspect all equipment for fluid leaks. If a leak is detected, the equipment will be removed from service for repair or replacement.

1.12.2 Laboratory Equipment

The ability to generate valid analytical data requires that all analytical instrumentation be properly maintained. The WESTON Analytical Laboratory maintains full service contracts on all major instruments. These service contracts not only provide routine preventive maintenance, but also emergency repair service. The elements of the maintenance program are discussed in the following subsections.

1.12.2.1 Instrument Maintenance Log Books

Each analytical instrument is assigned an instrument log book. All maintenance activities are recorded in the instrument log. The information entered in the instrument log includes:

- Date of service
- Person performing service
- Type of service performed and reason for service

- Replacement parts installed (if appropriate)
- Miscellaneous information

If service is performed by the manufacturer, a copy of the service record is taped into the page facing the notebook page where the above information is entered.

1.12.2.2 Instrument Calibration and Maintenance

Preventive maintenance and calibration by manufacturers' service representatives are provided on a routine basis. The maintenance procedures and frequencies for major analytical instruments are given in Table 1-4.

WESTON service agreements provide for preventative maintenance,emergency service, and emergency shipping of spare parts. For emergency response, service contracts on the gas chromatographs, GC/MS instruments, and AA/ICP require on-site response within 48-72 hours. (Typically, service representatives are on-site within 24 hours of a service call.) The service contracts also provide for 24-hour delivery of critical spare parts in response to a service request.

Table 1-4

Instrument Maintenance Schedule
WESTON Analytical Laboratories

Instrument	Preventative Maintenance	Service Contract
Gas Chromatograph/Mass Spectrometers	Semi-annually	Yes
Gas Chromatographs	Semi-annually	Yes
GC Detectors (FID,EC,PID,Hall,NPD,FPD)	As needed	Yes
High Performance Liquid Chromatographs	As needed	No
Atomic Absorption Spectrometers (Flame and Furnace)	Semi-annually	Yes
Inductively Coupled Plasma Spectrometers	Semi-annually	Yes
Analytical Balances	Annually	Yes
Ion Chromatographs	Annually	Yes
Spectrophotometers	As needed	No
Cold Vapor Mercury Analyzers	As needed	No
Technician Autoanalyzers	As needed	No
Conductivity Meters	As needed	No
Ovens	As needed	No
pH/Specific Ion Meters	As needed	No

1.12.2.3 Spare Parts

WESTON's laboratory maintains an inventory of routinely required spare parts (including for example sources, vacuum pumps, and filaments for GC/MS torches and burner heads for AA/ICP). The instrument operators along with the appropriate Section Manager have the responsibility to ensure that an acceptable inventory of spare parts is maintained.

1.13 DATA ASSESSMENT PROCEDURES

1.13.1 Field Data

1.13.1.1 Precision

Liquid samples will be tested for temperature and pH. These field parameter and measurements will be taken using precision procedures outlined in Section 2. These procedures are developed specifically for each individual measurement.

For metal and inorganic analyses, the QA objective for precision is a 20% relative percent difference (RPD) between replicate analytes.

To determine if project goals for precision were met, all useable QC analyses of a particular analyte for each sample type, i.e., soils, sediment, and surface water, will be averaged, and the percent relative standard deviation (%RSD) determined. This overall %RSD is compared to the respective goal.

1.13.1.2 Accuracy

To ensure accuracy of measurement of field parameters, the field instruments will be calibrated daily to standards of known concentrations as discussed in Subsection 1.7.

1.13.1.3 Completeness

The Field Supervisor is responsible for ensuring that all equipment is functioning and calibrated properly so that all field measurements made meet the requirements for accuracy and precision. Together, the Field Supervisor and Project Manager will review field data as it is compiled to ensure completeness.

1.13.2 Laboratory Data

The QA objectives for precision, accuracy and completeness were given in Subsection 1.4. This subsection will discuss the routine procedures used for assessment of those criteria.

1.13.2.1 Precision

The precision of analyses of replicate samples is calculated as given in Subsection 1.4.2. The precision requirements for organic analyses are given in Table 1-2. All analytical data are reviewed relative to those criteria.
For metal and inorganic analyses, the QA objective for precision is a 20% relative percent difference (RPD) between replicate analyses.

To determine if project goals for precision were met, all useable QC analyses of a particular analyte for each sample type, i.e., soils, sediment, and surface water, will be averaged, and the percent relative standard deviation (%RSD) determined. This overall %RSD is compared to the respective goal. For example, all useable Toluene - d-8 surrogate results for surfacewater VOA analyses will have a %RSD of $\leq$15% to meet project precision goals.

1.13.2.2 Accuracy

The calculation of analytical accuracy for organic compounds is given in Subsection 1.4.1, and the criteria for assessing accuracy for surrogate recovery are those given in Table 1-5.

For metals and wet chemistry, analytical accuracy is measured from analysis of a laboratory control standard and a sample fortified with the element of interest. The QA objectives for accuracy in metals analysis for these QC samples are:

Sample	Recovery (%)
Laboratory Control Standard	80 - 120*
Fortified Sample	75 - 125

*Exception: Antimony and silver in water are exempted per SOW 788, E-13, item 8 due to documented difficulties in obtaining reliable results.

To determine if project goals for accuracy were met, all useable QC analyses of a particular analyte for each sample type, i.e., soils, groundwater, and surface water, will be averaged to establish an average percent recovery (%R). This overall %R is compared to the respective goal. For example, all useable toluene-d8 surrogate results for surfacewater VOA analyses will have a %R of 88%-100% to meet project accuracy goals.

TABLE 1-5

QA Objectives for Accuracy (%) of
Laboratory Organic Surrogate Analyses

Fraction	Surrogate Compound	Low/Medium Water	Low/Medium Soil/Sediment	Water	Soil
VOA	Toluene-d8	88-100	81-117	15	25
VOA	4-Bromo-fluorobenzene	86-115	74-121	15	25
VOA	1,2-Dichloroe-thane-d4	76-114	70-121	15	25
BNA	Nitrobenzene-d5	35-114	23-120	50	50
BNA	2-Fluorobiphenyl	43-116	30-115	50	50
BNA	p-Terphenyl-d14	33-114	18-137	50	50
BNA	Phenol-d5	10- 94	24-113	50	50
BNA	2-Fluorophenol	21-100	25-121	50	50
BNA	2,4,6-Tribromo-phenol	10-123	19-122	50	50
Pest.	Dibutylchlorendate	24-154*	20-150*	30	50

*These recoveries are advisory only.

1.13.2.3 Completeness

Completeness has been defined in Subsection 1.4.3 as a measure of the amount of analytical data of acceptable quality (i.e., data meeting all accuracy and precision criteria) generated by an analytical method or system. The minimum goal for completeness is 85 percent, and the ability to exceed this goal is greatly dependent on the applicability of the analytical methods to the sample matrices analyzed (especially for organic analyses).

1.14 CORRECTIVE ACTION

1.14.1 Field Corrective Action

The initial responsibility for monitoring the quality of field measurements and observations lies with the field personnel. The Field Supervisor is responsible for verifying that all quality control procedures are followed. This requires that the Field Supervisor assess the correctness of field methods and the ability to meet quality assurance objectives. If a problem occurs which might jeopardize the integrity of the project or cause some specific quality assurance objective not to be met, the Field Supervisor will notify the Task Manager, the Project Manager, and the appropriate technical QA Officer. An appropriate corrective action will then be decided upon and implemented. The Field Supervisor will document the problem, the corrective action, and results. Copies of the documentation form will be provided to the Task Manager, the appropriate technical QA Officer, and the Project Manager. A typical Corrective Action Documentation Form is provided as Figure 1-10.

1.14.2 Laboratory Corrective Action

Laboratory Corrective Action is detailed in Section 13.0 of the Laboratory Quality Assurance Plan attached as Appendix A.

1.15 QUALITY ASSURANCE REPORTS

1.15.1 Field QA Reports

The Task Manager will provide the appropriate technical QA Officer with daily field progress reports and compiled field data sets at weekly or monthly intervals, as appropriate. In addition, the appropriate technical QA Officer will be copied on all corrective action documentation. The appropriate technical QA Officers may

FIGURE 1-10

CORRECTIVE ACTION DOCUMENTATION

AUDIT REPORT # _____

PAGE ___ OF ___

DISTRIBUTION:

- [X] JACK TUSCHALL
- [ ] SUE DURKE
- [ ] JOE LOEPER
- [ ] LEO O'SHEA
- [X] DIANNE THERRY
- [X] MONTHLY REPORT FILE

DATE/ORIGINATOR: _____

PERSON RESPONSIBLE FOR RESPONSE: _____

DESCRIPTION OF PROBLEM and when identified: _____

State cause of problem if known or suspected: _____

SEQUENCE OF CORRECTIVE ACTION: (If no responsible person is identified, bring this form directly to the QA Coordinator)

State date, person, and action planned: _____

CA Initially Approved By: _____ Date: _____

Follow-up dates: _____

Description of follow-up: _____

Final CA Approved By: _____ Date: _____

RFW 21-21-006/C-2/86

perform unannounced field QA audits. On the basis of this information, each of the technical QA Officers will provide contemporaneous QA update memos for this project to the Project Director. The Project Manager will be notified immediately of field QA situations requiring corrective action.

1.15.2 Laboratory QA Reports

The Laboratory Manager is copied on all internal QA reports to ensure proper resources are provided to resolve deficiencies, as well as to keep management apprised of positive QA/QC issues. Additionally, the Laboratory QA Section provides quarterly and annual reports to WESTON management. These reports summarize QA activities for the reporting period including results of performance audits (external and internal), results of system audits (external and internal), summaries of corrective action to remedy out of control situations, and recommendations for revisions of laboratory procedures to improve the analytical systems. Any QA problems associated with analysis conducted for this project 's sampling episodes will be addressed in the respective case narrative accompanying the data. The Project Manager will be notified immediately of laboratory QA situations requiring immediate corrective action affecting data quality.

Corrective actions are documented on a "Corrective Action Documentation" form (Figure 1-10). These are augmented through Discrepancy Reports specific to generic problems (e.g., holding time missed, redigestion requested, etc.), memoranda, and audit specific reports.

SECTION 2

METHODS PROTOCOLS

This section describes specific field and laboratory protocols to be applied to the L.E. Carpenter Wharton Facility investigation.

2.1 SITE-SPECIFIC FIELD PROCEDURES

To complete the sampling activities outlined in Section 3 of the Supplemental Sampling Plan the following specific sampling procedures will be performed:

- Soil Borings and Split Spoon Sampling
- Backhoe pit excavation
- Surface water Sampling

2.1.1 Soil Borings and Sampling Backhoe Pit Excavation

All drilling activities at the site will be performed by a New Jersey-licensed driller and will be accomplished using standard hollow stem, augering methodologies. Soil boring samples will be collected using split spoon samplers in accordance with standard soil sampling methods (ASTM Method D-1586-67/84). Split spoon samples will be collected continuously in the undisturbed soils ahead of the auger. A decontaminated split spoon will be used for each successive interval sampled. The recovered sampler will be opened and will be screened with the HNu PID and described by a qualified WSI geologist. This procedure will be performed for all split spoon samples collected.

Due to the presence of boulders in the shallow soil, split-spoon sampling and hollow stem augering techniques may not succeed. If, in the opinion of WSI's Geoscience staff, the standard soil boring methods are not applicable to the site, soil samples shall be collected by hand augering 6" from the surface exposed by a backhoe excavator. All equipment used in this procedure shall be considered sampling equipment and decontaminated prior to use.

If the groundwater interface is encountered during drilling, then the borehole will be sealed to the surface with a mixture of five pounds of bentonite per 94 pound bag of cement, dry mixed and added to eight gallons of water. If a backhoe is used, excavation will not proceed below the water table.

2.1.2 Surface Water Sampling

Surface water sampling will be conducted contemporaneous to soil sampling. All sampling equipment will be decontaminated as described in Section 2.4. A laboratory cleaned teflon bailer lowered with a teflon-coated stainless steel cable will be used to collect the water samples. Water samples will be carefully transferred from the bailer to the sample bottles to minimize the potential for aeration. All samples designated for volatile organics analysis will be collected first. If a bailer proves to be too long for adequate sampling, a laboratory decontaminated 1 liter bottle will be used to collect the surface water. Water from this bottle will be poured into the sample bottle to be sent to the laboratory for analysis. This sampling bottle will be used for only one location.

2.1.3 SAMPLE ANALYSIS

Samples collected from the L.E. Carpenter, Wharton facility are summarized in table 2-1. Samples will be analyzed for specific analytes as tabulated in table 2-1. Methods used in the analysis are tabulated in table 2-2.

2.2 GENERAL SAMPLING PROCEDURES

2.2.1 Sample Handling Procedures

Soil samples will be removed from the sampling device at each sampling location with decontaminated stainless steel scupulas or trowels. All samples will be placed in laboratory prepared jars with teflon-lined screw caps immediately after collection. In no case will the samples come into contact with the field personnel or foreign objects not decontaminated as described in Section 2.4.

Samples to be analyzed for volatile organic compounds will be placed in the jars, and careful procedures will be used to insure that zero head space remains in the jars. All samples will be stored on-site in coolers packed with ice and will be kept chilled to 4°C until they reach the testing laboratory.

All samples will be identified with a label which will be attached directly to the container. The sample location, sample number, depth, date, time and analysis to be conducted will be entered on the label with waterproof ink.

Table 2-1
Summary of Supplemental Sampling

Sample Identifier	Media	Analytes
P080A	Soil	PCB
P080B	Soil	PCB
P080C	Soil	PCB
P081A	Soil	PCB
P081B	Soil	PCB
P081C	Soil	PCB
P082A	Soil	PCB
P082B	Soil	PCB
P082C	Soil	PCB
P083A	Soil	PCB, VO +10, BN +10
P083B	Soil	PCB, VO +10, BN +10
P083C	Soil	PCB, VO +10, BN +10
P084A	Soil	PCB, VO +10, BN +10
P084B	Soil	PCB, VO +10, BN +10
P084C	Soil	PCB, VO +10, BN +10
P085A	Soil	PCB, VO +10, BN +10
P085B	Soil	PCB, VO +10, BN +10
P085C	Soil	PCB, VO +10, BN +10
P086A	Soil	PCB, VO +10, BN +10
P086B	Soil	PCB, VO +10, BN +10
P086C	Soil	PCB, VO +10, BN +10
P087A	Soil	PCB, VO +10, BN +10
P087B	Soil	PCB, VO +10, BN +10
P087C	Soil	PCB, VO +10, BN +10
P088A	Soil	PCB, VO +10, BN +10
P088B	Soil	PCB, VO +10, BN +10
P088C	Soil	PCB, VO +10, BN +10
P089	Soil	PP metals, VO +10
P090	Soil	PP metals, VO +10
P091	Soil	PP metals, VO +10
S007	Sediment	VO +10, BN +10, PCB
R007	Water	VO +10, BN +10, PCB
S008	Sediment	VO +10
R008	Water	VO +10
S009	Sediment	VO +10, BN +10, PCB
R009	Water	VO +10, BN +10, PCB
S010	Sediment	VO +10, BN +10, TAL metals
R010	Water	VO +10, BN +10, TAL metals

Table 2-2
Summary Method Table

Parameter	Method	Matrix
VO +10	CLP SOW - O	S + W
BN +10	CLP SOW - O	S + W
PCB	CLP SOW - O	S + W
PP metals	CLP SOW - I	S
TAL metals	CLP SOW - I	S + W

S - Soil, Sediment
W - Water

2.3 SAMPLING EQUIPMENT

The following list of equipment will be required to complete the sampling tasks:

HNu Photoionization Detector (with 10.2 eV probe)
Stainless Steel Trowels
Stainless Steel Scupulas
Steel Split Spoon Samplers
Teflon Bailer
Water Level Indicator
Conductivity/Temperature Meter
pH Meter
Decontamination Supplies
Personnel Safety Equipment (listed in Section 5)
Plastic Ground Cover
Sample Bottles and Labels
Coolers
Custody Seals and Chain-of-Custody Forms
Tape Measure
Log Book

2.4 SAMPLING EQUIPMENT DECONTAMINATION

Laboratory cleaned bailers and sample bottles will be provided by the laboratory performing the analysis prior to arrival at the site. This equipment will remain in the original packaging with custody seals in place until use. Information concerning the decontamination methodology, date, time and personnel will be recorded in the field log book.

All other sampling and ancillary drilling equipment which cannot be practically cleaned by the laboratory prior to use in the field will be decontaminated at the site prior to, and between each use. The following decontamination procedure will be used for sampling equipment such as stainless steel trowels, stainless steel scupulas and split spoon samplers.

- Non-phosphate detergent plus tap water wash
- Tap water rinse
- Distilled/deionized water rinse
- 10% nitric acid rinse (metals analysis only)
- Distilled/deionized water rinse

- Acetone (pesticide grade) rinse
- Total air dry
- Distilled/deionized water rinse

Prior to the start of drilling, all ancillary drilling equipment (augers, split spoon samplers) will be steam cleaned at a designated area. In addition, the drill rig or backhoe will be inspected for any fluid leaks. If a leak is detected, the equipment will be removed from service for repair or replacement. All drill rigs and ancillary equipment will be decontaminated prior to leaving the site to eliminate the transfer of contaminants off-site.

A decontamination area, as described in section 2.5.2 will be designated for both sampling equipment and drilling equipment. These areas will be located away from any potential sources of contamination and from any sampling activities.

All decontamination fluids, and drilling spoils will be handled in accordance with NJDEP Guidance Memorandum Disposition of Material Generated During Site Investigations, Appendix VII. Water suspected (visual observations, monitoring equipment indications) to be contaminated, they will be placed in lined, 55-gallon drums, and stored in a secure area. Once analysis is received, results will be reviewed with L.E. Carpenter personnel and a joint decision regarding the ultimate fate of purge water will be made between L.E. Carpenter and WSI. Likewise, drill and excavation spoils which appear to be contaminated, will be placed on plastic, covered, and sampled for disposal characteristics. Analysis will determine waste classification and assist in determining the fate of drill cuttings and excavated material.

2.4.1 Required Containers, Preservation Techniques, Holding Times, and Sample Volumes

All samples submitted for analysis on this project will be collected by WESTON personnel. Sampling containers and preservatives will be provided on request by WESTON Analytical Laboratories. The specific requirements for sample containers, preservatives, and analytical holding times are discussed in the following subsections.

2.4.1.1 Sample Containers

All containers provided by WESTON will be obtained from I-Chem, Hayward, California, the bottle contractor to the U.S. EPA Contract Laboratory Program or equivalent supplier or equivalent supplier. The containers provided are those described in 40 CFR Part 136, No. 209, 26 October 1984, page 28. These con-

tainers are cleaned by I-Chem in accordance with U.S. EPA protocols. The containers purchased from I-Chem are I-Chem Series 300 containers. Each lot of these containers is analyzed in accordance with I-Chem quality control requirements and is shipped by I-Chem with a certification of cleanliness.

All sample containers provided by WESTON will be shipped with chain-of-custody records (see Subsection 1.6). These chain-of- custody records will be completed by the field sampling personnel and returned with the samples. Table 2-3 presents sample container/sample volume requirements for this project.

2.4.1.2 Sample Preservation

Pre-spiked sample containers will be used. The required preservation methods for target analyses are listed in 40 CFR Part 136, No. 209, 26 October 1984. These procedures are presented in Table 2-4.

2.4.1.3 Holding Times

Holding times for CLP analytes will be those given in the EPA -CLP SOW's for organics and inorganics and begin from validated time of sample receipt. Holding times are presented in Table 2-4.

Upon sample receipt at the WESTON laboratory, all sample collection dates are noted by the sample custodian. The required date for completion of analysis (or extraction) is noted on the chain-of-custody record and is keyed to the holding time. All analyses with holding times of 48 hours or less are identified by the sample custodian, and the appropriate Laboratory Section Manager and Analyst are notified that the samples are in-house.

2.4.2 Sampling QA/QC Protocols

Field QA/QC samples will be collected and analyzed as part of all field sampling activities including soil, groundwater, surface water, and sediment sampling. The number of field QA/QC samples to be collected are detailed in Subsection 1.10.1 and summarized on Table 2-5. The sample identifier numbers for QA/QC samples are outlined in Subsection 1.6.2.1. The following protocols will be followed for collection of QA/QC samples.

Trip blanks will be prepared in the laboratory, shipped to the site with the sample

WSI
Weston Services, Inc

TABLE 2-3

L.E. CARPENTER, WHARTON REMEDIAL INVESTIGATION SAMPLE CONTAINER/SAMPLE VOLUME REQUIREMENTS

PARAMETER	MATRIX	BOTTLE TYPE	NO. OF BOTTLES
TCL VOA	WATER	40 ML GLASS VOA VIAL	2
TCL BNA	WATER	1000 AMBER GLASS	4
TCL PEST/PCB	WATER	1000 AMBER GLASS	4
TAL METALS	WATER	1 LITER PLASTIC	1
TCL VOA	SOIL	40 ML GLASS VOA VIAL	2
TCL BNA,TCL PEST/PCB	SOIL	500 ML GLASS JAR	1
TAL METALS,CYANIDE	SOIL	250 ML GLASS JAR	1

NOTE: WATER SAMPLES WHICH REQUIRE MS/MSD MUST BE COLLECTED IN TRIPLICATE VOLUME, SOIL SAMPLES DO NOT REQUIRE ADDTIONAL VOLUME.

a:tbls22f.at

TABLE 2-4

L.E. CARPENTER, WHARTON REMEDIAL INVESTIGATION
SAMPLE PRESERVATION/HOLDING TIMES

PARAMETER	PRESERVATION	HOLDING TIME	MATRIX
TCL VOA	$4^{o}C$ (HCL to pH2)	10 DAYS FROM RECEIPT	WATER
TCL VOA	4°	10 DAYS FROM RECEIPT	SOIL
TCL BNA	$4^{o}C$	5 DAY EXT., 40 DAY ANAL.	WATER
TCL BNA	$4^{o}C$	10 DAY EXT.,40 DAY ANAL.	SOIL
TCL PEST/PCB	$4^{o}C$	5 DAY EXT., 40 DAY ANAL.	WATER
TCL PEST/PCB	$4^{o}C$	10 DAY EXT.,40 DAY ANAL.	SOIL
TAL METALS	$4^{o}C$, HNO_3 pH <2	180 DAYS EX. Hg 26 DAYS	WATER
TAL METALS	$4^{o}C$	180 DAYS EX. Hg 26 DAYS	SOIL

A:tbls22f.at

WSI
Weston Services, inc.

Table 2-5
Summary of Quality Assurance Samples

Matrix	MS/MSD	TRIP	FIELD	DUPLICATE
SOIL	4	3	3	2
WATER	2	1	1	1
SEDIMENT	2	1	1	1

bottles, and handled as a sample. One trip blank will be sent to the laboratory with every cooler containing VOA samples for water.

Field blanks (equipment rinsate blanks) will be collected every day of groundwater and soil sampling and analyzed for the same parameters as the samples (per matrix). These samples will be collected by pouring ASTM Type II reagent water through the sampling device (e.g., bailer) and into the appropriate sampling container.

Field duplicates will be collected for water samples and all soil samples requiring analysis for either VOAs or BNAs. The number of field duplicates will equal 10-15 percent of the total number of samples. A field duplicate will be collected as a separate sample immediately after the collection of the field sample for which it is a duplicate. For duplicate soil samples, the VOA fraction is not homogenized, and the rest of the fractions, including BNAs, Pest/PCBs, and metals, are homogenized. Duplicate groundwater samples will be collected from alternating bailerfuls of groundwater extracted from the same well after pumping.
To allow for adequate sample volume for laboratory QA/QC requirements triplicate volumes of water samples will be taken at the frequency specified in this QA/QC plan for matrix spikes and matrix spike duplicates (and/or sample duplicates).

2.5 SITE MANAGEMENT

The basic components of site management in support of the planned field activities are described in the following subsections.

2.5.1 General Operations and Coordination with L.E. Carpenter

The Wharton Facility Manager is Mr. David Condon. All coordination with parties on-facility will be performed by WESTON through the Facility Manager and the L.E. Carpenter Designated Coordinator, Mr. Cris Anderson. Mr. Anderson is L.E. Carpenter's primary point of contact with the NJDEP. All contacts from outside parties concerning the project will be made either through the Facility Manager or the Designated Coordinator.

The Field Supervisor will be responsible for day-to-day coordination of WESTON field teams and subcontractors as well as day-to-day contact with L.E. Carpenter and Co. Wharton personnel. L.E. Carpenter will be responsible for arranging for personnel and vehicle passes for WESTON and subcontractor personnel, locating utilities, and coordinating issuance of digging permits for all sites designated for subsurface investigations. For each field activity involving more than one person,

a Field Team Leader will be designated by the Field Supervisor in agreement with the Project Manager from among the WESTON personnel present on-facility. The Field Team Leader will be responsible for coordinating the activities of his/her team, including subcontractors, and for notifying the Field Supervisor of progress and/or logistical problems.

2.5.2 On-Site Project Facilities

An office within the Wharton facility or a construction trailer may be used as an on-site project office. An indoor storage space will also be designated for the duration of the field portions of this project. The trailer may be equipped with telephone and electrical utilities and may contain a refrigerator, a copy machine, and a personal computer. It may be used as a central meeting point for planning field activities, daily debriefings, and, in case of contingencies or emergencies, it may serve as a field office for the Field Supervisor and other site personnel. In addition, it may contain dry storage space for staging of field equipment and sampling containers as necessary.

2.5.2.1 Site Access and Security

It is anticipated that all field work will be performed within the boundaries of the L.E. Carpenter Wharton Site. Access to the Wharton facility is limited to L.E. Carpenter and authorized visitors. The site is accessible at any time deemed necessary or appropriate to EPA personnel, NJDEP personnel and NJDEP's representatives.

During actual field operations, access to working areas will be limited to WESTON and subcontractor personnel and visitors authorized by L.E. Carpenter. All visitors will be requested to sign an entry logbook and to keep clear of field activities. If the presence of visitors creates a situation perceived by the WESTON Field Team Leader as dangerous, all work will be terminated until appropriate working conditions can be restored. If necessary, the Field Team Leader will notify the Field Supervisor, who will notify L.E. Carpenter.

2.5.2.2 Site Logistics

All water for field operations (except where ASTM Type II reagent water is specified) will be obtained from facility drinking water sources to be specified by L.E. Carpenter.

Decontamination of sampling equipment will be performed in the centralized

decontamination area. The decontamination area will be located over a paved portion of the L.E. Carpenter facility. All decontamination will be performed within this containment area using water from a treated potable supply except where ASTM Type II reagent water is specified (for sampling equipment only). Decontamination fluids and solids will be collected for possible disposal according to procedures outlined in Section 2.4.

2.5.3 Contingencies

In the event that any unforeseen circumstances arise during the course of the field activities which would endanger anyone on-site, the site will be vacated and both the Field Supervisor and L.E. Carpenter Facility Manager will be notified. Due to the nature of the contaminants found on-site it is not anticipated that fire or explosive conditions will be a problem. In an emergency, all personnel will be evacuated to the nearest point of safety, and if possible, will regroup at the field office.

Wherever appropriate, the provisions of the project Health and Safety Plan will be followed in an emergency.

APPENDIX A

LABORATORY QUALITY ASSURANCE PLAN

LABORATORY QUALITY ASSURANCE PLAN

ROY F. WESTON, INC.
Analytics Division
208 Welsh Pool Road
Lionville, PA 19353

Approval:

Date:

Carter P. Nulton, Ph.D.
Manager
Lionville Laboratory

10-4-88

Dianne Therry
QA Coordinator
Lionville Laboratory

10-4-88

Earl M. Hansen, Ph.D.
Technical Director
Analytics Division

10-4-88

TABLE OF CONTENTS

		Page #
1.0	Introduction	5
2.0	Organizational Chart and Individual Responsibilities	6
2.1	Introduction	6
2.2	Project Director & Project Manager	6
2.3	Technical Director	6
2.4	Laboratory Manager	6
2.5	Section Managers	6
2.6	Chemists-Technicians	7
2.7	Quality Assurance Coordinator	7
2.8	Report Manager	7
3.0	Quality Assurance Objectives	10
3.1	Introduction	10
3.2	Quality Assurance Objectives for Accuracy	10
3.2.1	Metals/Inorganic Analysis	11
3.2.2	Organic Analysis (GC and GC/MS)	11
3.3	Quality Assurance Objectives for Precision	12
3.3.1	Metals and Miscellaneous Inorganic Analyses	12
3.3.2	Organic Analyses (GC, GC/MS	12
3.4	QA Objective for Data Completeness	13
4.0	Sampling Procedures	16
4.1	Introduction	16
4.2	Sampling Plan	16
4.2.1	Safety	17
4.2.2	Sampling Points	18
4.2.3	Volume of Samples	18
4.2.4	Sampling Equipment	18
4.3	Sampling Containers	19
4.4	Sample Preservation & Holding Times	20
4.5	Sampling Procedures	20
4.6	Sample Handling and Packing	21
5.0	Chain of Custody	25
5.1	Introduction	25
5.2	Sample Receipt	25
5.3	Sample Storage	26
5.4	Sample Tracking	27
5.4.1	Organic Analysis	27

5.4.2 Metals Analysis 27
5.4.3 Record Keeping 27
5.4.4 Building Security 28

6.0 Calibration Procedures and Frequency 32

7.0 Analytical Procedures 33

7.1 Gas Chromatography/Mass Spectroscopy (GC/MS) 33
7.1.1 Tuning and GC/MS Mass Calibration 33
7.1.2 GC/MS: Initial Calibration 34
7.1.3 GC/MS: Continuing Calibration 34
7.1.4 GC/MS: Quality Control 34
7.1.5 GC/MS: Detection Limits 35
7.2 Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC) 35
7.2.1 GC & HPLC: Initial Calibration 35
7.2.2 GC & HPLC: Continuing Calibration 35
7.2.3 GC & HPLC: Quality Control 35
7.2.4 GC & HPLC: Detection Limits 35
7.3 Atomic Absorption Spectrophotometry (AA): Flame & Furnace 37
7.3.1 AA: Initial Calibration 37
7.3.2 AA: Continuing Calibration 37
7.3.3 AA: Quality Control 37
7.3.4 AA: Detection Limits 38
7.4 Inductively Coupled Argon Plasma (ICP) 38
7.4.1 ICP: Initial Calibration 38
7.4.2 ICP: Continuing Calibration 39
7.4.3 ICP: Quality Control 39
7.4.4 ICP: Detection Limits 40
7.5 Cold Vapor Mercury Analysis: Flameless AA (CVAA) 40
7.5.1 CVAA: Initial Calibration 40
7.5.2 CVAA: Continuing Calibration 40
7.5.3 CVAA: Quality Control 40
7.5.4 CVAA: Detection Limits 41
7.6 Total Organic Carbon (TOC) 41
7.6.1 TOC: Initial Calibration 41
7.6.2 TOC: Continuing Calibration 42
7.6.3 TOC: Quality Control 42
7.6.4 TOC: Detection Limits 42
7.7 Ion Chromatography (IC) 42
7.7.1 IC: Ion Chromatography 42
7.7.2 IC: Ion Chromatography 43
7.7.3 IC: Ion Chromatography 43
7.7.4 IC: Ion Chromatography 43
7.8 Spectrometry (Colorimetric Methods) 43
7.8.1 Spectrophotometry: Initial Calibration 43
7.8.2 Spectrophotometry: Continuing Calibration 44
7.8.3 Spectrophotometry: Quality Control 44
7.8.4 Spectrophotometry: Detection Limits 44
7.9 Balances 45

7.10 Thermometers 45
8.0 Data Reduction, Validation, and Reporting 47
8.1 Introduction 47
8.2 Data Reduction 47
8.3 Data Review/Validation 47
8.4 Data Reporting 48
8.4.1 Level 1: Standard Commercial Report 49
8.4.2 Level 2: Tier II Report 50
9.0 Internal Quality Control Checks: Laboratory 51
9.1 QC Monitoring 52
10.0 Performance and System Audit 53
10.1 External Audits 53
10.2 Internal Audits 53
11.0 Preventative Maintenance 55
11.1 Introduction 55
11.2 Instrument Maintenance Log Books 55
11.3 Instrument Calibration and Maintenance 55
11.4 Spare Parts 56
12.0 Procedures Used to Assess Data Quality 59
12.1 Introduction 59
12.2 Precision 59
12.3 Accuracy 59
12.4 Completeness 60
13.0 Corrective Action 61
14.0 Quality Assurance Reports to Management 63

LIST OF TABLES

		Page #
3-1	Quality Assurance Objectives for Accuracy for Organic Surrogate Analyses	14
3-2	Quality Assurance for Accuracy & Precision for Organic TCL Analyses	15
4-1	Sampling Points for Most Waste Receptacles	22
4-2	Sampling Equipment	23
4-3	Sampling Equipment for Particular Waste Types	24
7-1	GC/MS Calibration check Compounds (CCC's) and System Performance Check Compounds (SPCC's)	46
10-1	External Performance and Systems Audits WESTON Analytical Laboratories	54
11-1	Calibration Frequency and Mechanism for Major Instruments	57
11-2	Instrument Maintenance Schedule	58

LIST OF FIGURES

		Page #
2-1	WESTON Analytics Division Organizational Chart	8
2-2	Lionville Laboratory Organizational Chart	9
5-1	WESTON Custody Transfer-Work Request Form	29
5-2	WESTON Sample Extraction Form	30
5-3	WESTON Sample Digestion Record	31
13-1	Critical Path for Corrective Action	62

ROY F. WESTON, INC.
LABORATORY QUALITY ASSURANCE PLAN

1.0 Introduction

This document describes the Quality Assurance (QA) procedures employed by WESTON Analytics, a Division of Roy F. Weston, Inc., to ensure that all data generated in the laboratory conform to specific requirements for accuracy, precision, and completeness. These procedures are routinely incorporated into all analyses performed by the WESTON laboratory for the purpose of producing reliable data.

Customized, client-specific quality control measures can be added to or can supersede these basic guidelines to satisfy the needs of individual programs. Laboratory personnel are available to discuss the design, advantages, and disadvantages of other quality control options, and to aid the data user in developing a project specific Quality Assurance Project Plan (QAPP). At a minimum, the information provided for these project specific plans will include:

- background and overall project objectives,
- intended use of the acquired data,
- list of measurement parameters,
- number of samples to be taken,
- kinds of samples to be taken (e.g. soil, surface water, groundwater, biological, sludge, drums, etc.), and
- dates anticipated for project start and completion.

2.0 Organization Chart and Individual Responsibilities

2.1 Introduction

The organization of WESTON Analytics is shown in Figures 2-1 and 2-2. The specific duties and responsibilities of the Laboratory Manager, Quality Assurance Coordinator, Section Managers, Project Manager, Project Director, and Technical Director are described in detail in the relevant standard operating procedures (SOPs). These duties and responsibilities are summarized in the following sections.

2.2 Project Director and Project Manager

WESTON recognizes the importance of efficient project management. WESTON has established a Project Director (PD), Project Manager (PM) group which is responsible for managing all analytical projects. The PD is responsible for the overall direction of the project. The project managers are responsible for maintaining the laboratory schedule, ensuring that technical requirements are understood by the laboratory, and ensuring that project deliverables are submitted on-time and in the required format.

2.3 Technical Director

The WESTON Analytics Division Technical Director serves as technical liaison and assists in resolving any technical issues. He will coordinate these activities with the Project Manager and Quality Assurance Coordinator.

2.4 Laboratory Manager

The Laboratory Manager has the responsibility to see that all tasks performed in the laboratory are conducted according to the requirements of this Quality Assurance Plan (QAP).

2.5 Section Managers

The Section Managers are responsible for implementation of established polices and procedures. The responsibilities of the Section Managers are summarized below:

1. Provide technical direction to analysts in conformance with project requirements.

2. Monitor laboratory work schedules to ensure compliance with project commitments.

3. Review all analytical data prior to reporting to ensure conformance with this QAP.

4. With the Laboratory Manager and Quality Assurance Coordinator, identify and resolve technical problems consistent with the requirements of this QAP.

5. Ensure that assigned personnel are adequately trained to perform required analyses.

2.6 Chemists-Technicians

An effective laboratory quality assurance program depends on the performance of all laboratory staff who perform analyses. The responsibility of laboratory chemists and technicians include:

1. Initial review of QC data for acceptability.

2. Recording of data in bound laboratory notebooks (including any observations made during the analyses).

3. Informing direct supervisors of any problems with instruments or methods to ensure that prompt and effective corrective action is taken.

2.7 Quality Assurance Coordinator

The Laboratory Quality Assurance Coordinator has oversight responsibility for implementation of the quality assurance objectives. These responsibilities include:

1. Ensure that QA objectives of this QAP are met.

2. Submit performance samples for analysis appropriate to laboratory analytical requirements at least annually.

3. Provide an internal audit of representative analytical data reports.

4. Perform an internal laboratory systems audit at least once semi-annually.

5. Provide quality assurance reports to WESTON management.

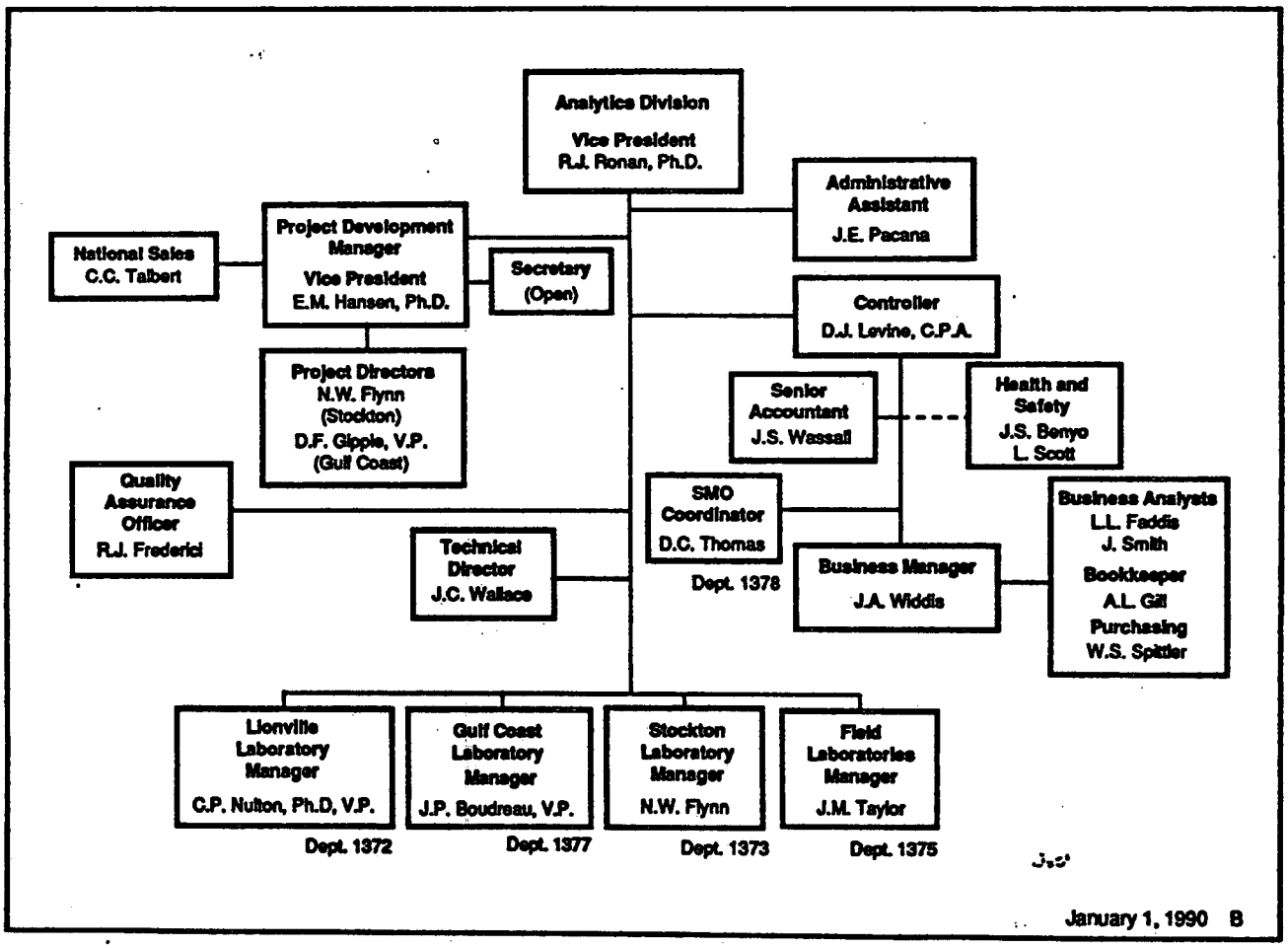
6. Coordinate on-site QA laboratory audits and ensure that any questions regarding QA requirements are resolved.

2.8 Report Manager

The Laboratory Report Manager is responsible for monitoring the status of all samples in the laboratory and ensuring that data are reported in a timely manner and in the proper format.

FIGURE 2-1

WESTON ANALYTICS DIVISION ORGANIZATIONAL CHART

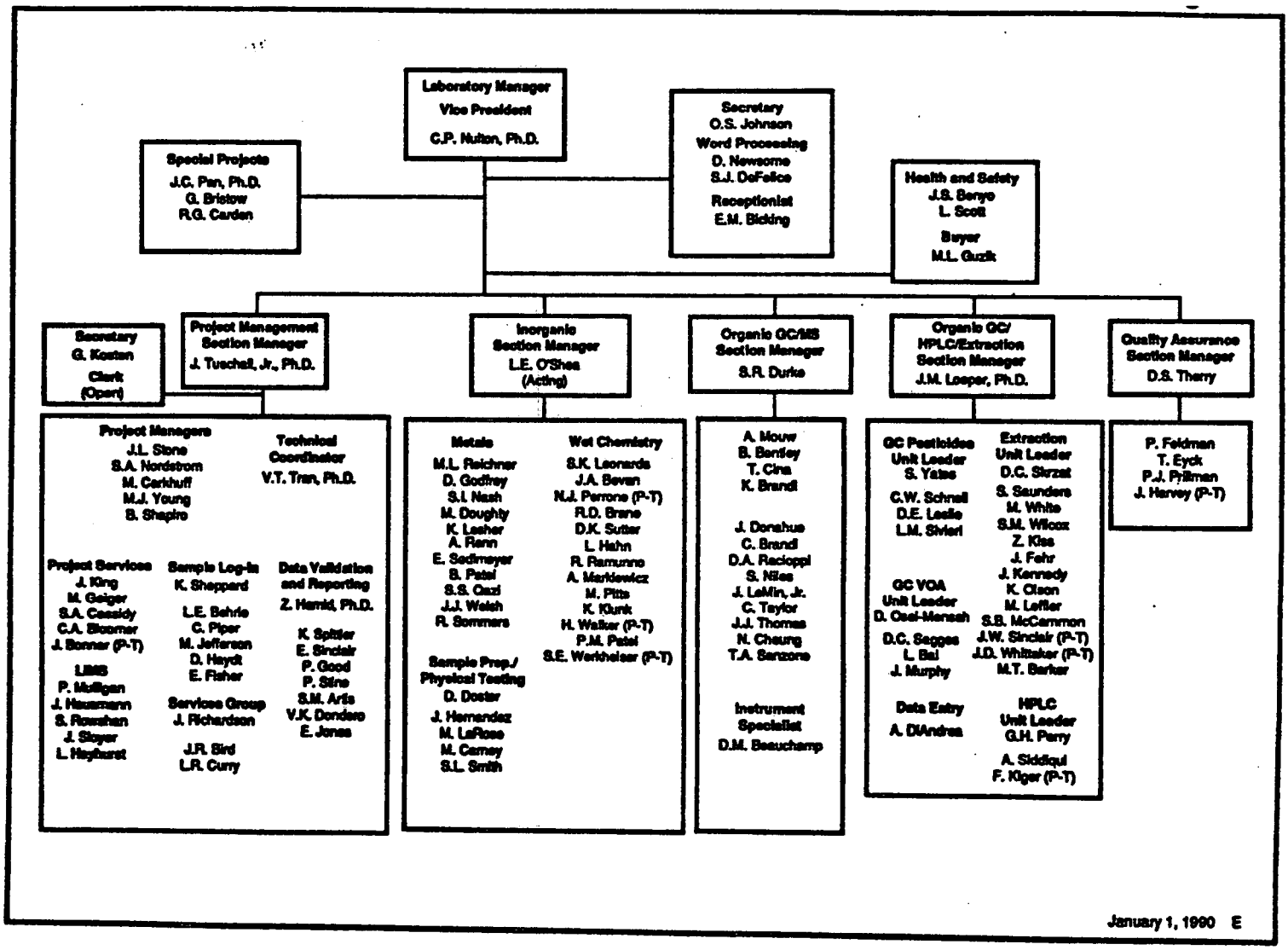


ANALYTICS DIVISION - DEPT. 1371

59

FIGURE 2-2

LIONVILLE LABORATORY ORGANIZATIONAL CHART



LIONVILLE LAB - DEPT. 1372

3.0 Quality Assurance Objectives

3.1 Introduction

The objective of this Quality Assurance Plan is to provide a framework to ensure that all analytical data which are reported are of known quality. The minimum requirements of an effective Quality Assurance program include:

- Sample Management: sampling, sample preservation, chain-of-custody
- Analytical Methodology: documented analytical procedures, calibration, data handling
- Laboratory Records: measurement data, maintenance records, equipment manuals
- Quality Control/Quality Assessment: control charts, quality control samples
- Data Review, Validation and Reporting
- Performance and System Audits/Corrective Action
- QA Reports to Management
- Personnel Training

All measurements made in this program will be representative of the matrix and conditions being measured. The data will be calculated and reported in units consistent with standard reporting conventions to enable comparability to existing data, standards, and/or regulatory action limits.

The specific procedures utilized by WESTON for these systems will be described in subsequent sections of this QAP. All of these systems help to establish the QA objectives, which are measured in terms of accuracy, precision, and completeness.

3.2 Quality Assurance Objectives for Accuracy

Analytical accuracy is expressed as the percent recovery of an analyte which has been used to fortify an investigative sample or a standard matrix (e.g., blank soil, analyte-free water, etc.) at a known concentration prior to analysis, and is expressed by the following formula:

$$\text{Accuracy} = \%\ \text{Recovery} = \frac{A_T - A_O}{A_F} \times 100\%$$

where:

A_T = Total amount found in fortified sample

A_O = Amount found in unfortified sample
A_F = Amount added to sample

The fortified concentration will be specified by laboratory quality control requirements, or may be determined relative to background concentrations observed in the unfortified sample. In the latter case, the fortified concentration should be enough different (2 to 5 times higher) from the background concentration to permit a reliable recovery calculation.

The quality assurance objectives for organic and inorganic analyses are tailored to the analytical technique used, and are discussed separately in subsequent sections of this QAP.

3.2.1 Metals/Inorganics Analysis

For metals analysis, analytical accuracy is obtained from the analyte recovery measured in a laboratory control standard and/or a sample fortified with the element of interest. The QA objectives for accuracy in routine metals analysis for these QC samples are summarized below:

Sample	Recovery (%)
Laboratory Control Standard (LCS)	80-120*
Fortified Field Sample	75-125

Recovery values outside the QC limits for an LCS (* with the exception of antimony and silver) will trigger corrective action. Recovery values for fortified field samples are advisory only.

For non-routine metals and inorganic parameters, laboratory control charts have been established and will be used to define Quality Assurance objectives.

3.2.2 Organic Analysis (GC and GC/MS)

For organic analysis, analytical accuracy is obtained from the surrogate recovery measured in each sample and blank and/or from the analysis of samples or blanks which have been fortified with a select number of target analytes.

The Quality Assurance objectives for accuracy are summarized in Table 3-1 for GC/MS surrogates and in Table 3-2 for GC/MS target analytes from fortified samples. The recovery values for surrogates and target analytes in investigative sample analyses are advisory for routine laboratory analysis. Only recovery values for standard matrix samples (e.g., blanks) are used for triggering corrective action, except for work performed under U.S. EPA CLP contract conditions, at which time CLP requirements are followed.

3.3 Quality Assurance Objectives for Precision

Analytical precision is calculated by expressing as a percentage the difference between results of analysis of duplicate samples relative to the average of those results for a given analyte. Precision can be expressed by the formula:

$$\% \text{ RPD} = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100\%$$

where:

RPD = Relative Percent Difference
C_1 = Concentration of analyte in sample
C_2 = Concentration of analyte in replicate

On the occasion when three or more replicate analyses are performed, precision is calculated by expressing as a percentage, the standard deviation of the analytical results of the replicate determinations relative to the average of those results for a given analyte. This precision measurement, percent relative deviation (% RSD), will have QA objectives identical to those for % RPD, and can be expressed by the formula:

$$\% \text{ RSD} = \frac{\sqrt{\Sigma c^2 - (\Sigma c)^2/n(n-1)}}{(C1 + C2 + \ldots Cn)/n} \times 100\%$$

where:

RSD = percent relative deviation
C = concentration of analyte in the sample, and ($C_1 + C_2 + \ldots C_n$) represents the sum of the concentration of each replicate
n = number of replicate analyses
Σ = "the summation of"

The QA objectives for metals (and other inorganic parameters) analysis are different from those for organic analyses. These QA objectives are discussed separately in the sections below.

3.3.1 Metals and Miscellaneous Inorganic Analyses

For metals (except antimony and silver) and inorganic analyses the QA objective for precision is ± 20% relative percent difference (% RPD) between replicate analyses. % RPD values outside the QC limits for duplicate LCS analyses will trigger corrective action. % RPD for duplicate investigative sample analyses are advisory only.

3.3.2 Organic Analyses (GC, GC/MS)

For organic analyses, precision is measured by comparison of the recovery of surrogate compounds in the standard matrix (e.g., blank, blank spike) and/or by comparison of the recovery of a

select number of target analytes in duplicate fortified samples or duplicate fortified blanks (e.g., matrix spike/matrix spike duplicate: MS/MSD, and/or blank spike/blank spike duplicate: BS/BSD). The QA objectives for precision as expressed by the % RPD for duplicate analysis of target analytes are given in Table 3-2. For surrogate compounds, laboratory control charts have been established and will be used to define QA objectives. These RPD limits are advisory only for investigative samples. Only evaluation of precision for standard matrices will trigger corrective action.

3.4 QA Objective for Data Completeness

Completeness is a measure of the relative number of analytical data points which meet all the acceptance criteria for accuracy, precision, and any other criteria required by the specific analytical methods used. The level of completeness can also be affected by loss or breakage of samples during transport, as well as external problems which prohibit collection of the sample.

The WESTON QA objective for completeness is to have 80% of the data usable without qualification. The ability to meet or exceed this completeness objective is dependent on the nature of samples submitted for analysis. For example, if the analytical methods proposed for use (particularly for organics analyses) are intended for analysis of environmental samples of low and medium hazard, the applicability of these methods to non-routine matrices such as drum samples, wipes, air samples, etc. may result in poor method performance and therefore adversely impact achievement of the data completeness goal.

TABLE 3-1

**QUALITY ASSURANCE OBJECTIVES FOR ACCURACY
FOR
ORGANIC SURROGATE ANALYSES**

Fraction	Surrogate Compound	Percent Recovery	
		Low/Medium Water	Low/Medium Soil/Sediment
VOA	Toluene-d8	88-100	81-117
VOA	4-Bromofluorobenzene	86-115	74-121
VOA	1,2-Dichloroethane-d4	76-114	70-121
BNA	Nitrobenzene-d5	35-114	23-120
BNA	2-Fluorobiphenyl	43-116	30-115
BNA	p-Terphenyl-d14	33-114	18-137
BNA	Phenol-d5	10- 94	24-113
BNA	2-Fluorophenol	21-100	25-121
BNA	2,4,6-Tribromophenol	10-123	19-122
PEST	Dibutylchlorendate	24-154*	20-150*

* These recoveries are advisory only. No corrective action (i.e., sample reanalysis) will be taken if these criteria are not met.

TABLE 3-2

QA OBJECTIVES FOR ACCURACY AND PRECISION FOR ORGANIC TARGET COMPOUND ANALYSES

Fraction	Matrix Spike Compound	% Recovery Limits		% RPD Limits	
		Water	Soil/Sed	Water	Soil/Sed
VOA	1,1-Dichloroethene	61-145	59-172	14	22
VOA	Trichloroethene	71-120	62-137	14	24
VOA	Chlorobenzene	75-130	60-133	13	21
VOA	Toluene	76-125	59-139	13	21
VOA	Benzene	76-127	66-142	11	21
BN	1,2,4-Trichloro-benzene	39- 98	38-107	28	23
BN	Acenaphthene	46-118	31-137	31	19
BN	2,4-Dinitrotoluene	24- 96	28- 89	38	47
BN	Pyrene	26-127	35-142	31	36
BN	N-nitroso-di-N-propylamine	41-116	41-126	38	38
BN	1,4-Dichlorobenzene	36- 97	28-104	28	27
ACID	Pentachlorophenol	9-103	17-109	50	47
ACID	Phenol	12- 89	26- 90	42	35
ACID	2-Chlorophenol	27-123	25-102	40	50
ACID	4-Chloro-3-methyl-phenol	23- 97	26-103	42	33
ACID	4-Nitrophenol	10- 80	11-114	50	50
PEST	Lindane	56-123	46-127	15	50
PEST	Heptachlor	40-131	35-130	20	31
PEST	Aldrin	40-120	34-132	22	43
PEST	Dieldrin	56-126	31-134	18	38
PEST	Endrin	56-121	42-139	21	45
PEST	4,4-DDT	38-127	23-134	27	50
PCB	Arochlor 1254	Not Established		30	50

% RPD = Relative Percent Difference

This list includes those compounds most commonly used for QA/QC accuracy and precision control in the groups of analytes shown based on current U.S. EPA Contract Laboratory Program (CLP) requirements. (USEPA SOW 10/86 as revised through 8/87). Stated control limits will be updated to the current CLP protocol, as required.

4.0 Sampling Procedures

4.1 Introduction

While samples submitted to the laboratory for analysis are generally collected by non-laboratory personnel, WESTON fully recognizes the importance of the sample collection program in the overall assessment of data quality and usability. Sampling procedures must ensure the integrity of the samples collected, provide representative samples of the media being evaluated, and be compatible with planned laboratory analysis.

4.2 Sampling Plan

The objective of sampling is to obtain information that provides a qualitative and quantitative measure of site conditions, so that appropriate action can be taken relative to project goals. These goals encompass areas such as:

- preliminary site investigation,
- emergency cleanup operations,
- remedial response operations,
- backup for litigation purposes,
- monitoring, and
- research or technology transfer.

It is important, therefore, that the sampling effort be preceded by a well-planned, custom-tailored sampling plan for each project. This will help ensure that goals are met, that sampling is completed in a timely, cost effective manner, safety of sampling personnel is maximized, samples are representative of the site, sampling errors are reduced, and integrity of the sample is preserved during and after sampling.

The sampling plan should address: (1) the definition of objectives, (2) selection of representative sampling sites, (3) collection of sufficient volumes of material, (4) selection and preparation of proper sample containers, (5) preservation of sample integrity, (6) identification of samples, (7) proper sample holding times, (8) safe handling and transportation procedures, and (9) standard chain-of-custody procedures.

The following steps are essential in preparation of the sampling plan:

1. Research background information on the site and samples: evaluate the site history, review any data available from prior sampling excursions, review available geotechnical data, consider the materials to be sampled (composition, form, expected concentrations, etc.), determine what analyses will best address the issues at the site.

2. Determine safety requirements and arrange for equipment and procedural needs for safe sampling.

3. Consider proper locations for sampling.

4. Determine the sample volume required for each location, with special considerations given to the type of sample container and preservative needed for each analyte. Analytes with the same container/preservative requirement may be able to be combined into one larger container (i.e., 1 L rather than three 250 mL bottles). Allow sufficient volume for field and laboratory QC samples.

5. Determine the sampling equipment needed and arrange to have the necessary facilities and supplies for proper decontamination between samples.

6. Review procedures for sample collection and plan training or refresher courses for samplers.

7. Review procedures for containing and handling samples.

8. Properly execute chain-of-custody procedures, beginning with bottle preparation.

9. Identify necessary packaging, labeling, and shipping requirements, including the following:

   a. Identify samples and protect from tampering (secure evidence tape if available).

   b. Record all sample information in a bound field notebook.

   c. Fill out the chain-of-custody sample analysis request form.

10. Deliver or ship the samples to the laboratory for analysis.

11. Consider analyte holding times when determining shipping frequency. Many laboratory contractual agreements measure holding times from the date of receipt at the laboratory, while regulatory holding times are measured from the date of sample collection.

4.2.1 <u>Safety</u>

The sampling plan will delineate the safety procedures for sample collection, such as respiratory protection required while sampling concentrated sources, procedures for entering buildings

or enclosed structures, length of time personnel are to remain in protective clothing while sampling, and identification of the person handling the field samples. Proper procedures must be used when opening drums, tanks, or other vessels, and all personnel must be notified of potential hazards when closed containers will be opened.

The sampling plan will also list telephone numbers, addresses, and directions to the nearest medical facility, ambulance service, fire department, police department, and the client contact. The fire department should be alerted to possible incidents during a very hazardous inspection.

4.2.2 Sampling Points

A representative sample is crucial to decision-making and to enforcement proceedings and is dependent on proper selection of sampling points. Special consideration will be required for hazardous wastes, which are usually multi-phase mixtures and are stored in receptacles of different sizes and shapes. No single series of sampling points can be specified for all types of waste receptacles. Table 4-1 lists most types of receptacles used for hazardous waste and the corresponding recommended sampling points.

In some cases, it may be appropriate to conduct a preliminary survey of the facility prior to sampling. This would consist of a brief site visit and survey, during which time safety requirements for the site would be ascertained and a sampling plan established by the inspector.

4.2.3 Volume of Samples

Sufficient volume of a sample, representative of the main body of the water or waste, must be collected. This sample must be adequate in size for all needs, including laboratory analysis, splitting with other organizations involved, etc. In all cases, the laboratory should be consulted for guidance prior to sampling. As general guidance, the sample containers provided by the laboratory should be filled. This will provide adequate volumes to perform analysis once. Choose at least one sample per twenty (20) for each matrix and collect triple volumes for all analytes to allow sufficient sample for laboratory duplicate and spike analysis.

4.2.4 Sampling Equipment

Receptacles (i.e., drums, tanks, etc.), should only be sampled when necessary to meet enforcement or cleanup requirements. Opening of drums or other sealed receptacles may be hazardous to sampling personnel unless proper safety procedures are followed.

Samples of waste materials, water, soil, or sediments will be collected through the use of peristaltic, mechanical or automatic pumps, soil augers, sediment dredges, hand scoops, and other equipment (see Table 4-2) as required. All samples should be collected in a manner that assures no contamination between samples. When possible, dedicated equipment should be used for each site to avoid the need for field cleaning of utensils.

Samples from drums, bags, reservoirs, or other small vessels are generally obtained by a dip or insertion tube (coliwasa sampler). After agitation of the vessel or container, if possible, the tube is inserted diagonally, sealed, and removed. Thus, the sample obtained is a cross-sectional representative sample, avoiding bias due to stratification of material in the container. Sometimes it is difficult to obtain a representative sample of large containers, such as bulk liquid storage tanks. In these cases, often the only sampling location is a bottom valve, and the sample obtained is from the bottom layer within the tank. Many times this may be a "worst case" sample, especially for PCB's and other dense substances. Whenever possible, surface, middle, and bottom samples are collected from large bulk liquid storage tanks in order to avoid possible stratification bias. Using this tiered sampling technique helps to accurately characterize the overall concentration of the parameter of interest. A general list of usage of sampling equipment is given in Table 4-3.

Sampling personnel frequently are required to split samples collected with facility personnel or EPA laboratories. It is essential that a true duplicate split be made, otherwise analytical results will not be comparable.

To obtain a true duplicate, a large quantity of sampled material will be collected, thoroughly mixed, and equally proportioned into similar containers. If preservation is necessary, both are preserved with an appropriate chemical from a common dispenser at the same time. Both duplicates are labeled with the same sample location description and marked as splits and logged into a field notebook.

4.3 Sample Containers

Upon request from the client, WESTON will provide, within 7 days, the required number and type of-sample containers for a specific sampling episode.

All containers provided by WESTON will be obtained from I-Chem, Hayward, California, or be of equivalent quality. I-Chem is the bottle contractor to the U.S. EPA-Contract Laboratory Program. These containers are cleaned by I-Chem in accordance with U. S. EPA protocols. The containers purchased from I-Chem are I-Chem Series 200 containers. Each lot of these containers is analyzed

in accordance with I-Chem quality control requirements and is not shipped by I-Chem unless the QC requirements are met.

All sample containers provided by WESTON will be shipped with chain-of-custody sheets (see Section 5). These chain-of-custody sheets will be completed by the field sampling personnel and returned with the samples.

4.4 Sample Preservation and Holding Times

The preservatives required for all analyses will be provided by WESTON with the sample containers. The required preservation methods will be in accordance with those given in 40 CFR, Part 136, No. 209, October 26, 1984, for water and in SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1986, for soils.

The holding times for all required analyses are measured from sample collection, and are given in SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1986. (This reference includes 40 CFR, Part 136, No. 209, October 1984 holding times for routine water samples, as well as holding times for waste samples.)

Some programs, e.g. the U.S. EPA Contract Laboratory Program (CLP) and CLP-type agency or client programs, measure holding times from verified time of sample receipt (VTSR) at the laboratory. Samples designated as CLP must specify in the project plan that holding times from sample collection are superseded by holding times from VTSR.

Upon sample receipt at the WESTON Laboratory all sample collection dates are noted by the sample custodian. The required date for completion of analysis (or extraction) is noted on the chain-of-custody sheet (see Section 5) and is keyed to the holding time if it falls sooner than the required reporting date for analyses.

All analyses which have holding times of 48 hours or less are identified by the sample custodian, and the appropriate section manager, unit leader and analyst are notified that samples are in house.

4.5 Sampling Procedures

Sampling procedures will vary depending on the medium sampled (liquid, solid, or gas) and the type of structure the waste is contained in, as indicated in Table 4-1. Sampling procedures to be used will be standardized as described in the "NPDES Compliance Sampling Manual, " U.S. EPA, Office of Water Enforcement (October, 1979), "Samplers and Sampling Procedures for Hazardous Waste Streams," U.S. EPA, Municipal Environmental

Research Laboratory (January, 1980), and SW-846 Test Methods for Evaluating Solid Waste, Third Edition (November 1986). Sample collection of project sites in the state of New Jersey will conform to the New Jersey Department of Environmental Protection Field Sampling Procedures Manual, February 1988.

4.6 Sample Handling and Packing

Sample handling and packing procedures are in accordance with the User's Guide to the U.S. EPA Contract Laboratory Program. The collected sample and its container represent one of the major avenues of personnel and environmental exposure. Precautions will be taken to ensure that all the samples removed from the site are within the sample container and that no residue remains on the outside of the container.

A unique code number is assigned to each sample. All sample bottles will be differentiated by use of a sample label. All information pertinent to the field activities will be recorded in bound field notebooks. The notebooks must contain the following information:

- source of sample (including plant name, location, and sample point description),
- analysis required and preservative type (where applicable),
- name of collector, date and time of collection, physical/environmental conditions during field activity,
- matrix sampled, sample collection method, number and volume of samples taken,
- sample identification number(s), custody seal numbers,
- any field measurements, and
- documentation of shipping dates and methods.

Samples will be packed and shipped following U.S. EPA recommended procedures and in accordance with applicable DOT regulations. Chain-of-custody is initiated in the field and will travel with the samples. Custody seals will be affixed to the shipping container. A detailed discussion of chain-of-custody procedures is found in Section 5.

Table 4-1

SAMPLING POINTS FOR MOST WASTE RECEPTACLES

Receptacles	Sampling Point
Drum, bung on one end	Withdraw sample through the bung opening.
Drum, bung on side	Sample drums only if they are laying on side with bung up. Withdraw sample through the bung opening.
Barrel, fiberdrum, buckets, sacks, bags	Withdraw samples through the top of barrels, fiberdrum, buckets, and similar receptacles. Withdraw samples through fill openings of bags and sacks. Withdraw samples through the center of the receptacles and to different points diagonally opposite the point of entry.
Vacuum truck and similar containers	Withdraw sample through open hatch. Sample all other hatches.
Pond, pit, lagoons	Divide surface area into an imaginary grid.* Take three samples, if possible; one sample near the surface, one sample at mid-depth or at center, and one sample at the bottom. Repeat the sampling at each grid section over the entire pond or site.
Waste pile	Withdraw samples through at least three different points near the top of pile to points diagonally opposite the point of entry.
Storage tank	Sample from the top through the sampling hole.
Soil	Divide the surface area into an imaginary grid.* Sample each grid section.

* The number of grid sections is determined by the desired number of samples to be collected which, when combined, should give a representative sample of the wastes.

Table 4-2

SAMPLING EQUIPMENT

Sampling plan
Sample containers (plastic and glass), caps, liners
Shovels
Soil Samplers (auger, scoop, steel spoon, etc.)
Stainless steel buckets
Remote barrel opener equipment, non-sparking bung wrench
Thermometer
Drager tubes
Tenax columns and power packs
Ambient air monitor
Surveyor's ribbon
Glass pipets and glass tubing
Wooden paddles (tongue depressors)
Monitoring well sampling equipment
Well sounder
Radiation detector (beta, gamma)
Explosimeter
pH paper
pH meter, spare probes

Table 4-3

SAMPLING EQUIPMENT FOR PARTICULAR WASTE TYPES

Type of Waste	Sampling Point: Drum	Sacks and Bags	Open Bed Truck	Closed Bed Truck	Storage Tanks or Bins	Waste Piles	Ponds, Lagoons & Pits	Con-veyor Belt	Pipe
Free Flowing Liquids and Slurries	Coli-wasa	N/A	N/A	Coli-wasa	Weighted Bottle	N/A	Dipper	N/A	Dipper
Sludge	Scoop	N/A	Scoop	Scoop	Scoop	N/A		N/A	N/A
Moist Powders or Granules	Scoop	Scoop	Scoop	Scoop	Scoop	Scoop	Scoop	Shovel	
Dry Powders or Granules	Thief	Thief	Thief	Thief	Thief	Thief	Thief	Shovel	
Sand or Packed Powders	Auger	Auger	Auger	Auger				N/A	
Large Grained Solids	Large Scoop	Large Scoop	Large Scoop	Large Scoop	Large Scoop	Large Scoop	Large Scoop	Large Scoop	

5.0 Chain-of-Custody

5.1 Introduction

The purpose of chain-of-custody procedures is to document the history of sample containers and samples (and sample extracts or digestates) from the time of preparation of sample containers, through sample collection, shipment and analysis. An item is considered to be in one's custody if:

1. it is in the physical possession of the responsible party,
2. it is in the view of the responsible party,
3. it is secured by the responsible party to prevent tampering, or
4. it is secured by the responsible party in a restricted area.

As discussed in Section 4, when sample containers are provided by WESTON, chain-of-custody documentation (see Figure 5-1) will be shipped with the sample containers. These forms will be completed by field personnel, with acknowledgment of time and date of transfer and placed in the shipping container in the plastic Ziploc container provided.

The following sections describe chain-of-custody procedures associated with sample receipt, storage, preparation, and analysis and general security procedures.

5.2 Sample Receipt

A designated sample custodian is responsible for samples received at WESTON. This individual is trained in all custody requirements and in the potential hazards of dealing with hazardous waste materials. In addition to receiving samples, the sample custodian is also responsible for documentation of sample receipt, storage before and after sample analysis, and eventual proper disposal of samples.

1. Upon receipt, the sample custodian will inspect the sample container for integrity. The presence of leaking or broken containers will be noted on the chain-of-custody form (see Figure 5-1). The sample custodian will sign (with date and time of receipt) the chain-of-custody form, thus assuming custody of the samples. If chain-of-custody forms are not included, the sample custodian will initiate these forms.

storage of volatiles samples separate from semivolatiles and inorganics samples. Within the refrigerators, samples are stored by RFW batch # for easy retrieval. Analysts request samples for analysis from the sample custodian. Both sign the chain-of-custody acknowledging transfer of custody to the analyst.

5.4 Sample Tracking

The standard operating procedures for sample tracking are described in detail in WESTON SOPs. They are summarized in this section.

5.4.1 Organic Analysis

Samples are received by the Organic Sample Preparation Section for extraction prior to analysis by gas chromatography, GC/MS, or liquid chromatography. All pertinent data are recorded in a bound laboratory notebook. This information is transferred to the Laboratory Information Management System (LIMS) and a hard-copy Sample Extraction Record is generated. A copy of this form is shown in Figure 5-2. The original is placed on the facing page of the laboratory notebook where extraction data have been entered and is used for custody transfer documentation to the analyst. Copies are provided to the analyst to inform them that extracts are ready for analysis.

Extracts are maintained by the Organic Sample Preparation Section in refrigerated storage until transferred to the analysts.

5.4.2 Metals Analysis

Samples are received by the Metals Sample Preparation Section for digestion prior to analysis for metals by Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectroscopy. When samples are prepared for digestion, the preparation technician records the pertinent information in a laboratory digestion notebook. This information is then transferred to LIMS and a hard-copy Sample Digestion Record is generated. A copy of this form is shown in Figure 5-3. The digestion record is maintained to acknowledge custody transfer of digestates to the metals analysis section. A copy of the Sample Digestion Record is provided to the metals analysis section to alert them that digestates are ready for analysis.

The original copy of the Sample Digestion Record is retained by the Metals Sample Preparation Section.

5.4.3 Record Keeping

Data related to all sample preparation and analysis procedures and observations by laboratory analysts are recorded in bound

laboratory notebooks which are issued by the Laboratory Quality Assurance Coordinator. Laboratory notebook pages are signed and dated daily by laboratory analysts. Corrections to notebook entries are made by drawing a single line through the erroneous entry and writing the correct entry next to the one crossed out. All corrections are initiated and dated by the analyst.

5.4.4 Building Security

The WESTON Laboratory maintains controlled building access at all times. During working hours, all non-WESTON laboratory personnel are required to sign in with the receptionist and are escorted by laboratory personnel while in the building.

The laboratory is locked between the hours of 5:00 p.m. and 8:00 a.m. Monday through Friday and during the weekend. The building is secured during non-working hours by an ADT Security System. This security system not only monitors building access but also monitors the temperature in the sample storage refrigerators. If the control temperature range is exceeded during working hours, an audible alarm sounds. During non-working hours, a silent alarm alerts ADT. Response by laboratory personnel is described below.

The building is accessed by laboratory employees during non-working hours by using a key and the passcode for the Building Security System.

Any breach of security during non-working hours releases a silent alarm to the security agency who alert the local law enforcement agency and one of three laboratory personnel via beeper call. Police response to security alarms takes place within 5 minutes and laboratory personnel are on-site within 20 minutes.

FIGURE 5-1

WESTON CUSTODY TRANSFER-WORK REQUEST FORM

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Client _____
Work Order _____
Date Rec'd. _____ Date Due _____
RFW Contact _____
Client Contact/Phone _____

RFA Use Only Lab ID	Client ID/Description	Matrix	Date Collected	Refrigerated									
				#/Type Container									
				Volume									
				Preservative									
				ANALYSES REQUESTED									

Matrix:
S - Soil
SE - Sediment
SO - Solid
W - Water
O - Oil
A - Air
WI - Wipe
DS - Drum Solids
DL - Drum Liquids
F - Fish
X - Other

Special Instructions:

Item/Process	Relinquished by	Received by	Date	Time	Item/Process	Relinquished by	Received by	Date	Time

RFW 21-21-001/A-7/88

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y N
NOTES:

4 Properly Preserved
Y N
NOTES:

5 Received Within Holding Times
Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Intact on Outer Package Y N
3 Present on Sample Y N
4 Intact on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

7-116

FIGURE 5-2

WESTON SAMPLE EXTRACTION FORM

SAMPLE EXTRACTION RECORD

Sheet No: 1

Extract. Date: Extraction Batch No: Analyst: Method:

Test: Cleanup Date: Analyst: Client:

Solvent: Adsorbent:

Sample No:	Client ID	pH	Initial WT/VOL	Surr. Mult.	Spike Mult.	Final VOL	Final VOL N/A	Split Mult.	% Solids	C/D FACTOR

Comments:
Surrogate:
Spike:

Extracts Transferred	Relinquished By	Date Time	Received By	Date Time	Reason for Transfer

FIGURE 5-3

WESTON SAMPLE DIGESTION RECORD

SAMPLE DIGESTION RECORD

Sheet No: 1 of 1

Digestion Date: Digestion Batch No: Analyst: Client:

Completion Date: Type of Prep.: Method: Matrix:

Parameters:

Type of Analysis:

Sample No:	Initial WT/VOL	Final VOL	Spike Mult.	pH <2>	% Solids	C/D FACTOR	Comments	PAN WT	WET WT	DRY WT

DIGESTION CUSTODY SHEET

Extracts Transferred	Relinquished By	Date Time	Received By	Date Time	Reason for Transfer

6.0 Calibration Procedures

Before any instrument is used as a measurement device, the instrumental response to known reference materials must be determined. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. All sample measurements are made within the calibrated range of the instrument. Preparation of all reference materials used for calibration will be documented in a standards preparation notebook.

Instrument calibration typically consists of two types: initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over the range is generally absorbance, peak height, etc., which can be expressed as a linear model with a correlation coefficient (e.g. for Atomic Absorption, Inductively Coupled Plasma, UV-Visible-Infrared Spectrophotometry, Ion Chromatography) or as a response factor or amount vs. response plot (e.g. for Gas Chromatography, Gas Chromatography/Mass Spectrometry, High Performance Liquid Chromatography).

Continuing calibration usually includes measurement of the instrument response to fewer calibration standards and requires instrument response to compare with certain limits (e.g. ± 10%) of the initial measured instrument response. Continuing calibration may be used within an analytical sequence to verify stable calibration throughout the sequence, and/or to demonstrate that instrument response did not drift during a period of non-use of the instrument.

Specific instrument calibration procedures for various instruments are detailed in Section 7 of this QAP.

7.0 Analytical Procedures

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard methods may be necessary to provide accurate analyses of particularly complex matrices. When modifications to standard analytical methods are performed, the specific alterations, as well as the reason for the change, will be reported with the results of analysis. Choice of method is determined by the type of samples and the client/agency program represented. These programs include, but are not limited to the following:

- Drinking Water,
- Wastewater,
- Hazardous Waste, and
- Air.

For non-routine analytical services (e.g. special matrices, research projects, non-routine compound lists, etc.), the method of choice is selected based on client needs and available technology.

The laboratory's reported method detection limits (MDL's) are based on program requirements, sample matrix, and in-house instrument capabilities. These MDL's may be higher than published method detection limits. However, published MDL's are generally determined using clean matrices which are free of interferences, such as deionized water, and which are analyzed under optimal laboratory conditions. For actual sample analysis, these MDL's may not be routinely achievable. Procedures in place to demonstrate that reported detection limits are obtainable, are described in the ensuing subsections of this section.

Individual sample detection limits may vary from the laboratory's routinely reported detection limits. This may be due to dilution requirements, variability in sample weight or volume used to perform the analysis, dry weight adjustment for solid samples, the presence of analytical background contaminants, or other sample-related or analysis-related conditions.

7.1 Gas Chromatography/Mass Spectrometry (GC/MS)

7.1.1 Tuning and GC/MS Mass Calibration

Mass spectrometers are calibrated with perfluorotributylamine (FC-43) as required to ensure correct mass assignment. In addition, once per 12-hour shift these instruments are tuned with decafluorotriphenylphosphine (DFTPP) for semivolatiles analysis and 4-bromofluorobenzene for volatiles analysis . Ion abundances will be within the windows dictated by the specific program requirements.

7.1.2 GC/MS: Initial Calibration

Once an instrument has been tuned, initial calibration curves for analytes appropriate to the analyses to be performed are generated for at least five solutions containing known concentrations of authentic standards of compounds of concern. These solutions are generally cocktails of the method target analytes. The calibration curves will bracket the anticipated working range of analyses. For some compounds in the calibration standard cocktail, such as benzoic acid, 2,4-dinitrophenol, 2,4,5-trichlorophenol, 2-nitroaniline, 3-nitroaniline, 4-nitroaniline, 4-nitrophenol, 4,6-dinitro-2-methylphenol, and pentachlorophenol, the detection is difficult at the lowest calibration appropriate for the majority of the compounds in the mix. In these instances, a four-point initial calibration will be acceptable. Linearity is verified by evaluating the response factors (RF) for the initial calibration standards. For an acceptable calibration, the percent relative standard deviation (% RSD) for the RF's of specified Calibration Check Compounds (CCC's) will be <30 percent. In addition, a minimum average RF of 0.050 must be demonstrated for specified System Performance Check Compounds (SPCC's). These specified CCC's and SPCC's are listed in Table 7-1.

Calibration data, to include linearity verification, will be maintained in the laboratory's permanent records of instrument calibrations.

7.1.3 GC/MS: Continuing Calibration

During each 12-hour operating shift, a daily midpoint calibration standard is analyzed to verify that the instrument responses are still within the initial calibration determinations. The response factor for each target compound in the daily standard is calculated and recorded, then compared to the average RF from the initial calibration. If significant (>30%) RF drift is observed for the CCC's, appropriate corrective actions will be taken to restore confidence in the instrumental measurements. In addition, a minimum RF of 0.050 must be reported for SPCC's.

7.1.4 GC/MS: Quality Control

All GC/MS analyses will include analysis of a method blank, a method blank spike (semi-volatiles and pesticides/PCB's), a matrix spike, and a laboratory duplicate in each lot of twenty (20) or fewer samples. The matrix spike solutions will contain the compounds listed in Table 3-2 and will be used for both matrix spikes and blank spikes. In addition, appropriate surrogate compounds as specified in Table 3-1 will be spiked into each sample. Recoveries from method spikes and surrogate compounds are calculated and recorded on control charts to maintain a history of system performance.

A method blank spike duplicate sample may be analyzed in place of the matrix spike for analytical lots of less than ten (10) samples.

Audit samples will be analyzed periodically to compare and verify laboratory performance against standards prepared by outside sources.

7.1.5 GC/MS: Detection Limits

The laboratory's detection limits routinely used for reporting GC/MS data are compared with laboratory-determined instrument detection limits to ensure that the reported values are attainable. Instrument detection limits are determined from triplicate analysis of target compounds measured at three to five times the reporting limit. The calculated instrument detection limit is three times the standard deviation of the measured values.

7.2 Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC)

7.2.1 GC & HPLC: Initial Calibration

Gas chromatographs and high performance liquid chromatographs will be calibrated prior to each day of use. Calibration standard mixtures will be prepared from appropriate reference materials and will contain analytes appropriate for the method of analysis.

Working calibration standards for initial calibration will be prepared fresh daily. The working standards will include a calibration blank and five (5) calibration standards covering the anticipated range of measurement. At least one of the calibration standards will be at or below the desired instrument detection limit. The correlation coefficient of this calibration must be equal to or greater than 0.990 to consider the response linear over a range. If a correlation coefficient of 0.990 cannot be achieved, additional standards must be analyzed to define the calibration curve.

7.2.2 GC & HPLC: Continuing Calibration

The response of the instrument will be verified for each analysis sequence by evaluation of a mid-range calibration check standard. In order to demonstrate that the initial calibration curve is still valid, the calibration check standard must be within ± twenty percent (20%) recovery of the initial calibration for the compounds of interest or the instrument must be recalibrated. For multi-analyte methods, this check standard may contain a representative number of target analytes rather than the full

list of target compounds. Optionally, initial calibration can be performed at the beginning of the analysis sequence.

Within the analysis sequence, instrument drift will be monitored by analysis of a mid-range calibration standard every 10 samples. The % difference (% D) in calibration factors (CF's) for the continuing calibration standard compared to the average CF from the initial calibration will be calculated and recorded. If significant (> 20%) calibration factor drift is observed for the compounds of interest, appropriate corrective actions will be taken to restore confidence in the instrumental measurements.

7.2.3 GC & HPLC: Quality Control

At least one method blank and two method spikes will be included in each laboratory lot of samples. Regardless of the matrix being processed, the method spikes and blanks will be in aqueous media. Method spikes will be at a concentration of approximately five (5) times the detection limits.

The method blanks will be examined to determine if contamination is being introduced in the laboratory.

The method spikes will be examined to determine both precision and accuracy. Accuracy will be measured by the percent recovery of the spikes. These recoveries will be plotted on control charts to monitor method accuracy. Precision will be measured by the reproducibility of both method spikes and will be calculated as relative percent difference (% RPD). These % RPD's will be plotted on control charts to monitor method precision.

7.2.4 GC & HPLC: Detection Limits

The laboratory's detection limits routinely used for reporting GC pesticide data are compared with laboratory determined instrument detection limits to ensure that the reporting values are attainable. Instrument detection limits are determined from triplicate analysis of target compounds measured at three to five times the reporting limit. The calculated instrument detection limit is three times the standard deviation of the measured values. For non-routine compounds, the reported detection limits will be limited by the lowest calibration standard analyzed for the respective method.

The reported detection limits for HPLC analyses are limited to the concentration of the lowest calibration standard analyzed on a particular day. The only exception to this for HPLC analyses are analyses conducted according to USATHAMA quality assurance plan," December 1985, 2nd Edition, March 1987 (U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, MD 21010-5401).

7.3 Atomic Absorption Spectrophotometry (AA): Flame & Furnace

7.3.1 AA: Initial Calibration

Atomic absorption spectrophotometers will be calibrated prior to each day of use. Calibration standards will be from appropriate reference materials, and working calibration standards prepared fresh daily. Initial calibration will include analysis of a calibration blank and a minimum of three (3) calibration standards covering the anticipated range of measurement. Duplicate injections will be made for each concentration. At least one of the calibration standards will be at or below the reported detection limit. The calibration curve generated must have a correlation coefficient equal to or greater than 0.996 in order to consider the responses linear over a range. If the correlation coefficient criteria of 0.996 are not met, the instrument will be recalibrated prior to analysis of samples.

Prior to analysis of samples, the initial calibration will be verified using a mid-range calibration standard from a source other than that used for initial calibration, and an initial calibration verification blank (ICB). The analysis result for the initial calibration verification standard (ICV) must be ± ten percent (10%) recovery of the true value. The ICB must be free of target analytes at and above the reporting limit. If the ICV or ICB are outside these criteria, the initial calibration must be repeated.

Calibration data, to include the correlation coefficient, will be entered into laboratory notebooks to maintain a permanent record of instrument calibration.

7.3.2 AA: Continuing Calibration

The initial calibration is verified during the analysis sequence by evaluation of a continuing calibration blank (CCB) and a continuing calibration verification standard (CCV) after every ten (10) samples are analyzed. The response of the continuing calibration verification standard must be within ± ten percent (10%) recovery of the true value. The continuing calibration blank must be free of target analytes at and above the reported detection limit.

7.3.3 AA: Quality Control

At least one method blank and two method blank spikes (laboratory control samples: LCS) will be included in each labortory lot of samples. Regardless of the matrix being processed, the LCS and blanks will be in aqueous media. The LCS will be at a concentration of approximately five (5) times the detection limit.

The method blanks will be examined to determine if contamination is being introduced in the laboratory and will be analyzed at a frequency of one per analytical lot or five (5) percent of the samples, whichever is more frequent. The LCS will be examined to determine both precision and accuracy. Accuracy will be measured by the percent recovery (% R) of the spikes. The recovery must be within the range 80-120 percent to be considered acceptable, with the exception of antimony and silver, due to documented method deficiencies in achieving reliable recovery (reference EPA's Contract Laboratory Program). Additionally, the LCS % R will be plotted on control charts to monitor method performance.

Precision will be measured by the reproducibility of both LCS's and will be calculated as relative percent difference (% RPD). Results must agree within twenty (20) percent RPD in order to be considered acceptable. The LCS RPD will be plotted on control charts to monitor performance.

7.3.4 AA: Detection Limits

The laboratory's routinely reported detection limits are compared with laboratory-determined Instrument Detection Limits (IDL's) on a quarterly basis to ensure that the reported values are attainable. IDL's are determined from three nonconsecutive day's analysis of seven consecutive measurements of target compounds at three to five times the IDL. Each day's seven measured values are averaged and the respective standard deviation calculated. Three times the standard deviation of the average of the standard deviations obtained from the three days' analysis is defined as the IDL. The IDL's must be at or below the routinely reported detection limits.

7.4 Inductively Coupled Argon Plasma (ICP)

7.4.1 ICP: Initial Calibration

The inductively coupled argon plasma spectrophotometer will be calibrated prior to each day of use. Calibration standards will be prepared from reliable reference materials and will contain all metals for which analyses are being conducted. Working calibration standards will be prepared fresh daily. Quarterly, calibration will be performed with a blank and a minimum of five (5) concentrations to cover the anticipated range of measurement. Duplicate readings will be made for each concentration. At least one of the calibration standards will be at or below the reporting limit. The calibration curve generated must have a correlation coefficient equal to or greater than 0.996 in order to consider the responses linear over a range. If the correlation coefficient criteria of 0.996 are not met, the instrument will be recalibrated prior to analysis of samples.

On a daily basis, the instrument will be calibrated using a standard at the high end of the calibration range and a blank. Prior to analysis of samples, the initial calibration will be verified using a mid-range calibration standard from a source other than that used for initial calibration, and an initial calibration verification blank (ICB). The analysis result for the initial calibration verification standard (ICV) must be ± ten percent (10%) recovery of the true value. The ICB must be free of target analytes at and above the reporting limit. If the ICV or ICB are outside these criteria, the initial calibration must be repeated.

Calibration data, to include the correlation coefficient, will be entered into laboratory notebooks to maintain a permanent record of instrument calibration.

7.4.2 <u>ICP: Continuing Calibration</u>

The initial calibration is verified during the analysis sequence by analysis of a continuing calibration blank (CCB) and a continuing calibration verification standard (CCV) after every ten (10) samples are analyzed. The response of the continuing calibration verification standard must be within ± ten percent (10%) recovery of the true value. The continuing calibration blank must be free of target analytes at and above the reported detection limit.

7.4.3 <u>ICP: Quality Control</u>

At least one method blank and two method blank spikes (laboratory control sample: LCS) will be included in each laboratory lot of samples. Regardless of the matrix being processed, the LCS's and blanks will be in aqueous media. The LCS will be at a concentration of approximately five (5) times the detection limit.

The method blanks will be examined to determine if contamination is being introduced in the labortory.

The LCS results will be examined to determine both precision and accuracy. Accuracy will be measured by the percent recovery (% R) of the spikes. The recovery must be within the range 80-120 percent to be considered acceptable. Additionally, the LCS % R will be plotted on control charts to monitor method accuracy.

Precision will be measured by the reproducibility of both LCS and will be calculated as relative percent difference (% RPD). Results must agree within twenty (20) percent RPD in order to be considered acceptable.

7.4.4 ICP: Detection Limits

The laboratory routinely reported detection limits are compared with laboratory-determined Instrument Detection Limits (IDL's) on a quarterly basis to ensure that the reported values are attainable. IDL's are determined from three nonconsecutive day's analysis of seven consecutive measurements of target compounds at three to five times the IDL. Each day's seven measured values are averaged and the respective standard deviation calculated. Three times the standard deviation of the average of the standard deviations obtained from the three days' analysis is defined as the IDL. The IDL's must be at or below the routinely reported detection limits.

7.5 Cold Vapor Mercury Analysis: Flameless AA (CVAA)

7.5.1 CVAA: Initial Calibration

The initial calibration procedures are as described in subsection 7.3.1 except that initial calibration requires analyses of a calibration blank and five (5) working standards. The correlation coefficient of the standard curve must be equal to or greater than 0.996. The initial calibration is verified by analysis of a calibration standard from an independent source prior to sample analysis. The response of the initial calibration verification standard must be within ± twenty percent (20%) recovery of the true value. If it is outside these limits, the instrument is recalibrated.

7.5.2 CVAA: Continuing Calibration

After every ten (10) samples, a continuing calibration blank (CCB) and continuing calibration verification standard (CCV) are analyzed. The response of the CCV must be within ± twenty percent (20%) recovery of the true value. The CCB must be free of target analyte at and above the reported detection limit.

7.5.3 CVAA: Quality Control

At least one method blank and two method blank spikes (laboratory control samples: LCS) will be included in each labortory lot of samples. Regardless of the matrix being processed, the LCS and blanks will be in aqueous media. The LCS will be at a concentration of approximately five (5) times the detection limit.

The method blanks will be examined to determine if contamination is being introduced in the laboratory and will be analyzed at a frequency of one per analytical lot or five (5) percent of the samples, whichever is more frequent. The LCS will be examined to determine both precision and accuracy. Accuracy will be measured by the percent recovery (% R) of the spikes. The recovery must

be within the range 80-120 percent to be considered acceptable, with the exception of antimony and silver, due to documented method deficiencies in achieving reliable recovery (reference EPA's Contract Laboratory Program). Additionally, the LCS % R will be plotted on control charts to monitor method performance.

Precision will be measured by the reproducibility of both LCS's and will be calculated as relative percent difference (% RPD). Results must agree within twenty (20) percent RPD in order to be considered acceptable. The LCS RPD will be plotted on control charts to monitor performance.

7.5.4 CVAA: Detection Limits

The laboratory's routinely reported detection limits are compared with laboratory-determined Instrument Detection Limits (IDL's) on a quarterly basis to ensure that the reported values are attainable. IDL's are determined from three nonconsecutive day's analysis of seven consecutive measurements of target compounds at three to five times the IDL. Each day's seven measured values are averaged and the respective standard deviation calculated. Three times the standard deviation of the average of the standard deviations obtained from the three days' analysis is defined as the IDL. The IDL's must be at or below the routinely reported detection limits.

7.6 Total Organic Carbon (TOC)

7.6.1 TOC Initial Calibration

The total organic carbon analyzer will be calibrated prior to each day of use.

Calibration standards will be prepared from potassium hydrogen phthalate, and working calibration standards will be prepared fresh daily. The working standards will include a blank and a minimum of five (5) concentrations to cover the anticipated range of measurement.

At least one of the calibration standards will be at or below the desired instrument detection limit. The correlation coefficient of the plot of known versus found concentrations will be at least 0.996 in order to consider the responses linear over a range. If a correlation coefficient of 0.996 cannot be achieved, the instrument will be recalibrated prior to analysis of samples. Calibration data, to include the correlation coefficient, will be entered into laboratory notebooks to maintain a permanent record of instrument calibrations.

7.6.2 TOC: Continuing Calibration

A continuing calibration standard and blank will be analyzed at a frequency of ten percent (10%) and at the end of the analysis shift. The response calculated as a percent recovery of the standard must be ± fifteen percent (15%) of the true value. The response of the blank must be less than the detection limit.

7.6.3 TOC Quality Control

At least one method blank and two method spikes will be included in each laboratory lot of samples. Method spikes will be at a concentration of approximately five (5) times the detection limit.

The method blanks will be examined to determine if contamination is being introduced in the laboratory. The method spikes will be examined to determine both precision and accuracy. Accuracy will be measured by the percent recovery (% R) of the spikes. The recovery must be within the range 80-120 percent to be considered acceptable. In addition, % R will be plotted on control charts to monitor method accuracy.

Precision will be measured by the reproducibility of both method spikes and will be calculated as relative percent difference (% RPD). Results must agree within twenty percent (20%) RPD in order to be considered acceptable.

7.6.4 TOC Detection Limits

The detection limits are based on the concentration of the lowest standard analyzed. Results below the lowest standard are reported as below the detection limit.

7.7 Ion Chromatography (IC)

7.7.1 IC Initial Calibration

The ion chromatograph will be calibrated prior to each day of use. Calibration standards will be prepared from appropriate reference materials, and working calibration standards for the ions of interest will be prepared fresh daily. The working standards will include a blank and a minimum of five (5) concentrations to cover the anticipated range of measurements. At least one of the calibration standards will be at or below the desired instrument detection limit. The correlation coefficient of the plot of known versus found concentrations will be at least 0.996 in order to consider the response linear over a range. If a correlation coefficient of 0.996 cannot be achieved, the instrument will be recalibrated prior to analysis of samples.

Calibration data, to include the correlation coefficient, will be entered into laboratory notebooks to maintain a permanent record of instrument calibrations.

7.7.2 IC: Continuing Calibration

A continuing calibration standard and blank will be analyzed at a frequency of ten percent (10%) and at the end of the analysis shift. The response calculated as a percent recovery of the standard must be ± fifteen percent (15%) of the true value. The response of the blank must be less than the detection limit.

7.7.3 IC: Quality Control

At least one method blank and two method spikes will be included in each laboratory lot of samples. Regardless of the matrix being processed, the method spikes and blanks will be in aqueous media. Method spikes will be at a concentration of approximately five (5) times the detection limit.

The method blanks will be examined to determine if contamination is being introduced in the laboratory.

The method spikes will be examined to determine both precision and accuracy. Accuracy will be measured by the percent recovery (% R) of the spikes. The recovery must be within the range of 80-120% to be considered acceptable. Additionally, % R will be plotted on control charts to monitor method accuracy.

Precision will be measured by the reproducibility of both method spikes and will be calculated as relative percent difference (% RPD). Results must agree within twenty percent (20%) RPD in order to be considered acceptable.

7.7.4 IC: Detection Limits

The detection limits are based on the concentration of the lowest standard analyzed. Results below the lowest standard are reported as below the detection limit.

7.8 Spectrophotometry (Colorimetric Methods)

7.8.1. Spectrophotometry: Initial Calibration

Spectrophotometers will be calibrated prior to each day of use. The calibration standards will be prepared from reference materials appropriate to the analyses being performed, and working standards will include a minimum of five (5) concentrations which cover the anticipated range of measurement. At least one of the calibration standards will be at or below the desired detection limit. Additionally, a calibration blank will be analyzed. The requirement for an acceptable initial

calibration will be a correlation coefficient equal to or greater than 0.996 in order to consider the response linear over the measured range. If the correlation coefficient criteria of 0.996 is not met, the instrument will be recalibrated prior to analysis of samples. Calibration data, to include the correlation coefficient, will be entered into the laboratory notebook with the sample data to maintain a permanent record of instrument calibrations.

Before sample analysis, an initial calibration verification standard is analyzed. The response calculated as percent recovery of this standard must be within ± fifteen percent (15%) of the true value or the instrument is recalibrated.

7.8.2 Spectrophotometers: Continuing Calibration

A continuing calibration verification standard (CCV) and blank (CCB) will be analyzed at a frequency of ten percent (10%) and at the end of the analysis sequence. The response, calculated as a percent recovery of the true value, must be ± fifteen percent (15%) of the true value. The response of the blank must be less than the detection limit.

7.8.3 Spectrophotometers: Quality Control

At least one method blank and two method spikes will be included in each laboratory lot of samples. Regardless of the the matrix being processed, the method spikes and blanks will be in aqueous media. Method spikes will be at a concentration of approximately five (5) times the detection limit.

The method blanks will be examined to determine if contamination is being introduced in the labortory.

The method spikes will be examined to determine both precision and accuracy.

Accuracy will be measured by the percent recovery (% R) of the spikes. The recovery must be in the range (80-120 percent) in order to be considered acceptable. Additionally, % R will be plotted on control charts to monitor method accuracy.

Precision will be measured by the reproducibility of both method spikes and will be calculated as relative percent difference (% RPD). Results must agree within twenty (20) percent RPD in order to be considered acceptable.

7.8.4 Spectrophotometers: Detection Limits

The detection limits are based on the concentration of the lowest standard analyzed. Results below the lowest standard are reported as below the detection limit.

7.9 Balances

Laboratory balances will be calibrated and serviced annually by a factory representative. In addition, the analyst will check the balance before each use with two masses: one in the gram range and one in the milligram range. A record of calibrations and daily checks will be kept in the balance log.

The Class P weights used by the analysts for daily balance checks will be calibrated annually against a set of Class S certified weights.

7.10 Thermometers

Oven and refrigerator thermometers will be calibrated annually against a National Bureau of Standards (NBS) certified thermometer in the range of interest. Annual calibrations will be recorded in a calibration notebook. Daily readings will be recorded with the respective oven or refrigerator.

TABLE 7-1

GC/MS CALIBRATION CHECK COMPOUNDS (CCC's) AND SYSTEM PERFORMANCE CHECK COMPOUNDS (SPCC's)

Volatiles

chloromethane
* vinyl chloride
* 1,1-dichloroethene
# 1,1-dichloroethane
* chloroform
* 1,2-dichloropropane
# bromoform
# 1,1,2,2-tetrachloroethane
* toluene
# chlorobenzene
* ethylbenzene

Semivolatiles

* phenol
* 1,4-dichlorobenzene
# N-nitroso-di-N-propylamine
* 2-nitrophenol
* 2,4-dichlorophenol
* hexachlorobutadiene
* 4-chloro-3-methylphenol
# hexachlorocyclopentadiene
* 2,4,6-trichlorophenol
* acenaphthene
# 2,4-dinitrophenol
# 4-nitrophenol
* N-nitrosodiphenylamine
* pentachlorophenol
* fluoranthene
* di-N-octylphthalate
* benzo-a-pyrene

* = calibration check compounds
# = system performance check compounds

8.0 Data Reduction, Validation and Reporting

8.1 Introduction

All analytical data are recorded into bound laboratory notebooks issued by the QA Coordinator. Data are recorded and associated with a unique WESTON sample identification number and a client sample identity. These pages minimally contain the following information: analytical method, analyst, date, reagent concentrations, instrument settings (as applicable), and raw data.

The laboratory analysts sign and date all notebook entries daily. The notebook pages are reviewed periodically by the Section Manager. Copies of instrument outputs (chromatograms, strip charts, etc.) are maintained on file.

8.2 Data Reduction

Data reduction is performed by the individual analysts and consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. The complexity of the data reduction will be dependent on the specific analytical method and the number of discrete operations (extractions, dilutions, and concentrations) involved in obtaining a sample that can be measured.

For those methods utilizing a calibration curve, sample response will be applied to the linear regression line to obtain an initial raw result which is then factored into equations to obtain the estimate of the concentration in the original sample. Rounding will not be performed until after the final result is obtained to minimize rounding errors, and results will not normally be expressed in more than two (2) significant figures.

Copies of all raw data and the calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date.

8.3 Data Review/Validation

System reviews are performed at all levels. The individual analyst constantly reviews the quality of data through calibration checks, quality control sample results, and performance evaluation samples. These reviews are performed prior to submission to the Section Managers or the Analytical Project Manager.

The Section Manager and/or the Analytical Project Manager review data for consistency and reasonableness with other generated data and determine if program requirements have been satisfied. Selected hard copy output of data (chromatograms, spectra, etc.)

will be reviewed to ensure that results are interpreted correctly. Unusual or unexpected results will be reviewed, and a resolution will be made as to whether the analysis should be repeated. In addition, the Analytical Project Manager or Section Manager will recalculate selected results to verify the calculation procedure.

The Quality Assurance Officer independently conducts a complete review of selected projects to determine if laboratory and client quality assurance/quality control requirements have been met. Discrepancies will be reported to the appropriate Section Manager and/or Analytical Project Manager for resolution.

The final routine review is performed by the Laboratory Manager prior to reporting the results to the client. Non-routine audits are performed by regulatory agencies and client representatives. The level of detail and the areas of concern during these reviews are dependent on the specific program requirements.

8.4 Data Reporting

Reports will contain final results (uncorrected for blanks and recoveries), methods of analysis, levels of detection, surrogate recovery data, and method blank data. In addition, special analytical problems, and/or any modifications of referenced methods will be noted. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Consequently, most analytical results will be reported to no more than two (2) significant figures. Data are normally reported in units commonly used for the analyses performed. Concentrations in liquids are expressed in terms of weight per unit volume (e.g., milligrams per liter). Concentrations in solid or semi-solid matrices are expressed in terms of weight per unit weight of sample (e.g., micrograms per gram).

Reported detection limits will be the concentration in the original matrix corresponding to the low level instrument calibration standard after concentration, dilution, and/or extraction factors are accounted for, unless otherwise specified by program requirements.

The final data report provided by WESTON Analytics conforms to one of three types:

1. Level 1: WESTON Standard Client Report,

2. Level 2: A Tier II Report (as specified by the State of New Jersey). This Report provides support data including a case narrative, quality control data, and a chain-of-custody report,

3. Level 3: U.S. EPA-CLP format report as described in WESTON OP 21-20-020, Section B, or

4. Level 4: Tier 1 Report (as specified by the State of New Jersey). This Report provides support data including a case narrative, quality control data, a methods summary, negative proofs of mass spectral quantitation library search "false positives", and a lab chronicle, and chain-of-custody for receipt and analyses. The basis submittal is U.S. EPA-CLP format (Level 3 above) with a few NJDEP-specified extras.

8.4.1 Level 1: Standard Client Report

The standard commercial report contains a transmittal letter and the following for Organic Analyses:

- cover page describing: data qualifiers, sample collection, extraction and analysis dates, and a description of any technical problems encountered with the analysis,
- spreadsheet sample data and QC result summaries, and
- five-peak library search report for GC-MS volatiles and semivolatiles.

QC for batches of twenty (20) samples or less includes a method blank, a method blank spike (semivolatiles and pesticide/PCB's), a matrix spike, a laboratory duplicate or spike duplicate, and surrogate recoveries. For sample batches of less than ten (10), laboratory duplicates and matrix spikes may be taken from other samples processed at the same time. Also, a method blank spike duplicate may be substituted for a matrix spike in smaller batches.

Although the EPA CLP methodology is used for Level 1, re-analyses will not be required for surrogate outliers unless poor recoveries are determined to be due to laboratory error.

Inorganic Analyses Level 1 reports contain a transmittal letter and the following:

- cover page describing: data qualifiers, sample receipt, digestion and analysis dates, and a description of any technical problems encountered with the analyses,
- sample data summary report including lab blanks, and
- QC summary report on laboratory control samples (accuracy).

8.4.2 Level 2: Tier II Report

The Level 2 report contains a transmittal letter and the following for Organic Analyses:

- cover page,
- chain of custody-sample request form,
- case narrative and laboratory chronicle,
- tune summaries,
- sample data results, with accompanying chromatograms and appropriate spectra, and
- QC data including:
  - method blanks,
  - surrogate recoveries, and
  - matrix spike-matrix spike duplicate recoveries.

Inorganic Analyses Level 2 reports contain a transmittal letter and the following:

- lab chronicle,
- cover page describing: data qualifiers, sample receipt, digestion and analysis dates, and a description of any technical problems encountered with the analyses,
- sample data summary report including lab blanks,
- QC summary report on laboratory control samples (accuracy),
- QC summary report on sample matrix spike (accuracy) and duplicate (precision analyses), and
- chain-of-custody/analysis request form.

9.0 Internal Quality Control Checks: Laboratory

The daily quality of analytical data generated in the WESTON laboratories is controlled by the implementation of this Analytical Laboratory Quality Assurance Plan. The types of internal quality control checks are described in this section.

- Method Blanks. Method blanks usually consist of laboratory reagent grade water treated in the same manner as the sample (i.e., digested, extracted, distilled, etc.) which is then analyzed and reported as a standard sample would be.

- Method Blank Spike. A method blank spike is a sample of laboratory reagent grade water fortified (spiked) with the analytes of interest which is prepared and analyzed with the associated sample batch. Method blank spikes are not included with volatiles analyses since the same function is served by the calibration standard analysis.

- Laboratory Control Sample for Inorganics. This is a standard solution with a certified concentration which is analyzed as a sample and is used to monitor analytical accuracy. (Equivalent to a method blank spike).

- Matrix Spikes. A matrix spike is an aliquot of an investigative sample which is fortified (spiked) with the analytes of interest and analyzed with an associated sample batch to monitor the effects of the investigative sample matrix (matrix effects) on the analytical method. Matrix spikes are performed only in association with selected protocols. Frequency of matrix spikes will be specified in the project-specific Quality Assurance Project Plan.

- Laboratory Duplicate Samples. Duplicate samples are obtained by splitting a field sample into two separate aliquots and performing two separate analyses on the aliquots. The analysis of laboratory duplicates monitors sample precision; however, it may be affected by sample inhomogeneity, particularly in the case of nonaqueous samples. Laboratory duplicates are performed only in association with selected protocols and at the client's request. Frequency of duplicates will be specified in the project-specific Quality Assurance Project Plan.

- Known QC Check Sample. This is a QC sample of known concentration obtained from the U.S. EPA, the National Bureau of Standards (NBS) or a commercial source. This

QC sample is to check the accuracy of an analytical procedure. It is particularly applicable when a minor revision or adjustment has been made to an analytical procedure or instrument.

9.1 QC Monitoring

The analyses of quality control samples are entered chronologically onto quality control charts specifically maintained for each analytical procedure. These control charts are labeled with upper and lower warning and control limits, the analysis which is being charted and the value (e.g., % recovery, % RPD, etc.) which is being monitored. Control charts are updated monthly and are used to demonstrate method performance and help identify system errors.

10.0 Performance and System Audits

10.1 External Audits

WESTON participates in several external audits sponsored by State Regulatory Agencies and the U.S. EPA. These audits include performance and system audits.

The performance audits are in the form of blind performance samples submitted by the auditing agency. System audits involve on-site evaluation of the WESTON laboratory systems. A representation of the number, type, and auditing agency are summarized in Table 10-1. WESTON is certified in over states, and many of these states (e.g., Ohio, Utah, Colorado, etc.) also perform on-site audits as part of their certification requirement.

10.2 Internal Audits

The laboratory QA Coordinator has overall responsibility for monitoring the internal Quality Assurance/Quality Control program. The QA Coordinator has a staff to provide in-house audits, and to review and validate analytical data packages. The QA Coordinator is also responsible for scheduling and coordinating external systems audits and reviewing data for performance samples received.

The QA Coordinator supplies blind performance samples to the laboratory at least semi-annually.

The QA Coordinator audits laboratory systems and procedures at least once annually. Unique client audit procedures and data requirements will be complied with as contractually specified. The internal audit consists of a review of laboratory systems, procedures and documentation. Any deficiencies and/or deviations are documented and a summary report is prepared. (See also Section 13)

TABLE 10-1

EXTERNAL PERFORMANCE AND SYSTEMS AUDITS
WESTON ANALYTICAL LABORATORIES

Agency	Parameters	Type	Frequency	Required for
Illinois EPA	WS-WP	Performance System	Semi-annually	Water/Waste Water Cert.
NY Dept of Health	WS-WP	Performance	Semi-annually	Water/Waste Water Cert.
NY State Dept. Env. Conserv.	Inorganic-Organic TCL	Performance System	EPA CLP Qtrly Blind	State Analytical Contract
NJ Dept. of Environ. Protection	WS-WP	Performance System	Annually Every 2 Yrs.	Water/Waste Water Cert.
	Haz.Waste	Performance	EPA CLP Qtrly	Haz.Waste Approval
Oklahoma WRB	WS-WP	Performance	Semi-annually	Water/Waste Water Cert.
PA Dept. of Environ. Res.	WS	Performance System	Annually Every 2 Yrs.	Water Cert.
	Haz.Waste	Performance	EPA CLP Qtrly	State Anal. Contract
U.S.EPA	Inorganic-Organic TCL	Performance System	Quarterly Every 2 Yrs.	Superfund Related Analytical Work
U.S. Army Corps of Engineers (DERA)	Inorganic-Organic	Performance System	As Contract Requires	Water/Waste Water, Superfund Analytical Work

- Last on-site by U.S.EPA was performed in May 1988
- Last PA DER on-site was performed in May 1987, and last IEPA on-site was performed in September 1988.

WS = Water Supply (Drinking Water)
WP = Water Pollution (Wastewater)

11.0 Preventive Maintenance

11.1 Introduction

The ability to generate valid analytical data requires that all analytical instrumentation be properly and regularly maintained. The WESTON Analytical Laboratory maintains full service contracts on all major instruments. These service contracts not only provide routine preventative maintenance but also emergency repair service. The elements of the maintenance program are discussed in the following sections.

11.2 Instrument Maintenance Log Books

Each analytical instrument is assigned an instrument log book. All maintenance activities are recorded in the instrument log. The information entered in the instrument log includes:

1. date of service,
2. person performing service,
3. type of service performed and reason for service,
4. replacement parts installed (if appropriate), and
5. miscellaneous information.

If service is performed by the manufacturer, a copy of the service record is taped into the page facing the notebook page where the above information is entered.

11.3 Instrument Calibration and Maintenance

The routine calibration procedures used for analytical instrumentation are described in Section 6 and shown in Table 11-1. Preventative maintenance and calibration by manufacturer service representatives are provided on a routine basis.

The maintenance procedures and frequencies for major analytical instrumentation are given in Table 11-2.

WESTON service agreements provide for preventative maintenance, emergency service, and emergency shipping of spare parts. For emergency response, service contracts on the Gas Chromatographs, GC/MS instruments and AA-ICP require on-site response within 48-72 hours. (Typically, service representatives are on site within 24 hours of a service call.) The service contracts also provide for 24-hour delivery of critical spare parts in response to a service request.

11.4 Spare Parts

WESTON Laboratory maintains an inventory of routinely required spare parts (for example, spare sources, vacuum pumps and filaments for GC/MS, spare torches, burner heads for AA-ICP).

The instrument operators have the responsibility, with the appropriate Section Manager, to ensure that an acceptable inventory of spare parts is maintained.

TABLE 11-1

CALIBRATION FREQUENCY AND MECHANISM FOR MAJOR INSTRUMENTS WESTON ANALYTICAL LABORATORY

Instrument	Frequency of Calibration	Standard	Indicator Parameters
GC/MS	Daily (or every 12 hrs)	Standard soln of analytes to be measured	Response-Sensitivity
GC (Hall, PID,EC,NPD, FID,FPD)	Daily (or more frequently as required)	Standard soln of analytes to be measured	Retention Time Response-Sensitivity
HPLC	Daily	Standard soln of analytes to be measured	Retention Time Response-Sensitivity
AA	Daily (or more frequently	Standard soln of analytes to be measured	Response Linear Range
ICP	Daily (or more more frequently)	Standard soln of analytes to be measured	Response Linear Range
Ion Chromatograph	Daily	Standard soln of analytes to be measured	Retention Time Response
Spectro-photometers	Daily	Standard soln of analytes to be measured	Response Linear Range
Technicon AutoAnalyzer	Daily	Standard soln of analytes to be measured	Response Linear Range
Conductivity Meter	Daily	Standard soln of analytes to be measured	Response
Analytical Balance	Daily, when used	Class S wts. (NBS cert)	Accuracy
Ovens	Quarterly	Thermometer (NBS-cert)	Accuracy

TABLE 11-2

INSTRUMENT MAINTENANCE SCHEDULE
WESTON ANALYTICAL LABORATORY

Instrument	Preventative Maintenance	Service Contract
Gas Chromatograph-Mass Spectrometer	Semi-annually	Yes
Gas Chromatographs	Semi-annually	Yes
GC Detectors (FID,EC,PID,Hall,NPD,FPD)	As needed	Yes
High Performance Liquid Chromatographs	As needed	No
Atomic Absorption Spectrometer (Flame and Furnace)	Semi-annually	Yes
Inductively Coupled Plasma Spectrophotometer	Semi-annually	Yes
Analytical Balance	Annually	Yes
Ion Chromatograph	Annually	Yes
Spectrophotometers	As needed	No
Cold Vapor Mercury AA	As needed	No
Technicon Autoanalyzer	As needed	No
Conductivity Meter	As needed	No
Ovens	As needed	No
pH-Specific Ion Meter	As needed	No

12.0 Procedures Used to Assess Data Quality

12.1 Introduction

The QA objectives for precision, accuracy, and completeness were given and discussed in Section 3. All analytical data are reviewed relative to these criteria and specific project requirements to assess the quality of the analytical data. Where all criteria are met, data are deemed acceptable without qualification. Where precision and accuracy goals are not met, the sample set is re-analyzed or reported with qualification in the case narrative. Some of the factors affecting this final sample disposition include:

- project-specific QA/QC requirements,
- availability of sufficient sample for re-analysis,
- holding time considerations, and
- regulatory action limits.

12.2 Precision

Precision is measured through analyses of replicate QC controls and field samples. Results from these measurements are calculated as relative percent difference (% RPD) or percent relative standard deviation (% RSD) and evaluated according to the criteria set forth in subsections 3.3-3.3.2. Laboratory QC control samples are used to demonstrate acceptable method performance, and are used to trigger corrective action when control limits are exceeded.

Precision measurements from field samples give an indication of sample homogeneity. Problems with sample homogeneity are more likely to occur with soil and sediment samples, water samples containing a noticeable amount of solids, and non-standard matrices.

12.3 Accuracy

Accuracy is measured through the analysis of fortified reagent free matrices and fortified field samples. Results from these measurements are calculated as percent recovery and evaluated according to the criteria set forth in subsections 3.2-3.2.2. Laboratory QC control samples are used to demonstrate acceptable method performance, and are used to trigger corrective action when control limits are exceeded.

Accuracy measurements from field samples give an indication of physical or chemical interferences present which can either enhance or mask the actual presence of target analytes. Determination of percent recovery (% R) requires analysis of a fortified sample and a non-fortified sample, so that any background analyte already present in the sample can be accounted

for in the recovery determination. Thus, sample homogeneity also becomes a factor in recovery determinations, as variable background can affect the apparent analyte recovery. Problems with sample recovery are more likely to occur with soil and sediment samples, water samples containing a noticeable amount of solids, and non-standard matrices.

12.4 Completeness

Completeness has been defined in subsection 3.4 as a measure of the amount of analytical data generated by an analytical method or system meeting all accuracy and precision criteria. As stated, the minimum goal for completeness is 80% and the ability to exceed this goal (especially for organic TCL analyses) is dependent on the applicability of the analytical methods to the sample matrices analyzed. However, even if data have not met this laboratory definition of data able to be reported without qualification, project completion goals may still be met if the qualified data, i.e. data of know quality even if not perfect, is suitable for specified project goals.

13.0 Corrective Action

The initial responsibility to monitor the quality of an analytical system lies with the analyst. In this pursuit, the analyst will verify that all quality control procedures are followed and results of analysis of quality control samples are within acceptance criteria. This requires that the analyst assess the correctness of all of the following items as appropriate:

- sample preparation procedure,
- initial calibration,
- calibration verification,
- method blank result,
- duplicate analysis,
- laboratory control standard, and
- fortified sample result.

If the assessment reveals that any of the QC acceptance criteria are not met, the analyst must immediately assess the analytical system to correct the problem. The analyst notifies the appropriate supervisor and the QA Coordinator of the problem and, if possible, identifies potential causes and corrective action.

The nature of the corrective action obviously depends on the nature of the problem. For example, if a continuing calibration verification is determined to be out of control, the corrective action may require recalibration of the analytical system and reanalysis of all samples since the last acceptable continuing calibration standard.

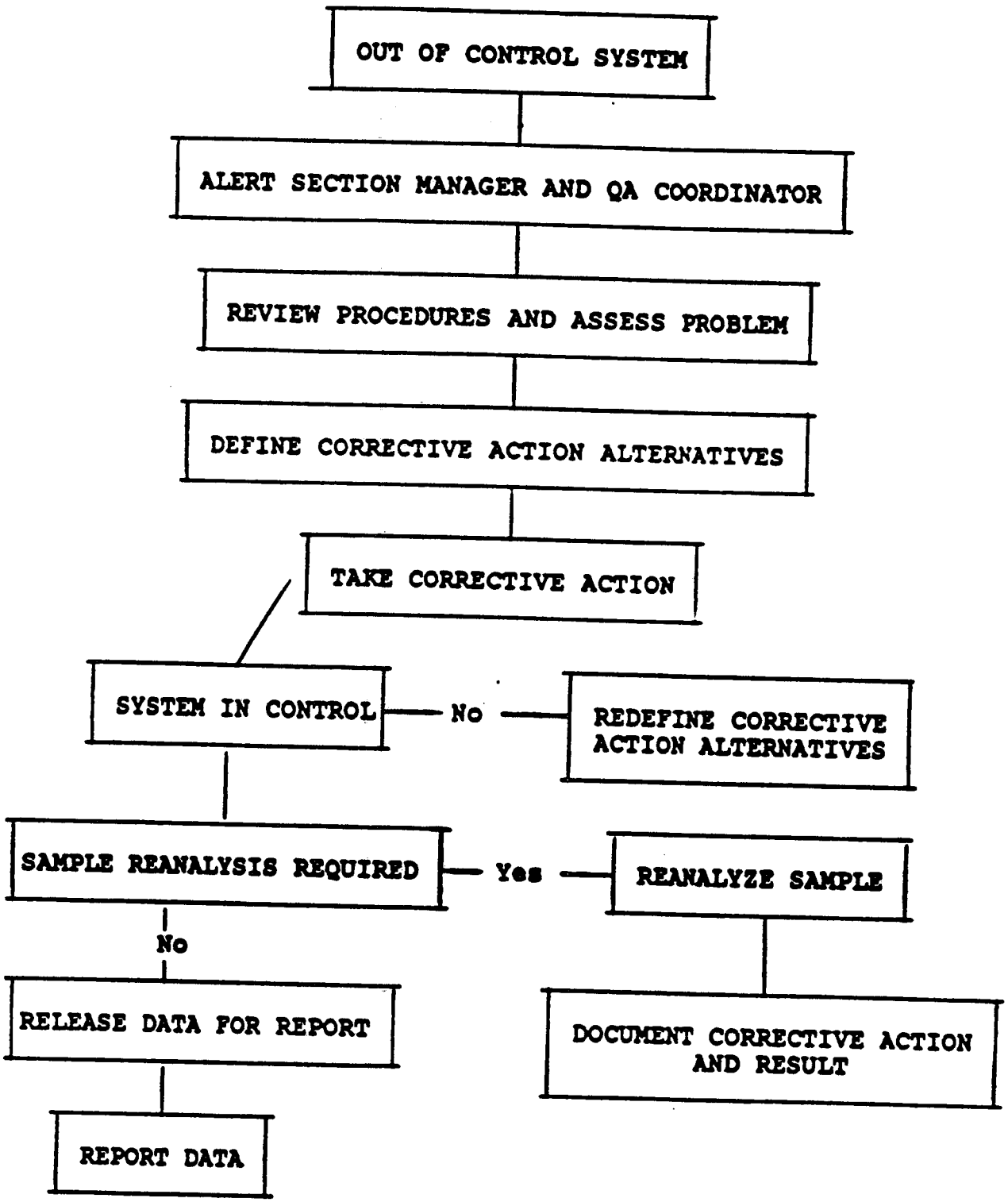
When the appropriate corrective action measures have been defined and the analytical system is determined to be "in control", the analyst documents the problem, and the corrective action. Copies of the form summarizing these actions are provided to the Section Manager and QA Coordinator.

Data generated concurrently with an out-of-control system will be evaluated for usability in light of the nature of the deficiency. If the deficiency does not impair the usability of the results, data will be reported and the deficiency noted in the case narrative. Where sample results are impaired, the Laboratory Project Manager is notified and appropriate corrective action (e.g., reanalysis) is taken.

The critical path for assessing the correctness and acceptability of analytical data is shown in Figure 13-1.

FIGURE 13-1

CRITICAL PATH FOR CORRECTIVE ACTION IN THE WESTON LABORATORY



14.0 Quality Assurance Reports to Management

The QA Coordinator provides quarterly and annual reports to the WESTON Laboratory Analytic Division and Corporate management. These reports summarize QA activities for the reporting period including results of performance audits (external and internal), results of system audits (external and internal), summaries of corrective action to remedy out of control situations and recommendation for revision in laboratory procedures to improve the analytical systems. The Project Manager as well as the Laboratory Manager, QA Manager, and appropriate Service Group Supervisors will be notified immediately of laboratory QA situations requiring immediate corrective action.

MINIMUM DETECTION LIMITS

Volatile Organic Compounds

Matrix: Soil and Water

74-87-3 Chloromethane	10	U
74-83-9 Bromomethane	10	U
75-01-4 Vinyl Chloride	10	U
75-00-3 Chloroethane	10	U
75-09-2 Methylene Chloride	5	U
75-35-4 1,1-Dichloroethene	5	U
75-34-3 1,1-Dichloroethane	5	U
540-59-0 1,2-Dichloroethene (total)	5	U
67-66-3 Chloroform	5	U
107-06-2 1,2-Dichloroethane	5	U
71-55-6 1,1,1-Trichloroethane	5	U
56-23-5 Carbon Tetrachloride	5	U
75-27-4 Bromodichloromethane	5	U
78-87-5 1,2-Dichloropropane	5	U
10061-01-5 cis-1,3-Dichloropropene	5	U
79-01-6 Trichloroethene	5	U
124-48-1 Dibromochloromethane	5	U
79-00-5 1,1,2-Trichloroethane	5	U
71-43-2 Benzene	5	U
10061-02-6 Trans-1,3-Dichloropropene	5	U
110-75-8 2-chloroethylvinylether	10	U
75-25-2 Bromoform	5	U
127-18-4 Tetrachloroethene	5	U
79-34-5 1,1,2,2-Tetrachloroethane	5	U
108-88-3 Toluene	5	U
108-90-7 Chlorobenzene	5	U
100-41-4 Ethylbenzene	5	U
95-50-1 1,2-Dichlorobenzene	5	U
541-73-1 1,3-Dichlorobenzene	5	U
106-46-7 1,4-Dichlorobenzene	5	U

MINIMUM DETECTION LIMITS

Semivolatile Organic Compounds

Matrix: Soil

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	
534-52-1	4,6-Dinitro-2-methylphenol	1600	U
86-30-6	N-Nitrosodiphenylamine (1)	330	U
101-55-3	4-Bromophenyl-phenylether	330	U
118-74-1	Hexachlorobenzene	330	U
87-86-5	Pentachlorophenol	1600	U
85-01-8	Phenanthrene	330	U
120-12-7	Anthracene	330	U
84-74-2	Di-n-Butylphthalate	330	U
206-44-0	Fluoranthene	330	U
129-00-0	Pyrene	330	U
85-68-7	Butylbenzylphthalate	330	U
91-94-1	3,3'-Dichlorobenzidine	330	U
56-55-3	Benzo(a)anthracene	660	U
218-01-9	Chrysene	330	U
117-81-7	bis(2-Ethylhexyl)phthalate	330	U
117-84-0	Di-n-Octyl phthalate	330	U
205-99-2	Benzo(b)fluoranthene	330	U
207-08-9	Benzo(k)fluoranthene	330	U
50-32-8	Benzo(a)pyrene	330	U
193-39-5	Indeno(1,2,3-cd)pyrene	330	U
53-70-3	Dibenzo(a,h)anthracene	330	U
191-24-2	Benzo(g,h,i)perylene	330	U
62-75-9	N-Nitrosodimethylamine	330	U
92-87-5	Benzidine	1600	U
108-95-2	Phenol	330	U
111-44-4	bis(2-Chloroethyl)ether	330	U
95-57-8	2-Chlorophenol	330	U
541-73-1	1,3-Dichlorobenzene	330	U
106-46-7	1,4-Dichlorobenzene	330	U
95-50-1	1,2-Dichlorobenzene	330	U
108-60-1	bis(2-Chloroisopropyl)ether	330	U
106-44-5	4-Methylphenol	330	U
621-64-7	N-Nitroso-Di-n-propylamine	330	U
67-72-1	Hexachloroethane	330	U
98-95-3	Nitrobenzene	330	U
78-59-1	Isophorone	330	U
88-75-5	2-Nitrophenol	330	U
105-67-9	2,4-Dimethylphenol	330	U
111-91-1	bis(2-Chloroethoxy)methane	330	U
120-83-2	2,4-Dichlorophenol	330	U
120-82-1	1,2,4-Trichlorobenzene	330	U
91-20-3	Naphthalene	330	U
87-68-3	Hexachlorobutadiene	330	U
59-50-7	4-Chloro-3-methylphenol	330	U
77-47-4	Hexachlorocyclopentadiene	330	U
88-06-2	2,4,6-Trichlorophenol	330	U
91-58-7	2-Chloronaphthalene	330	U
131-11-3	Dimethylphthalate	330	U
208-96-8	Acenaphthylene	330	U
606-20-2	2,6-Dinitrotoluene	330	U
83-32-9	Acenaphthene	1600	U
51-28-5	2,4-Dinitrophenol	1600	U
100-02-7	4-Nitrophenol	330	U
121-14-2	2,4-Dinitrotoluene	330	U
84-66-2	Diethylphthalate	330	U
7005-72-3	4-Chlorophenyl-phenylether	330	U
86-73-7	Fluorene	330	U

MINIMUM DETECTION LIMITS

Semivolatile Organic Compounds

Matrix: Water

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	
534-52-1	4,6-Dinitro-2-methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)phthalate	10	U
117-84-0	Di-n-Octyl phthalate	10	U
205-99-2	Benzo(b)fluoranthene	10	U
207-08-9	Benzo(k)fluoranthene	10	U
50-32-8	Benzo(a)pyrene	10	U
193-39-5	Indeno(1,2,3-cd)pyrene	10	U
53-70-3	Dibenzo(a,h)anthracene	10	U
191-24-2	Benzo(g,h,i)perylene	10	U
62-75-9	N-Nitrosodimethylamine	10	U
92-87-5	Benzidine	50	U
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
95-50-1	1,2-Dichlorobenzene	10	U
108-60-1	bis(2-Chloroisopropyl)ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
111-91-1	bis(2-Chloroethoxy)methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-methylphenol	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
91-58-7	2-Chloronaphthalene	10	U
131-11-3	Dimethylphthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U

MINIMUM DETECTION LIMITS

Pesticide Organic Compounds

Matrix: Soil

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/kg) ug/kg	
319-84-6	Alpha-BHC	8.0	U
319-85-7	Beta-BHC	8.0	U
319-86-8	Delta-BHC	8.0	U
58-89-9	gamma-BHC (Lindane)	8.0	U
76-44-8	Heptachlor	8.0	U
309-00-2	Aldrin	8.0	U
1024-57-3	Heptachlor epoxide	8.0	U
959-98-8	Endosulfan I	8.0	U
60-57-1	Dieldrin	16	U
72-55-9	4,4'-DDE	16	U
72-20-8	Endrin	16	U
33213-65-9	Endosulfan II	16	U
72-54-8	4,4'-DDD	16	U
1031-07-8	Endosulfan sulfate	16	U
50-29-3	4,4'-DDT	16	U
72-43-5	Methoxychlor	80	U
7421934	Endrin aldehyde	16	U
5103-71-9	alpha-Chlordane	80	U
5103-74-2	gamma-Chlordane	80	U
8001-35-2	Toxaphene	160	U
12674-11-2	Aroclor-1016	80	U
11104-28-2	Aroclor-1221	80	U
11141-16-5	Aroclor-1232	80	U
53469-21-9	Aroclor-1242	80	U
12672-29-6	Aroclor-1248	80	U
11097-69-1	Aroclor-1254	160	U
11096-82-5	Aroclor-1260	160	U

MINIMUM DETECTION LIMITS

Pesticide Organic Compounds

Matrix: Water

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	
319-84-6	Alpha-BHC	0.050	U
319-85-7	Beta-BHC	0.050	U
319-86-8	Delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
7421934	Endrin aldehyde	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

MINIMUM DETECTION LIMITS

Metals

Matrix: Soil and Water

Element	Tech.	Prep Water	Water MCAWW	D.L. ug/L	Prep Soil	Soil SW846	D.L. Mg/kg
SILVER TOTAL	ICP	3020	200.7	10.00	3050	6010	2.00
ARSENIC TOTAL	GFAA	3020	206.2	10.00	3050	7060	2.00
BERYLLIUM TOTAL	ICP	3020	200.7	5.00	3050	6010	1.00
CADMIUM TOTAL	ICP	3020	200.7	5.00	3050	6010	1.00
CHROMIUM TOTAL	ICP	3020	200.7	10.00	3050	6010	2.00
COPPER TOTAL	ICP	3020	200.7	25.00	3050	6010	5.00
MERCURY TOTAL	CVAA	3020	245.1	0.20	3050	7470	0.10
NICKEL TOTAL	ICP	3020	200.7	40.00	3050	6010	8.00
LEAD TOTAL	GFAA	3020	239.2	3.00	3050	7421	0.60
ANTIMONY TOTAL	ICP	3020	200.7	60.00	3050	6010	12.00
SELENIUM TOTAL	GFAA	3020	270.2	5.00	3050	7740	1.00
THALLIUM TOTAL	GFAA	3020	279.2	10.00	3050	7841	2.00
ZINC TOTAL	ICP	3020	200.7	20.00	3050	6010	4.00