HOWLAND HOOK MARINE TERMINAL
START ONE
ADMINISTRATIVE RECORD FILE
INDEX OF DOCUMENTS

1.0 FACTUAL INFORMATION/DATA

1.3 POLREPs

P.	100001-100004	Pollution Report One (1) and Final, Removal Action, Howland Hook Marine Terminals, Staten Island, New York, prepared by Mr. Joseph Cosentino, On-Scene Coordinator, Response and Prevention Branch, U.S. EPA, Region II, Recipients: See Distribution List, January 19, 1989.
P.	100005-100006	Pollution Report Two (2), Removal Action, Howland Hook Marine Terminals, Staten Island, New York, prepared by Mr. Joseph Cosentino, On-Scene Coordinator, Response and Prevention Branch, U.S. EPA, Region II, Recipients: See Distribution List, March 31, 1989.
P.	100007-100007	Pollution Report Three (3), Removal Action, Howland Hook Marine Terminals, Staten Island, New York, prepared by Mr. Joseph Cosentino, On-Scene Coordinator, Response and Prevention Branch, U.S. EPA, Region II, Recipients: See Distribution List, October 11, 1989.
P.	100008-100008	Pollution Report Four (4), Removal Action, Howland Hook Marine Terminals, Staten Island, New York, prepared by Mr. Joseph Cosentino, On-Scene Coordinator, Response and Prevention Branch, U.S. EPA, Region II, Recipients: See Distribution List, December 8, 1989.
P.	100009-100010	Pollution Report Five (5), Removal Action, Howland Hook Marine Terminals, Staten Island, New York, prepared by Mr. Joseph Cosentino, On-Scene Coordinator, Response and Prevention Branch, U.S. EPA, Region II, Recipients: See Distribution List, January 25, 1990.
P.	100011-100012	Pollution Report Six (6), Removal Action, Howland Hook Marine Terminals, Staten Island, New York, prepared by Mr. Joseph Cosentino, On-Scene Coordinator, Response and Prevention Branch, U.S. EPA, Region II, Recipients: See Distribution List, March 15, 1991.

P. 100013-100014 Pollution Report Seven (7), Removal Action, Howland Hook Marine Terminals, Staten Island, New York, prepared by Mr. Joseph Cosentino, On-Scene Coordinator, Response and Prevention Branch, U.S. EPA, Region II, Recipients: See Distribution List, April 30, 1991.

P. 100015-100016 Pollution Report Eight (8), Removal Action, Howland Hook Marine Terminals, Staten Island, New York, prepared by Mr. Joseph Cosentino, On-Scene Coordinator, Response and Prevention Branch, U.S. EPA, Region II, Recipients: See Distribution List, May 12, 1993.

1.6 Sampling Plan

P. 100017-100182 Plan: Sampling QA/QC Plan for the United States Lines Marine Department Stores Yard, Howland Hook Container Terminal, Staten Island, New York, prepared by Weston (A Business Trust), prepared for The Port Authority of New York and New Jersey, September, 1989.

1.7 Sampling Data/Data Summary Sheets/Chain of Custody Forms

P. 100183-100183 The actual document is available for review in the Howland Hook Marine Terminal site file. Site files are located at the U.S. EPA, Region II, Removal Record Center, Building 205, 2890 Woodbridge Avenue, Edison, New Jersey, 08837.

U.S. Environmental Protection Agency

POLLUTION REPORT

Region II
Response and Prevention Branch
Edison, New Jersey 08837

201-548-8730 - Commercial & FTS
24-Hour Emergency

TO: W. Muszynski, EPA
S. Luftig, EPA
R. Salkie, EPA
J. Frisco, EPA
B. Sprague, EPA
M. Randol, EPA
C. Simon, EPA
ERD, WH-548B (E-Mail)
TAT
NRC
NYSDEC, Region II
NYCDEP
USCG, COTPNY
LEPC

POLREP NO.: One and Final
INCIDENT/SITE NO.: 295-89
POLLUTANT: Abandoned materials
CLASSIFICATION: Potential major
SOURCE: Abandoned facility
LOCATION: Howland Hook Terminals
Staten Island, N.Y.
AMOUNT: Unknown
WATER BODY: Old Creek, Arthur Kill

1. SITUATION:

On January 6, 1989, at 1820 hours, EPA was notifed by the Port Authority of New York and New Jersey of an abandoned facility containing hazardous materials.

On January 9, 1989 a meeting was held at the Howland Hook Marine Terminal in Staten Island, New York to assess an area identified as the ship stores yard and develop a plan to futher investigate the site and identify appropriate remedial measures. The meeting was attended by the following organizations;

Port Authority of New York & New Jersey
Roy F. Weston (Port Authority Contractor)
New York City Department of Environmental Protection
New York State Department of Environmental Concervation
United States Coast Guard
N.Y. Fire Department - Haz Mat 1
N.Y. City Department of Ports, International Trade and Commerce
U.S. Environmental Protection Agency

The City of New York is the owner of the Howland Hook Marine Terminal. The City had entered into an agreement with United States Lines to operate the facility. When the City and United

100001

States Lines required additional financing to update and modernize the facility, the Port Authority provided finances and entered into a lease agreement with the City and United States Lines. United States Lines became a sublessee of the Port Authority.

Approximately two years ago, United States Lines filed for bankruptcy in Federal Bankruptcy Court. Presently, the City and Port Authority are in litigation concerning the status of their agreement with U.S. Lines.

The ship stores yard was utilized by United States Lines to provide materials and services in connection with the operation and maintenace of its ocean-going vessels, which docked at the facility. The yard lies immediately north of the access ramp to the Goethals Bridge at the foot of Western Avenue. Old Creek borders the southern end of the facility and the Arthur Kill the western. The yard is fenced and egress controlled by the Port Authority. The yard consist of five buildings, four box trailers and numerous abandoned materials. These materials include: approximately 25 cylinders (15 labeled and 10 unknowns), 200 fifty-five gallon drums of lube oil and diesel fuel, 100 five gallon containers of corrosives (sodium hydroxide) and various amounts of reactives, ignitables and pesticides. The containers are in various condition, some are apparently leaking and numerous ground stains were observed. In addition, an uncovered manhole was discoverer in the yard.

Personnel from the Port Authority's Environmental Management Division discovered the yard while conducting a routine site inspection during the first week of January. Their concerns resulted in notification of the National Response Center, New York State Department of Environmental Conservation, U.S. Coast Guard, U.S. Environmental Protection Agency, New York City Fire Department and the New York City Department of Ports, International Trade and Commerce. The Port Authority then arranged a meeting to discuss the site and possible remedial measures.

2. CAUSE CODE: O (abandoned facility)

3. ACTION TAKEN:

EPA's Response and Prevention staff attended ameeting to discuss

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long and short term aspects of clean-up held at 1300 hours on 1-9-89 at the Howland Marine Terminal. Personnel were briefed on the history of the terminal, specifically the ships stores yard, and the involvement of the City of New York, Port Authority and United States Lines.

Following the meeting a tour of the site was conducted. Due to the lack of overall site safety and the nature of the hazards associated with the materials observed the DEC official recommended that the tour be ended. EPA agreed and supported DEC's request. Facility personnel agreed and terminated the site tour.

Personnel reassemble to discuss site observations and make recomendations. The following concerns were brought to the attention of Port Authority personnel;

- Coast Guard representatives requested that an open manhole in the yard be covered and its discharge point boomed.
Port Authority agrees to accomplish this within 24 hours, their contractor (Roy F. Weston) also agrees.

- DEP recommends that the site be completely evaluated, secured, access restricted and clean-up activities be initiated as expediently as possible.
The Port Authority agrees to initiate a site assessment and clean-up activities. Weston personnel agree to submit a scope of work proposal within two weeks.

- The Bankruptcy Court will be asked to provide United States Lines with an "Order to Abandon" the materials subject to clean-up and removal, as these materials are presently considered assets of the company and it's creditors. The Port Authority agrees to pursue this matter.

- New York City DEP calls in the local response team, New York City Fire Department's Haz Mat 1, to evaluate the site. The team arrives at 1430. They conclude that conditions at the site do not warrant an emergency response.

- New York State DEP conducts a survey of Old Creek and find several drums in the marsh area adjacent to the creek and visually apparent contamination of the creek. They recommend that this area also be addressed in the clean-up proposal.

- New York City DEP and New York State DEC state that their departments will oversee remediation activities.

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4. FUTURE PLANS and RECOMMENDATIONS:

The abandonment of materials by United States Lines may be subject to RCRA regulation and constitute illegal hazardous waste disposal under the definition of disposal as defined in 40 CFR, Part 260, Subpart A. Therefore, this matter will be referred to EPA's Office of Waste Management.

Final Polrep __X__ Further Polreps Forthcoming _____ Submitted By Joseph V. Cosentino

Joseph Cosentino
On-Scene Coordinator
Response & Prevention Br.

Date OSC Released 1-19-89

U. S. Environmental Protection Agency

POLLUTION REPORT

Region II
Response and Prevention Branch
Edison, New Jersey 08837

201-548-8730 - Commercial & FTS
24-Hour Emergency

TO: W. Muszynski, EPA
S. Luftig, EPA
R. Salkie, EPA
J. Frisco, EPA
B. Sprague, EPA
M. Randol, EPA
ERD, WH-548B (E-Mail)
TAT
NRC
NYSDEC, Region II
NYCDEP
USCG, COTPNY
P. Simon, EPA
V. Cam, EPA

POLREP NO: Two (2)
INCIDENT NO: 295-89
POLLUTANT: Abandoned Materials
CLASSIFICATION; Potential major
SOURCE: Abandoned facility
LOCATION: Howland Hook Terminals
Staten Island, N.Y.
AMOUNT: Unknown
WATER BODY: Old Creek, Arthur Kill

1. Situation:

See POLREP number one, due to the issuance of an Administrative Consent Order EPA will assume the lead role in the oversight of the PRP's clean-up efforts. Further POLREPs are forthcoming.

2. CAUSE CODE: O (abandoned facility)

3. ACTION TAKEN:

On February 14, 1989 a draft Administrative Order was distributed for review and comment. On February 15, 1989 a confrence call was conducted to discuss the Order. The Response and Prevention Branch, Site Compliance and Office of Regional Counsel participated in this conference.

On February 16, 1989 a draft Administrative Consent Order was issued to the Port Authority of New York and New Jersey, the City of New York and United States Lines, Inc. calling for the implementation of removal activities at the Howland Hook Terminal's Marine Stores Yard. A meeting was scheduled for February 28, 1989 to discuss the draft Order.

On March 1, 1989 comments on the draft Consent Order prepared by Weston were received. On March 13, 1989 the City of New York, the Port Authority of New York and New Jersey and United States Lines provided their comments. A meeting to discuss the comments received was held on March 22, 1989.

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An inventory of materials contained in the Ships Stores Yard was started on March 2, 1989 by Weston Associates. Prior to the start of these activities baseline air monitoring and a preliminary assessment were conducted on February 22, 1989. Air monitoring, using an HNu, was continued during the inventory of site materials. Numerous materials have been identified, these include; virgin oil, waste oils, greases, acids, caustics, paints, thinners, solvents, pesticides (gas and liquid) and cylinders of oxygen and acetylene. Relatively few containers appear to be unlabeled or unknown.

United States Lines, the former operator of the Marine Stores Yard, has expressed an intrest in attempting to sell some of the material found on site or offering it for reuse. Representatives of U.S. Lines were scheduled to visit the site, to observe the condition of the containers, during the week of March 13, 1989.

On March 22, 1989 the inventory of materials in the Ship Stores Yard was completed. Presently, Weston is preparing a smpling and analysis plan. The plan will be submitted to EPA for review and comment prior to initiation.

4. FUTURE PLANS and RECOMMENDATIONS:

Weston Associates will continue with the removal activities as outlined in the scope of work previously submitted and reviewed by EPA. The Response and Prevention Branch will continue oversight of these activities.

	FURTHER POLREPs		
Final POLREP _____	Forthcoming __X__	Submitted By	Joseph V. Cosentino

Joseph Cosentino
On-Scene Coordinator
Response & Prevention Br.

Date of OSC Release 3-31-89

U. S. Environmental Protection Agency

Pollution Report

Region II
Response and Prevention Branch
Edison, New Jersey 08837

201-548-8730 - Commercial & FTS
24-Hour Emergency

To: W. Muszynski, EPA
S. Luftig, EPA
R. Salkie, EPA
J. Frisco, EPA
B. Sprague, EPA
ERD, WH-548B (E-Mail)
TAT
NRC
NYSDEC, Region II
NYCDEP
USCG, COTPNY
P. Simon, EPA
V. Cam, EPA
C. Pellegrino, EPA

POLREP NO: Three (3)
INCIDENT NO: 295-89
POLLUTANT: Abandoned Materials
CLASSIFICATION: Potential Major
SOURCE: Abandoned facility
LOCATION: Howland Hook Marine Terminals
Staten Island, N.Y.
AMOUNT: Unknown
WATER BODY: Old Creek, Arthur Kill

1. SITUATION:

See POLREP number one.

2. CAUSE CODE: 0 (abandoned facility)

3. ACTION TAKEN:

In fulfillment of the requirements of Administrative Order, Index No. II CERCLA 90206, the Port Authority of New York and New Jersey submitted a Project Work Plan, Health and Safety Plan and Sampling QA/QC Plan on June 28 and 30, 1989. These plans were reviewed by EPA and comments submitted to the Port Authority on August 16, 1989. Revised plans, incorporating all of EPA's comments, were received on September 13, 1989. Written approval to implement the work plan was transmitted to the Port Authority on October 2, 1989.

Cleanup activities are scheduled to begin on October 19, 1989, under an expedited work plan schedule that will implement various activities simultaneously.

4. FUTURE PLANS AND RECOMMENDATIONS:

PRP removal activities will be conducted in accordance with the approved work plans. The Response and Prevention Branch will continue oversight of these activities.

FINAL POLREP _____ FURTHER POLREPs FORTHCOMING ✓ SUBMITTED BY Joseph Cosentino

Joseph Cosentino
On-Scene Coordinator
Response & Prevention Br.

DATE OF OSC RELEASE 10-11-89

100007

U. S. Environmental Protection Agency

Pollution Report

Date: December 8, 1989

Region II
Response and Prevention Branch
Edison, New Jersey 08837

201-548-8730 - Commercial & FTS
24-Hour Emergency

To: S. Luftig, EPA
R. Salkie, EPA
J. Frisco, EPA
B. Sprague, EPA
ERD, WH-548B (E-Mail)
NRC
NYSDEC, Region II
NYCDEP
USCG, COTPNY
P. Simon, EPA
V. Cam, EPA
C. Pellegrino, EPA

POLREP NO: Four (4)
INCIDENT NO: 295-89
POLLUTANT: Abandoned Materials
CLASSIFICATION: Potential Major
SOURCE: Abandoned facility
LOCATION: Howland Hook Marine Terminals
Staten Island, N.Y.
AMOUNT: Unknown
WATER BODY: Old Creek, Arthur Kill

1. SITUATION:

See POLREP number one.

2. CAUSE CODE: 0 (abandoned facility)

3. ACTION TAKEN:

A. Cleanup activities, as scheduled, began on October 19, 1989, under an expedited schedule that implemented various workplan activities simultaneously.

B. On October 19 and 20, 1989, a preliminary soil gas survey was conducted by representatives of the Port Authority.

C. To date sixteen soil borings have been collected, six groundwater monitoring wells installed and all drums and containers sampled. An additional five soil borings and four monitoring wells require completion. These tasks require the use of specialty equipment (tracked drilling rig) to traverse the marsh/wetland areas to the east and north of the ships stores yard.

4. FUTURE PLANS AND RECOMMENDATIONS:

PRP removal activities will be conducted in accordance with the approved work plans. The Response and Prevention Branch will continue oversight of these activities.

FINAL POLREP _____ FURTHER POLREPs FORTHCOMING ✓ SUBMITTED BY Joseph Cosentino

Joseph Cosentino
On-Scene Coordinator
Response & Prevention Br.

DATE OF OSC RELEASE December 8, 1989

100008

U. S. Environmental Protection Agency

Pollution Report

Date: January 25, 1990

Region II
Response and Prevention Branch
Edison, New Jersey 08837

201-548-8730 - Commercial & FTS
24-Hour Emergency

To: S. Luftig, EPA
R. Salkie, EPA
J. Frisco, EPA
B. Sprague, EPA
ERD, WH-548B (E-Mail)
NRC
NYSDEC - Region II
NYCDEP
USCG, COTPNY
V. Cam, EPA
P. Simon, EPA

POLREP NO: Five (5)
INCIDENT NAME: Howland Hook Marine Terminals
INCIDENT NO: 295-89
POLLUTANT: Abandoned Materials
CLASSIFICATION: Potential Major
SOURCE: Abandoned facility
LOCATION: Howland Hook Marine Terminals
Staten Island, N.Y.
AMOUNT: Unknown
WATER BODY: Old Creek, Arthur Kill

1. SITUATION:

See POLREP number one.

2. CAUSE CODE: 0 (abandoned facility)

3. ACTION TAKEN:

A. Cleanup activities, as scheduled, began on October 19, 1989, under an expedited schedule that implemented various workplan activities simultaneously.

B. On January 23, 1990 all perliminary sampling activities were completed. These activities included the sampling of all containers requiring off site disposal, the collection of 22 soil borings and the installation and sampling of 10 groundwater monitoring wells.

C. All soil and ground water samples, including associated QA/QC samples, will be analized for VOC, BNA, pesticides, metals, cyanide, petroleum hydrocarbons and PCBs. Sample analysis will be performed by Weston Analytics. The Port Authority expects to receive preliminary sampling data by the begining of February, 1990.

D. The Port Authority expects to receive bids, on the sampling and disposal of the 20 gas cylinders, shortly.

E. CX Press Trailer Repair, Inc. of Richmond, Virginia has expressed an intrest in reuse/recycling of some paints and lubricants. CX Press has submitted an affidavit stating that they are willing to accept this material for use in their operations. RPB has contacted EPA Region III and the State of Virginia for information on CX Press, if available, prior to approval of this action.

4. FUTURE PLANS AND RECOMMENDATIONS

PRP removal activities will be conducted in accordance with the approved work plans. The Response and Prevention Branch will continue oversight of these activities.

FINAL POLREP _____ FURTHER POLREPs FORTHCOMING ✓ SUBMITTED BY Joseph Cosentino

Joseph Cosentino
On-Scene Coordinator
Response & Prevention Br.

DATE OF OSC RELEASE 1-25-90

U.S. ENVIRONMENTAL PROTECTION AGENCY
PROGRESS POLLUTION REPORT

I. **Heading**

Date: March 15, 1991
From: Joseph V. Cosentino, OSC

To:
R. Salkie, EPA
B. Sprague, EPA
D. Kodama, EPA
J. Frisco, EPA
P. Simon, EPA
V. CAM, EPA
ERD, OS-210 (E-Mail)
NRC
USCG, COPNY
NYDEC, Region II
NYCDEP

Subject: Howland Hook Marine Terminals
POLREP: POLREP Six (6)

II. **Background**

Site No: 3Y
Response Authority: CERCLA
NPL Status: non-NPL
Start Date: June 6, 1989

III. **Response Information**

A. **Situation**

See POLREP No. one (1).

B. **Actions Taken**

During the week of March 16, 1991 all remaining drums, containers and cylinders were removed from the ship's stores yard. In addition, all buildings and structures on the site have been removed and limited surface contamination removed. The OSC inspected the site on April 11, 1991 to confirm the removal and inspect the site for areas of surface soil contamination. Two (2) suspect areas were identified. The Port Authority of New York and New Jersey was notified and will address these areas in accordance with the requirements of Administrative Order, Index No. II CERCLA 90206.

C. **Next Steps**

EPA is currently reviewing soil and groundwater sampling data to determine if additional site remediation is required. A preliminary review indicates areas of significant soil contamination. However, groundwater data indicates that these contaminants are not mobile, as these contaminants are not found in the underlying groundwater table.

The removal of visible surface soil contamination and soil remediation, if necessary, will complete the clean-up of the Howland Hook Marine Terminals, Ship's stores yard.

D. **Key Issues**

Delays were encountered when the Port Authority of New York and New Jersey elected to terminate the services of their removal contractor and complete the removal with in-house personnel. In addition, problems were encountered securing the necessary waste approvals and acceptance, due to the mixture and volume of wastes found on-site.

U.S. ENVIRONMENTAL PROTECTION AGENCY
PROGRESS POLLUTION REPORT

I. **Heading**

Date: April 30, 1991
From: Joseph V. Cosentino, OSC Joseph Cosentino

To:
K. Callahan, EPA
R. Salkie, EPA
B. Sprague, EPA
D. Kodama, EPA
J. Frisco, EPA
P. Simon, EPA
V. Cam, EPA
ERD, OS-210 (E-Mail)
NRC
USCG, COPNY
NYDEC, Region II
NYCDEP

Subject: Howland Hook Marine Terminals
POLREP: POLREP Seven (7)

II. **Background**

Site No: 3Y
Response Authority: CERCLA
NPL Status: non-NPL
Start Date: June 6, 1989

III. **Response Information**

A. **Situation**

See POLREP No. one (1).

B. **Actions Taken**

On April 25, 1991 the OSC met with the Port Authority and it's clean-up contractor to delineate two (2) areas of visible soil contamination. The Port Authority has agreed to excavate these areas and dispose of the soil. This will complete the removal/remediation of surface contamination at the subject facility as per the requirements of Administrative Order, Index No. II CERCLA 90206.

A review of data collected from soil borings and groundwater monitoring wells has been completed. This data indicates that the soil beneath the site is contaminated with organic and inorganic constituents. However, the resulting groundwater monitoring data indicates that these contaminants, with the exception of zinc, silver and arsenic, are not impacting the underlying groundwater table. Zinc was found at all ten (10) groundwater sampling locations, silver at two (2) and arsenic at one (1).

C. **Next Steps**

The removal of visible surface soil contamination is tentatively scheduled for sometime over the next two weeks. This will complete the clean-up of surface contamination at the Howland Hook Marine Terminals, Ship's stores yard.

Based upon the review of sampling data and the inference that the contaminants appear non-mobile and indigenous to the site's fill material, the OSC will suggest the following:

1. The asphalt surface of the site should be repaired and/or replaced to prevent the infiltration of precipitation and

2. The groundwater monitoring wells be sampled periodically for the compounds detected in the soil to verify that they are immobile and not impacting the groundwater table.

Initiation of the above recommendations would conclude site remediation activities, unless groundwater conditions dictate otherwise.

D. **Key Issues**

Delays were encountered when the Port Authority of New York and New Jersey elected to terminate the services of their removal contractor and complete the removal with in-house personnel. In addition, problems were encountered securing the necessary waste approvals and acceptance, due to the mixture and volume of wastes found on-site.

U.S. ENVIRONMENTAL PROTECTION AGENCY
FINAL POLLUTION REPORT

I. **Heading**

Date: May 12, 1993
From: Joseph V. Cosentino, OSC

To:
K. Callahan, EPA
R. Salkie, EPA
B. Sprague, EPA
J. Daloia, EPA
J. Frisco, EPA
P. Simon, EPA
G. Pavlou, EPA
ERD, OS-210 (E-Mail)
NRC
USCG, COPNY
NYDEC, Region II
NYCDEP

Subject: Howland Hook Marine Terminals
POLREP: POLREP Eight (8)

II. **Background**

Site No: 3Y
Response Authority: CERCLA
NPL Status: non-NPL
Start Date: June 6, 1989

III. **Response Information**

A. **Situation**

See POLREP No. one (1).

B. **Actions Taken**

On May 4, 1993 the OSC inspected the former Ship's Stores Yard at the Howland Hook Marine Terminals in Staten Island, New York. The Port Authority of New York and New Jersey had completed all aspects of the removal/remediation activities required under Administrative Consent Order, Index No. II CERCLA-90206.

The asphalt surface of the site had been repaired and/or replaced to minimize the infiltration of precipitation through the underlying soil.

C. **Next Steps**

1. No further action is anticipated or required. The completion of the above mentioned activities have concluded site remediation activities at the subject facility under the Administrative Consent Order.

D. **Key Issues**

Delays were encountered when the Port Authority of New York and New Jersey elected to terminate the services of their removal contractor and complete the removal with in-house personnel. In addition, problems were encountered securing the necessary waste approvals and acceptance, due to the mixture and volume of wastes found on-site.

THE PORT AUTHORITY OF NY & NJ
One World Trade Center
New York, New York 10048

Sampling QA/QC Plan for the United States Lines Marine Department Stores Yard, Howland Hook Container Terminal, Staten Island, New York

September 1989

Prepared By:

WESTON
MANAGERS DESIGNERS/CONSULTANTS
Raritan Center
Raritan Plaza 1
Edison, New Jersey 08837

SAMPLING QUALITY ASSURANCE / QUALITY CONTROL PLAN

For The

United States Lines Marine Department Stores Yard,
Howland Hook Container Terminal,
Staten Island, New York

September 1989

Prepared By:

WESTON (A BUSINESS TRUST)

1 Raritan Plaza
Raritan Center
Edison, New Jersey 08037

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SECTION 1

QUALITY ASSURANCE/QUALITY CONTROL

1.1 INTRODUCTION

This Sampling (QA/QC) Plan is one of three planning documents that describes activities to be undertaken as part of the Administrative Order on Consent between the Port Authority of New York and New Jersey, the City of New York and the USEPA on the United States Lines Marine Department Stores Yard, Howland Hook Marine Terminal, Staten Island (Richmond County), New York. The other documents are:

- Work Plan - presents the available information concerning the site's history and potential hazards, and activities proposed to assess the nature and extent of contaminates there and the threat posed by that contamination.

- Health and Safety Plan (HSP) - contains 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 purpose of the QA/QC 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 United States Lines Marine Department Stores Yard (Stores Yard), Howland Hook Container Terminal, Staten Island, New York. is located in an industrial section of Staten Island, New York, immediately north of the access ramp to the Goethals Bridge at the foot of Western Avenue. Old Place Creek borders the southern end

of the Stores Yard, and a marshy area leading to the Arthur Kill borders the western end of the Stores Yard. The site is approximately one acre in size and encompasses five buildings, four box trailers and, as described below, numerous abandoned materials. Figure 1-1 shows the location of the site. A summary inventory of materials found on the site is included in the work plan.

The Stores Yard was utilized by the United States Lines in connection with the operation and maintenance of its ocean-going vessels which docked at the Howland Hook Marine Terminal. United States Lines has filed for bankruptcy in the Federal Bankruptcy Court. The City and Port Authority are in litigation concerning the status of the City - Port Authority - U.S. Lines Agreements in view of the bankruptcy action.

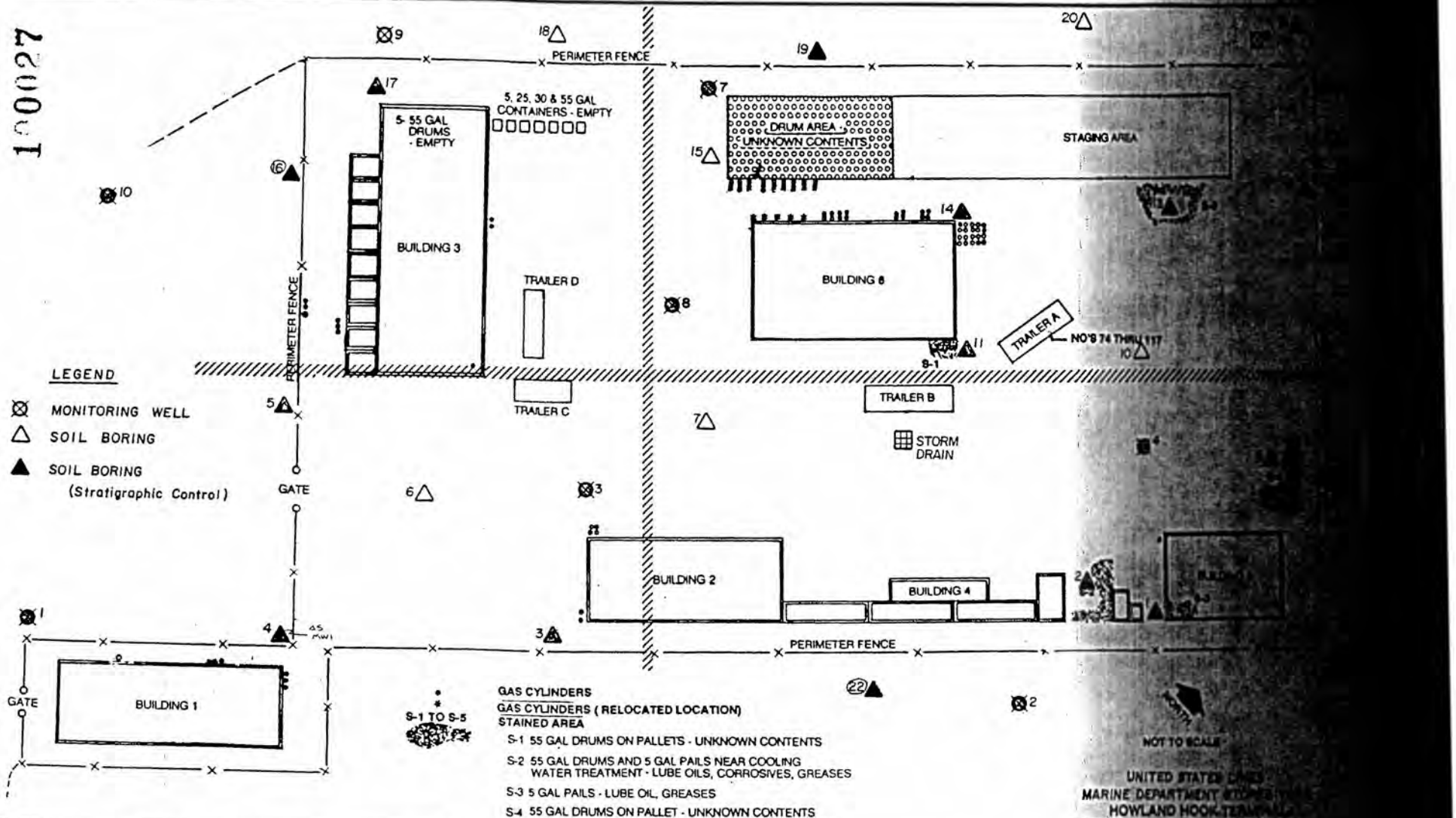
1.2.2 Background

Under the terms of the Administrative Order, Index No. II CERCLA 90206, effective 6 June 1989, the Port Authority of NY and NJ (Port Authority), and the City of New York have assumed responsibility for the removal of hazardous substances from the Stores Yard.

The City of New York is the owner of the Howland Hook Marine Terminal since 1972. The City had entered into a long-term agreement with United States Lines to lease and operate the facility in 1973. When the City and United States Lines required additional financing to modernize the facility, the Port Authority provided the finances and entered into a lease agreement with the City. The United States Lines became a sublessee of the Port Authority.

The Port Authority made notification to the National Response Center and various agencies on 6 January 1989 that the Stores Yard contained a number of drums and other materials showing signs of leakage into the environment. In January 1989, an initial emergency containment response action was conducted for the Port Authority by WESTON consultants, and the site was secured and stabilized with appropriate spill control measures.

The United States Environmental Protection Agency (EPA) has determined that the release and threat of release of hazardous substances to the environment from the Stores Yard may present an imminent and substantial endangerment to the public health, welfare and the environment within the meaning of Section 106(a) of CERCLA, 42 U.S.C. 9606(a).



WESTON — THE PORT AUTHORITY	SAMPLING LOCATION MAP
U.S LINES MARINE DEPARTMENT STORES YARD	FIGURE 1-2

1.2.3 Project Objectives

The primary objective of this effort is to sample and analyze the soil, sediments, groundwater, and surface water at the Stores Yards. The objective of this sampling event is to assess the nature and extent of contamination and determine the threat posed by the contamination.

1.2.4 Project Scope

The Scope of Work for the Stores Yard includes both general activities (ambient air monitoring and maintenance of sorbent booms) and site-specific activities. Site-specific field activities include test borings, monitor well installation, and sampling and analysis of soils/sediments, groundwater, and surface water. Specific protocols for each activity are addressed in Section 2.

Soil samples will be collected at locations on and surrounding the site. In addition samples will be collected where visibly stained soil is present. Sediment samples will be collected from below the storm water outfall and on the bank of the Old Place Creek branch adjacent to the site.

Groundwater samples will be collected from the monitoring wells located hydraulically up-gradient and downgradient from the site. The proposed locations are shown in Figure 1-2.

One surface water sample will be collected from the storm water outfall which receives runoff from the Stores Yard.

The proposed sample locations are shown in Figure 1-2. The final location of the soil borings and monitor wells will be contingent upon the actual site conditions and access.

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:

- Initial subsurface investigations (test borings, and soil sampling) and associated geophysical investigations and surveying.

Table 1-1

Summary of Analytical Methods -

Parameter	Methods (Soil/Sediment)	Methods (Water)
Organics[1]		
VOAs	EPA CLP Statement of Work for Organics Analysis[2]	
BNAs	EPA CLP Statement of Work for Organics Analysis[2]	
Pesticides/PCBs	EPA CLP Statement of Work for Organics Analysis[2]	
Inorganics[2]		
As	EPA CLP Statement of Work for Inorganics Analysis	
Se	EPA CLP Statement of Work for Inorganics Analysis	
Pb	EPA CLP Statement of Work for Inorganics Analysis	
Hg	EPA CLP Statement of Work for Inorganics Analysis	
ICP Metals[3]	EPA CLP Statement of Work for Inorganics Analysis	
Cyanide	EPA CLP Statement of Work for Inorganics Analysis	
Total Petroleum Hydrocarbons	SW9071[4]/E418.1[5]	NA

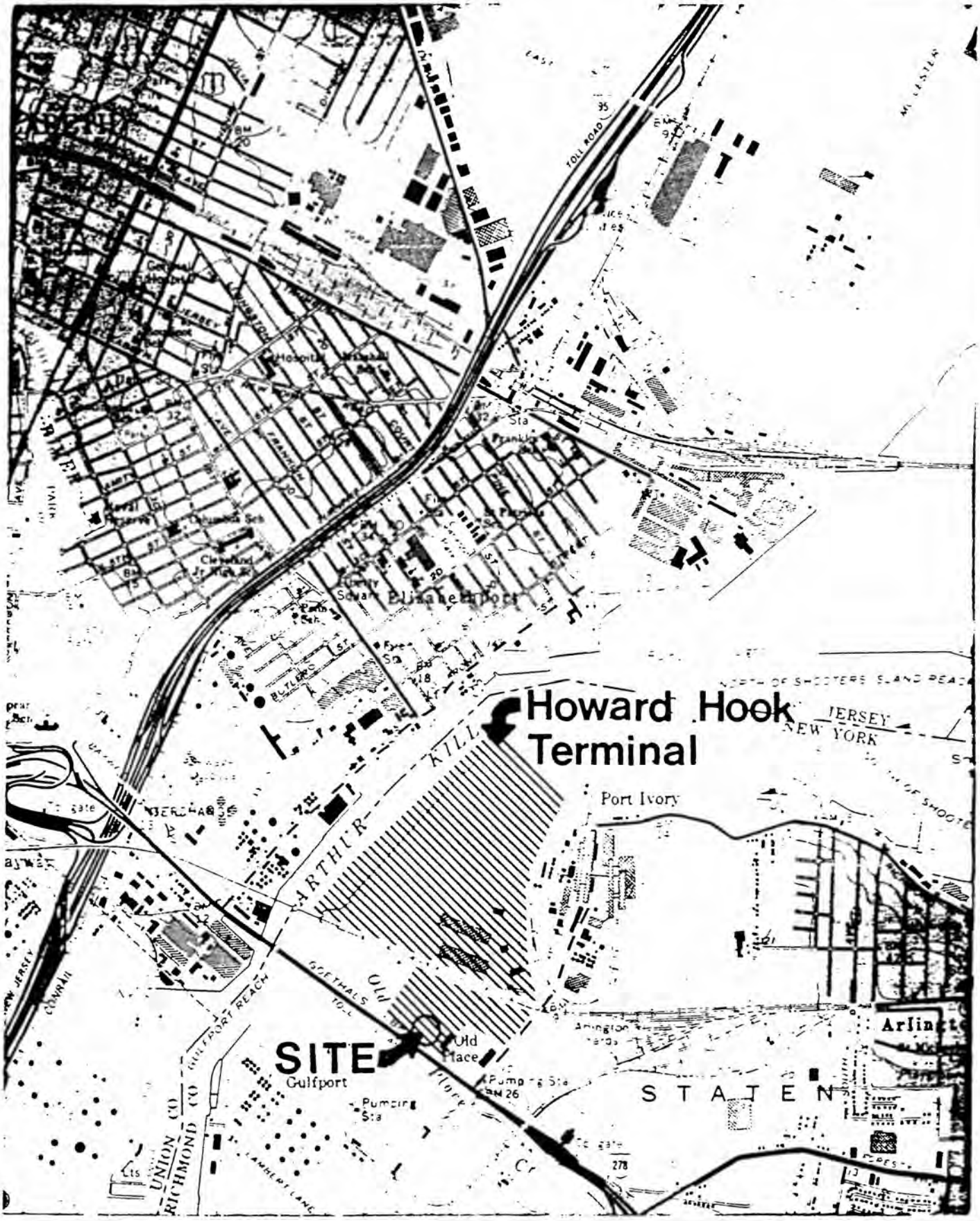
1 EPA CLP Statement of Work for Organic Analysis Multi-media, Multi-concentration 2/88 with revisions

2 EPA CLP Statement of Work for Inorganic Analysis Multi-media, Multi-concentration 7/88 with revisions

3 Includes nineteen additional metals by ICP. See Appendix B for full list.

4 EPA SW 846, Test Methods for Evaluating Solid Waste EPA 600/4-79-020 revised 3/83.

5 EPA-600/4-79-020, Methods for Chemical Analysis of Water and Waste, March 1983 revision.



WESTON THE PORT AUTHORITY	LOCATION MAP	FIGURE 1-1
U.S. LINES MARINE DEPARTMENT STORES YARD	SCALE: 1" = 2000'	

- Monitor well installation, follow-on subsurface investigation, associated surveying, and first round water and sediment sampling.

One draft report and a final report are planned to document the results of field work and preliminary remedial action evaluation. The actual Scope of Work and schedule may be revised by the Port Authority, after consultation with the United States Environmental Protection Agency, 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.

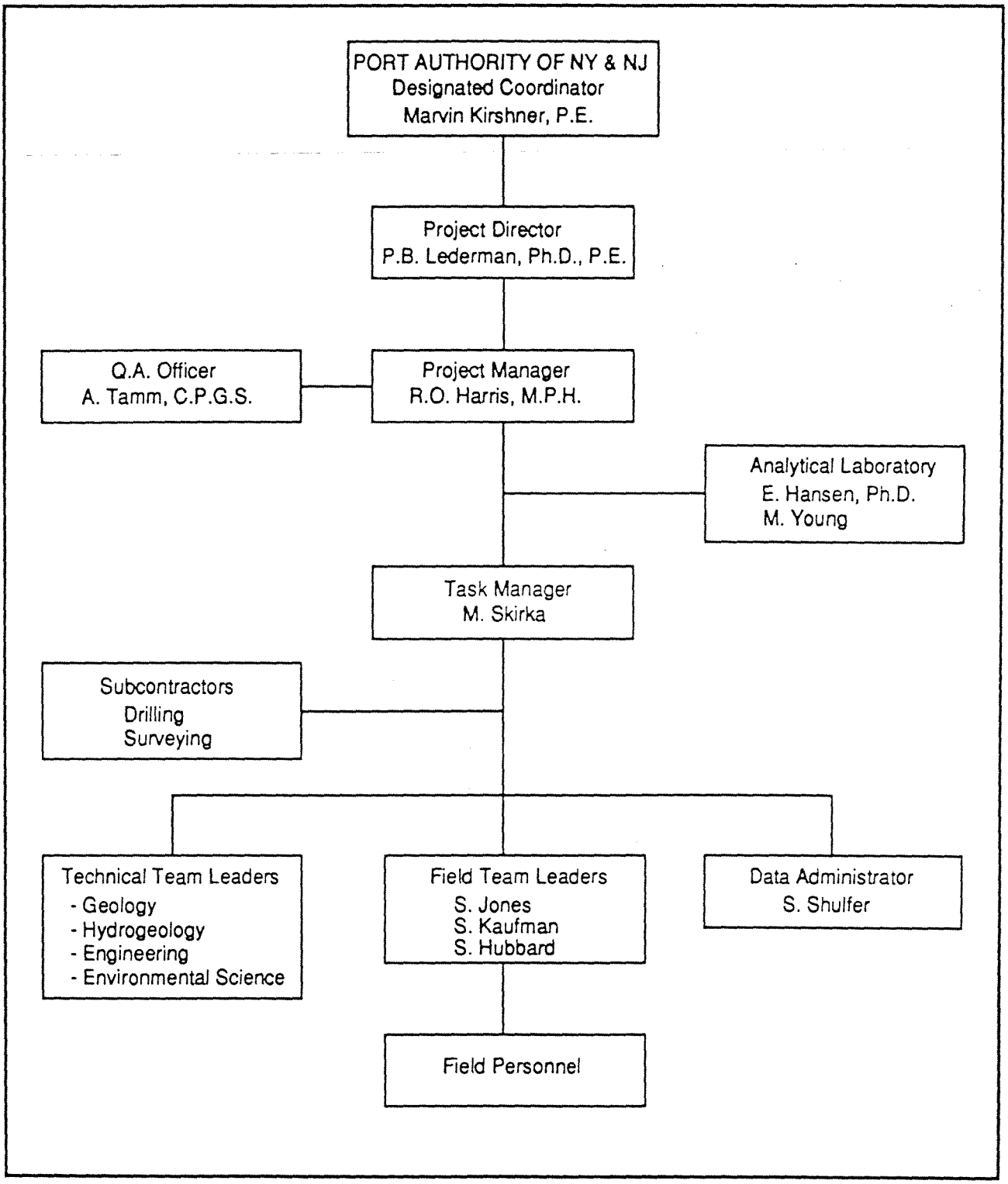
The Project Director, Peter B. Lederman, Ph.D., P.E., is responsible for overall management and quality assurance for this Port Authority project. His responsibility includes ensuring that all necessary corporate resources for the successful completion of the project are provided. The Program Director is the primary point of contact between the Port Authority and WESTON.

The Project Manager, Robert O. Harris, along with the Project Director, is responsible for technical and financial management of this project and is the direct contact individual between the Port Authority and WESTON.

The Task Manager is responsible for technical management of this task assignment including scheduling, subcontracting, communications, technical supervision, and execution of the field effort. Assisting the Task Manager are the Technical Leads for the project, the Field Supervisor, and the Data Administrator.

The Technical Leads are responsible for tracking technical progress within the project scope relating to each of their disciplines (engineering; geosciences including geology, hydrology, and soil science; and environmental sciences including biology, toxicology, and public health) and ensuring that the technical objectives of the Scope of Work 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 Task 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 Field Supervisor is responsible for coordinating the activities



PROJECT ORGANIZATION CHART
FIGURE 1-4

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 QA/QC as they apply to the field effort, for keeping the field teams supplied, and for coordination of logistical issues. The Field Supervisor prepares daily field reports during all field activities and communicates progress and problem areas to the Task Manager on a daily basis. The Field Supervisor also is responsible for coordination and day-to-day contact with the Point-Of-Contact (POC). The Data Administrator is responsible for ensuring data validation and 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 and well 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 Quality Assurance Officer for the project will report directly to the Project Manager and Program Director. The QA Officer is responsible for conducting unannounced field visits to observe data collection procedures and for periodic 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 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 (EPA 540/G-87/0003A).

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 ratio X/T. For this project accuracy will

be expressed as the ratio X/T. 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 manufactures' 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

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:

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

where:

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

1.4.3 Completeness

Completeness is a measure of the relative number of data points which meet all the acceptance criteria including accuracy, precision, and any other required by the specific analytical method used.

It is usually a comparison of actual numbers of valid data points and expected numbers of valid data points which is expressed as a percentage.

Access to various areas and/or media along with unanticipated difficulties with sample collection affect field data completeness. For example, poor sample recovery in a split-spoon sample reduces the number of soil samples that can be collected and, therefore, affects the completeness.

Difficulties encountered during sample handling in the laboratory as well as unforseen complications regarding analysis methods may affect completeness during sample analysis. For example, the analytical methods proposed for use (particularly for the organics analyses) are intended for analysis of "environmental samples" of low- and medium-level concentrations, and the applicability of these methods to unknown or hazardous- level samples may result in poor method performance and have, therefore, an adverse impact on achieving the data completeness goal.

The overall completeness goal for investigations at the Stores Yard is 85 percent.

There are certain data points which are considered critical to the investigation. Critical data points are sample locations for which valid data must be obtained in order that the sampling event be considered complete, and/or that can be expressed by a percentage of samples taken in a medium. An 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 Stores

Yard investigation will be determined in the field by the Task Manager and the Technical Lead with the Field Supervisor prior to the initiation of each applicable field activity. Because of the importance of these critical data points, the completeness goal for these points is 100 percent.

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.

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 protocols to be used for obtaining and analyzing samples, data sets should be comparable regardless of who obtained the sample or performed the analysis.

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

In general, sampling and analysis procedures, including sample preservation and holding times for the relevant chemical analyses and matrices and the CLP SOW, will strictly comply 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

FEDERAL REGISTER

VOL 51, NO 114, 13 June 1986	Toxicity Characteristic Leaching Procedure (TCLP)

Manuals

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)
SW-846	Test Methods for Evaluating Solid Waste, Third Edition (1986)

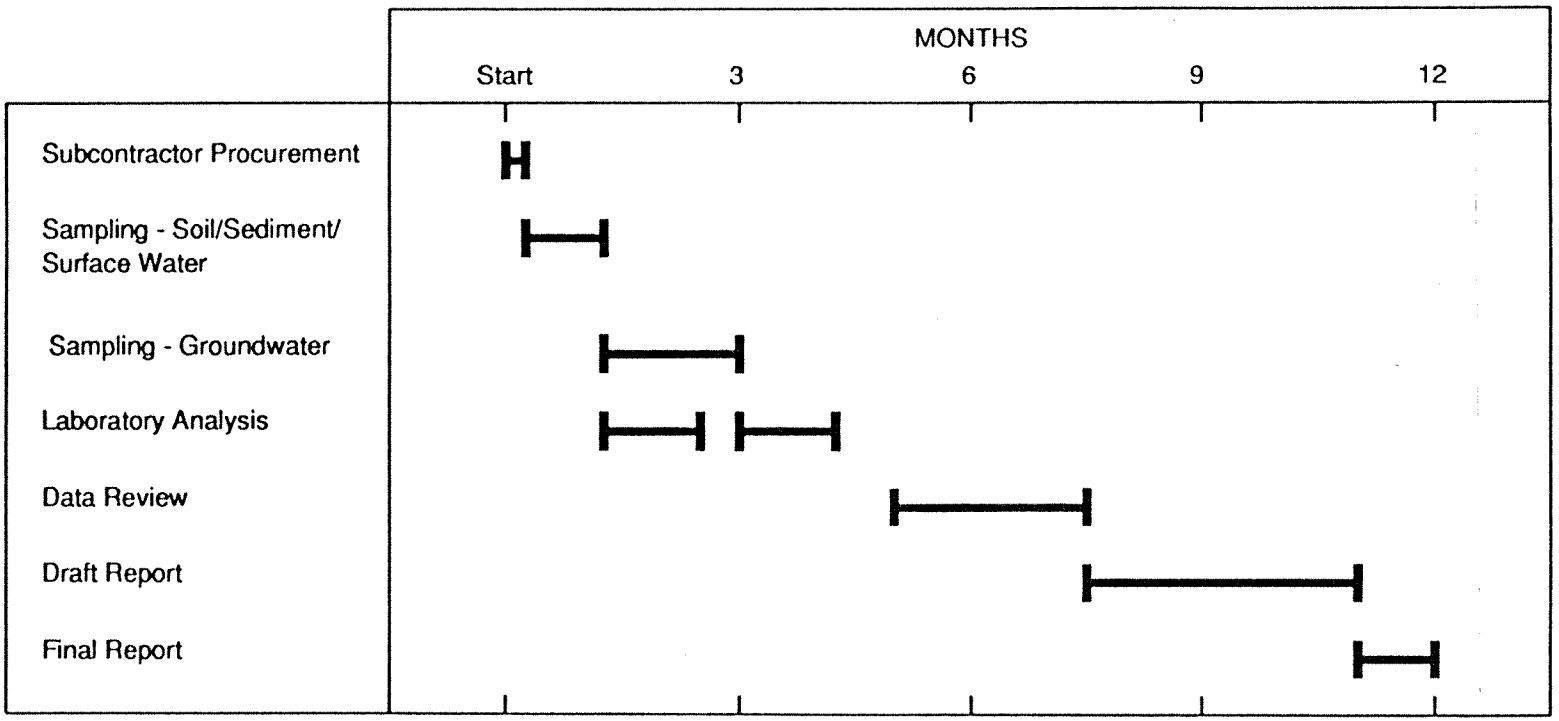
AMERICAN PUBLIC HEALTH ASSOCIATION (APHA, AWWA, & WPCF)

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-2487	Unified Soil Classification System
D-2488	Recommended Practices for Visual- Manual Description of Soils

FIGURE 1-3
PROPOSED SCHEDULE OF WORK



Handbooks

ENVIRONMENTAL PROTECTION AGENCY

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

Guidance Documents

ENVIRONMENTAL PROTECTION AGENCY

EPA-540/G-85-002 Guidance on Remedial Investigations under CERCLA

EPA-540/G-85-003 Guidance on Feasibility Studies under CERCLA

Specific methodologies to be followed, including any revisions to techniques in the above listed documents which are required by the Port Authority 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 (base) name.
- Parameters to be analyzed.
- Preservative (if any).
- 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.

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.

FIGURE 1-5

WESTON

Custody Transfer Record/Lab Work Request

Received By _____ Client _____ RFW Contact _____

Date _____ Client Contact _____ Date Due _____

Assigned to _____ Phone _____ Project Number _____

SAMPLE IDENTIFICATION						ANALYSES REQUESTED							
Sample No.	Client ID No.	Description	Matrix	Date Collected	Container/Preservative								

Matrix:
S- Soil DS- Drum Solids
W- Water DL- Drum Liquids
O- Oil X- Other

Special Instructions:

Items/Reason	Relinquished By	Received By	Date	Time	Items/Reason	Relinquished By	Received By	Date	Time

100141

RFW 21-21-001/A 1/86

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.

- 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° +/- 2°C. The temperature is monitored by the laboratory security system and recorded daily in a bound log by the sample custodian. 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 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.

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

WESTEN

SAMPLE DIGESTION RECORD

Digestion Date _____ Digestion Batch No. _____ Analyst _____

Completion Date _____ Type of Prep. _____ Method _____

Parameters _____ Client _____

Type of Analysis _____ Matrix _____

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

Comments:

FIGURE 1-7 SAMPLE DIGESTION RECORD

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 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 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 non-working hours by using a key and the passcode for the building security system.

Any breach of security during non-working 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 sample 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. They are listed in Table 1-2.

- Location Identifier - A three-digit designation will be used to identify the sample location within each site such as the number of a monitor well or soil boring.

- 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:

  S - Shallow soils (test pits, power auger holes, hand trowels)
  M - Monitor wells
  B - Soil borings
  W - Surface water and seeps
  D - Sediment samples

  The remaining three characters will be digits and will be used to provide additional information depending on the type of sample. For a monitor well or surface water sample, the three digits will indicate from which sampling round the sample came, e.g., 001, 002, etc. For a soil or sediment sample, the three digits will indicate the depth sequence from which the soil sample was obtained, e.g., 001, 002, 010 (S-1, S-2, S-10, etc.). The depth interval for that sample number will be cross-referenced in the field logs.

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.

TABLE 1-2

SUMMARY OF SITE IDENTIFIER NUMBERS

Site #	Site Name	Site Identifier#
1	Quandrant 1	01
2	Quandrant 2	02
3	Quandrant 3	03
4	Quandrant 4	04
5	Building 1	05
	Surface Water/System	
	Arthur Kill	30

Provision will be made where circumstances require a slight modification to the numbering sequence for a specific sample. Two typical sample numbers follow:

- 02-001-M001 - groundwater sample collected from monitor well 1, Quadrant 2 during the first sampling round.
- 02-001-B004 - Soil sample number 4 taken from boring 1 at quadrant 02 at a depth of 14 to 16 feet cross referenced in the field notebook).

Monitor Wells

The last four characters 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 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.

- 02-505-M101 - Field duplicate of the groundwater sample collected from monitor well 505, Quadrant 2, sampling round 1.
- 02-001-B105 - Field duplicate soil sample taken from boring 001 at Quadrant 02, sample S-5.

Equipment Blanks

The first character of the sample identifier will denote the sample type. The next three characters will be digits, the first of which will always be a 2 to indicate an equipment blank. The next two digits will indicate from which sampling round the sample was collected. The site and location identifiers for the equipment blank will be the numbers of the location and corresponding site which was sampled immediately prior to collecting the equipment blank.

- 02-505-M201 - Equipment blank collected during round 1

immediately after sampling monitor well 505 at Quadrant 2.

Trip Blanks

The first character of the sample identifier will denote the sample type. The next three characters will be digits, the first of which will always be a 3 to denote a trip blank. The next two digits will indicate from which round the sample was collected. 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.

- 02-505-M301 - Trip blank collected during round 1; 02-505 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.

Ambient Blanks

The first character of the sample identifier will denote the sample type. The next three characters will be digits, the first of which will be a 4 to denote an ambient blank. The next two digits will indicate from which round the sample was collected. The site and location identifiers will be the number of the location and corresponding site of the last sample collected at that site.

- 02-505-M401 ambient blank collected during round 1 at Quadrant 2; (for illustration, the last well sampled at that site was monitor well 505).

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 TVO field screening.

In general, all groundwater and surface water samples at the Stores Yard 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. 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 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.

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).
- Laboratory equipment (including both inorganic and organic analytical equipment).

1.7.1 Field Equipment

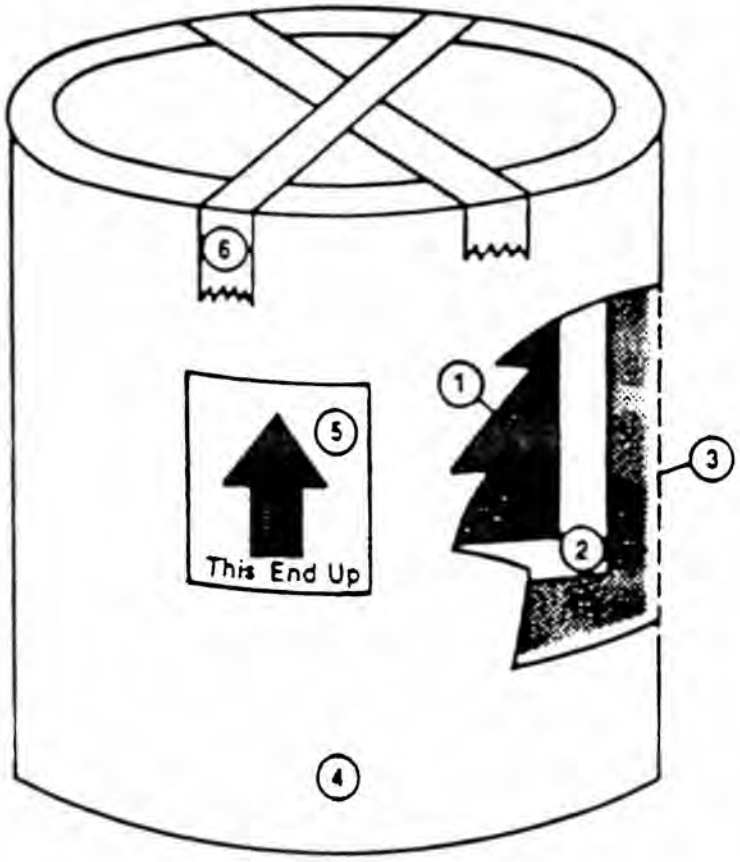
The in-field analytical instruments to be used during the Stores Yard investigation are listed below:

- HNu Photoionization Analyzer
- Organic Vapor Analyzer (OVA)
- Combustible Gas Indicator (CGI) or Explosimeter
- MSA Samplair Pump and Gas Detector Tubes
- Gillian Low-Volume Air Samplers
- Drager Tubes
- pH Meter
- Charcoal Tubes

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

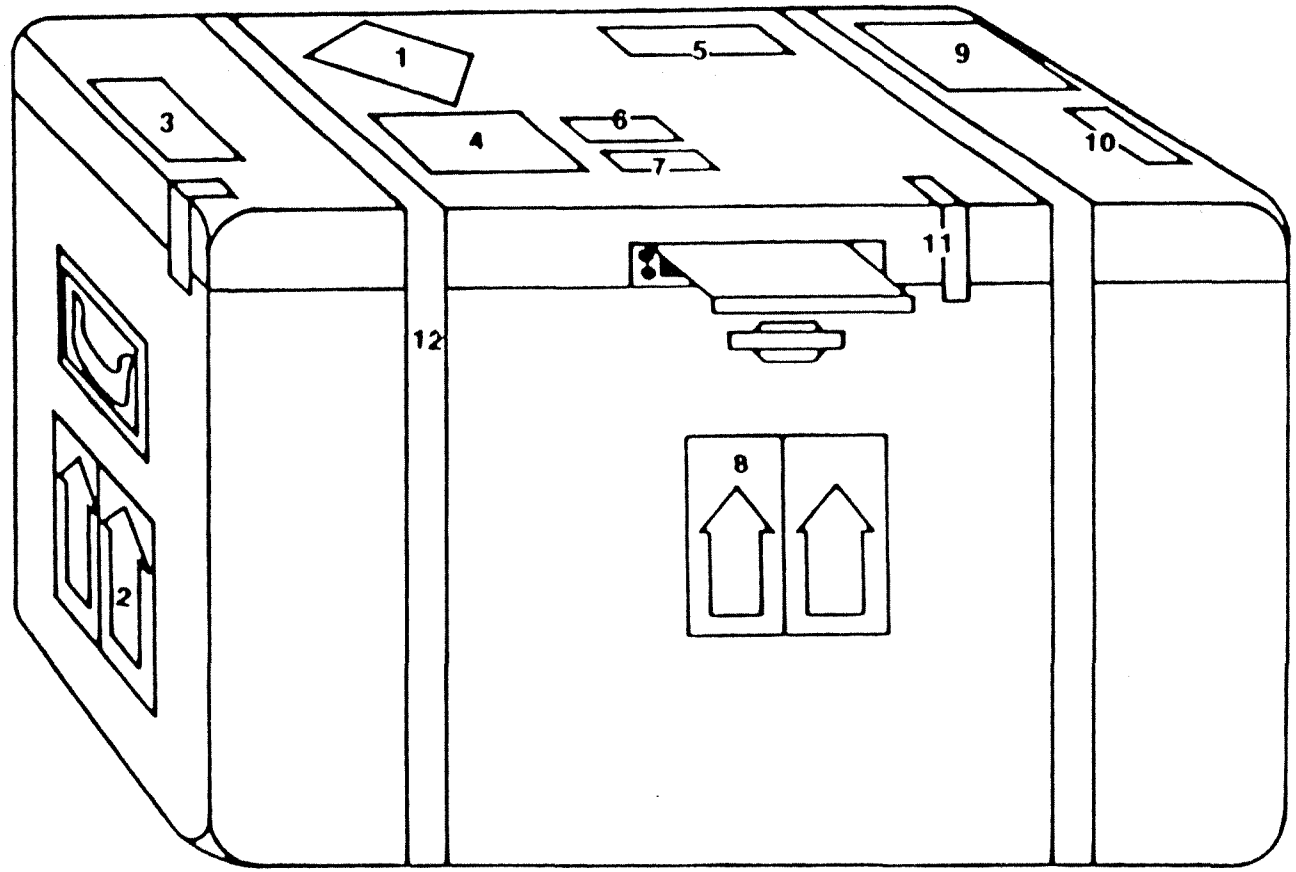
The HNu photoionization analyzer is designed to measure the



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

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 ultra-violet 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.

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 prior to use on a daily basis in a well-ventilated area.

1.7.1.3 Explosimeter/Combustible Gas Indicator (CGI)

The explosimeter or combustible gas indicator (CGI) is an air monitoring device designed to indicate a flammable/explosive atmosphere and the level of oxygen present. The CGI registers combustible gas or vapors in terms of their Lower Flammability

Limit (L.F.L.) which is the lowest concentration at which a combustible gas may ignite (or explode) under normal atmospheric conditions. Since the instrument measures both the level of oxygen in the atmosphere and the level a combustible gas reaches before igniting, the calibration of the instrument comprises a two-step process.

The oxygen portion of the instrument is calibrated by placing the meter in normal atmospheric air and rotating the CAL. OXYGEN control knob until the oxygen meter reads exactly 20.9 percent oxygen. This calibration will be done once daily when in use.

The combustible gas indicator is calibrated to methane at the laboratory to indicate directly the percentage L.F.L. of methane in air.

It is recommended that the gas detector be calibrated at least once every month and whenever the detector filament is replaced. The calibration kit included with the CGI contains a calibration gas cylinder, a valve attachment to release the calibration gas, flexible tubing (delivery tube), and a cylinder to encapsulate the sensor probe.

Recalibration Instructions

1. Disassemble case by removing the four retaining screws.

2. Allow the instrument to warm up for 15 minutes.

3. Assemble the calibration gas tank and delivery tube/ cylinder.

4. Carefully open the valve on the gas tank to bathe the sensor with just enough gas to cause the needle on the L.F.L. meter to move.

5. Adjust the L.F.L. CAL. control screw on circuit board until the percentage L.F.L. meter indicates exactly the correct L.F.L. as indicated on the calibration gas cylinder.

Calibration in an atmosphere of combustible gases requires a source of methane test gas and a source of compressed air:

1. Using compressed air, bathe the gas sensor in a flow of air, and adjust the ZERO L.F.L. control knob.

2. Calibrate the oxygen meter by rotating the CAL. OXYGEN control knob until the oxygen meter indicates 20.9 percent.

3. Using the methane test gas, bathe the sensor in a flow of test

gas and calibrate, if necessary, by adjusting the L.F.L. CAL. control screw on the circuit board.

1.7.1.4 MSA Samplair Pump/Draeger Pump and Gas Detector Tubes

For health and safety purposes, air sampling pumps and gas detector tubes will be used during drilling and test pit sampling activities. For MSA universal sampling pumps, the pump filter disc should be removed and cleaned periodically by gently tapping or blowing on the surface to remove any foreign matter. Every six months the pump piston should be relubricated with high-vacuum silicone grease. Tube holders should be replaced when they show signs of wear or loss of elasticity. The test for leaks after an extended period of idleness or periodically during use is as follows.

Lock rotating head in orifice No. 4. Insert tube into tube holder. Pull handle back to lock piston into 100 cc position. Wait 2 minutes. Rotate handle to release locking mechanism. The piston should then return to the 0 cc position. If this does not occur another test should be performed. Adjust rotating head so that the locking button is positioned halfway between any two index numbers. Lock piston into 100 cc position. Wait 2 minutes and unlock. The piston should return to the 0 cc position if the seal between the piston and cylinder is adequate.

1.7.1.5 Gillian Low-Volume Air Samplers

Gillian low-volume air samplers will be used to characterize gas emissions during selected test pit excavations. The air samplers are calibrated daily before excavation begins. Calibration of the air samplers consists of determining the flow velocity of air through the sampler using a bubble meter as outlined below:

1. Connect bubble meter to air sampler pump via a clear tube with marked intervals.

2. Fill bubble meter reservoir with soapy liquid.

3. Squeeze bulb on bubble meter to release a bubble.

4. Turn on pump.

5. When bubble reaches the first mark on the tube, turn on stopwatch.

6. Turn off stopwatch when bubble reaches the second mark on the tube.

7. Turn off pump.

8. Record time of travel for bubble.

9. Divide the length the bubble traveled by the time of travel to obtain a flow velocity; record in field notebook.

1.7.1.6 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 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 analyzed after every 15 samples.

1.7.1.7 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. All solutions must be at the same temperature to reduce meter stabilization time and to maintain accuracy. The instrument is 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 Lab 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 1 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 instrument detection limits for clean water (with no interference). Instrument detection limits are determined by following the procedures detailed in the proceeding section. Reporting for both organic and inorganics analyses parameters will be the SOW - specified LODs listed in Appendix B.

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 (nonlaboratory) data which will be collected during the Stores Yard 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 QA Coordinator. 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

At the completion of a set of analyses, all calculations are completed and checked by the analyst. 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.

After the appropriate Laboratory Section sign-off of approved data is completed, the Laboratory Data Manager is notified that data are ready to be reported, and the completed analyses are removed from the laboratory backlog.

The Laboratory Data Manager, with input from the appropriate laboratory section reviews and assembles (as needed) the data report and narrative which is reviewed and signed by the Laboratory Section Manager and/or the Laboratory Manager.

1.9.2.2 Laboratory Data Validation

In addition to the data review performed by analysts and the appropriate Laboratory Section Manager, the Laboratory QA Coordinator audits a portion of the data reported by the WESTON Analytical Laboratory. This audit focuses on compliance of data with laboratory quality control requirements and client contractual requirements. This audit includes selective checks on calculations, verification of the report format, and completeness of the data report package.

1.9.2.3 Laboratory Data Reporting

Laboratory data reporting will be performed via magnetic media using the tabular outputting capabilities of the WALIS 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 NJDEP Tier II 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 nonenvironmental 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), is transported to the site, is handled like a sample, and is returned to the laboratory for analysis (trip blanks are not to be opened in the field). The trip blank for soils is Type II Reagent water just as in the case of water samples.

- 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 this will be made available for inspection during audits in the form of a specification sheet or analysis results of a sample of the water analyzed prior to environmental sample shipment and

analysis (For VOA, this analysis may be concurrent to shipment of the batch of water prepared for that day's shipment. These specification sheets and analysis results will be kept at Weston Analytics office in Lionville, PA.

- One ambient conditions blank per VOA sampling round (water) at a particular site or zone. Definition of Ambient Conditions Blank: Type II Reagent water is poured into a sample container at the site, is then handled like a sample, and is transported to the laboratory for analysis.

- One set of equipment rinsate blanks for every day of aqueous and non-aqueous sampling (all parameters analyzed). Definition of Equipment Rinsate 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, 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.

- Ten 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.

- Ten percent field duplicate or replicates (all parameters analyzed) for soil/sediment samples. Definition of Replicate: a single sample is collected and then divided into two equal parts for the purpose of analysis. Replicate sample are often called "splits". Field replicates shall be indistinguishable from other analytical samples so that personnel performing the analyses are not able to determine which samples are replicates.

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 superceeded 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, matrix spikes will be prepared once every 20 samples per matrix as summarized in tables 2-1 and 2-2.

- 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, a laboratory duplicate will be run with every 20 field samples, as summarized in Tables 2-1 and 2-2.

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 QA/QC) and the auditor will then determine whether the QA/QC is in-place. 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 QA/QC 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 provided to the Project Manager who will insure that the corrective actions have been implemented.

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. 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 Coordinator 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 1-3. These performance audits are in the form of blind performance samples submitted by the auditing agency.

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

1.12 PREVENTIVE MAINTENANCE OF EQUIPMENT

1.12.1 Field Equipment

As discussed in Subsection 1.7, the field equipment will have been 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.

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/Wastewater 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 by U.S. EPA was performed in May 1987, last PA DER on-site was performed in May 1987, and last IEPA on-site was performed in June 1987.

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

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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.

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

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

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.

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 1-6. 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.

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 1-6.

For metals, 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

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 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 and the appropriate technical QA Officer and the Project Manager.

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

1.15.2 Laboratory QA Reports

The Laboratory QA Coordinator 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.

Table 1-5
QA Objectives for Accuracy and Precision of
Laboratory Organic Target Compound 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.

Table 1-6

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

Fraction	Surrogate Compound	Low/Medium Water	Low/Medium Soil/Sediment
VOA	Toluene-d8	88-100	81-117
VOA	4-Bromo-fluorobenzene	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.

SECTION 2

METHODS PROTOCOLS

This section describes specific field and laboratory protocols to be applied to the Stores Yard investigation.

2.1 Soil Borings and Exploratory Drilling

All drilling at the United States Lines Marine Stores Yard will be accomplished using standard augering methodologies. Soil samples will be collected using 24 inch steel split barrel samplers of standard construction and length. All borehole cuttings will be placed in 55-gallon drums provided by the subcontractor. Cuttings may be secured on-site between plastic sheeting. Screening with a photoionization detector (PID) will be used to screen soil samples, drill cuttings as well as breathing zone during drilling operations. If the drilling cutting appear contaminated through a visual inspection or if the PID measures total volatile organics at a level of 5 parts per million (ppm) above background, the soils will be containerized, sealed, labeled and staged onsite. All soil boring residues, decontamination fluids, purge water generated during these activities are the property of the Port Authority and will be disposed of by the Port Authority.

2.1.1 Soil Borings

Twenty-two soil borings, locations are shown in Figure 1-2, will be drilled using hollow-stem drilling techniques. The subsurface soil samples will be collected using decontaminated split barrel samplers in accordance with standard soil sampling methods (ASTM 1586-67/84). Split barrel samples will be collected in the undisturbed soils ahead of the auger. The recovered sampler will be opened, the sample will be split in half using a clean knife and will be screened with the PID and described as to soil type, following the unified soil classification system, color and geologic features by a qualified WESTON geologist. A copy of the drilling log form is provided in Figure 2-1. Soil samples will be collected at the five foot intervals from the ground surface to the groundwater interface. At the groundwater interface, a soil sample will be collected with a decontaminated split barrel sampler and submitted for laboratory analysis for the parameters specified in

WESTERN

DRILLING LOG

WELL NUMBER: _____ OWNER: _____

LOCATION: _____ ADDRESS: _____

_____ _____

_____ TOTAL DEPTH _____

SURFACE ELEVATION: _____ WATER LEVEL: _____

DRILLING COMPANY: _____ DRILLING METHOD: _____ DATE DRILLED: _____

DRILLER: _____ HELPER: _____

LOG BY: _____

NOTES

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)

* A.S.T.M. D1586

FIGURE 2-1 DRILLING LOG

SHEET ___ OF ~~100~~ 80

the work plan. In addition to these samples, an additional soil sample will be collected at soil boring locations 2, 8, and 13. At these soil stained areas, a soil sample will also be collected from the surface to two feet below. These samples will be described and submitted for laboratory analysis.

Soil borings 16, 31, and 22 will be used for stratigraphic control of the site. At these locations, the soil boring will be advanced down to the shales and sandstones underlying the site. Split barrel samples (reference samples) will be collected at the groundwater interface and at regular 5 foot intervals, or more frequently as required by the on-site geologist to determine the underlying geology of the site. These reference samples will be placed in glass jars and left in the custody of the Port Authority for future reference.

After the completion of each boring, the borehole will be grouted from the bottom of the borehole to the surface with a mixture consisting of five pounds of bentonite per 94 pound bag of cement, dry mixed and added to 8 gallons of water.

2.2 Monitor Wells

10 monitoring wells (Figure 1-2), will be used to determine groundwater quality below the site as well as determine horizontal direction of groundwater flow. The well borings will be advanced ten feet below the groundwater table. Continuous split barrel samples will be collected within the screen zone.

Within the borehole, a monitor well will be constructed using nominal 4-inch ID schedule 40 polyvinyl chloride (PVC) pipe with flush fitting threaded joints and schedule 40 PVC No. 10 slot (0.010 inch) machine-slit well screen. A graded gravel or sand will be placed in the annulus from the bottom of the well to two feet above the top of the well screen. The sand pack shall be placed as the augers are slowly withdrawn from the well bore by slowly pouring the sand around the annulus between the screen and the inside of the augers. Above the sand pack, a two feet thick bentonite seal consisting of bentonite pellets will be placed. Cement grout will then be placed in the borehole annulus from the bentonite seal to the surface. A six inch diameter, steel protective locking casing will be placed over the PVC well casing and will be anchored into the cement surface seal. All locks will be keyed alike. A small hole placed near the bottom of the

protective casing will allow for drainage of water between the PVC well and protective outer casing.

At the completion of the monitoring well, a well construction summary will be completed. A copy of this summary is provided in Figure 2-2. The typical well construction is illustrated in Figure 2-3.

2.2.1 Final Development and Hydraulic Testing

Upon completion, each monitor well will be developed for a period of one hour or until a clear, relatively sediment free discharge is achieved. The wells will be developed with a centrifugal or bladder pump or with compressed air. If compressed air is used, then a blowing tee will be placed on top of the well, and the discharge will be directed to a drum.

All air lines or suction hoses will be either decontaminated or replaced between wells. A licenced surveyor will establish a reference point on the PVC well casing of each monitor well. The reference point will be tied in to a U.S. Coast and Geodetic Survey (USCGS) or United States Geological Survey (USGS) benchmark and will be the basis for establishing groundwater level elevations.

2.3 SAMPLE COLLECTION

2.3.1 Groundwater Samples

Groundwater samples will be collected from each monitor well and analyzed for Target Compound List compounds and total petroleum hydrocarbons. The groundwater samples will also be tested in the field for temperature, pH and specific conductance. These measurements will be recorded in the field log book.

Groundwater sampling will be accomplished only after the wells have been properly developed. Groundwater sampling will occur no earlier than 7 calendar days after well development has been completed because drilling and well construction disturb the natural groundwater system and some time is necessary before sampling to allow the groundwater system to return to chemical equilibrium. Surface water and sediment samples will be collected during the same sampling episodes as the groundwater samples. Upgradient wells will be sampled first at each site.

Well _____

Well Construction Summary

Location or Coords: _____ Elevation: Ground Level _____

_____ Top of Casing _____

Drilling Summary:

Total Depth _____

Borehole Diameter _____

_____

Driller _____

_____

_____

Rig _____

Bit(s) _____

_____

Drilling Fluid _____

_____

Surface Casing _____

Well Design:

Basis: Geologic Log ____ Geophysical Log ____

Casing String(s): C = Casing S = Screen

____	–	____	____	____	–	____	____
____	–	____	____	____	–	____	____
____	–	____	____	____	–	____	____
____	–	____	____	____	–	____	____
____	–	____	____	____	–	____	____
____	–	____	____	____	–	____	____
____	–	____	____	____	–	____	____
____	–	____	____	____	–	____	____

Casing: C1 _____

_____

C2 _____

_____

Screen: S1 _____

_____

S2 _____

_____

Centralizers _____

_____

_____

Filter Material _____

_____

Cement _____

_____

Other _____

_____

_____

_____

Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling:				
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
Geophys. Logging:	____	____	____	____
Casing:				
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
Filter Placement:	____	____	____	____
Cementing:	____	____	____	____
Development:	____	____	____	____
Other:				
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____

Well Development:

_____

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_____

Comments:

_____

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FIGURE 2-2 WELL CONSTRUCTION SUMMARY

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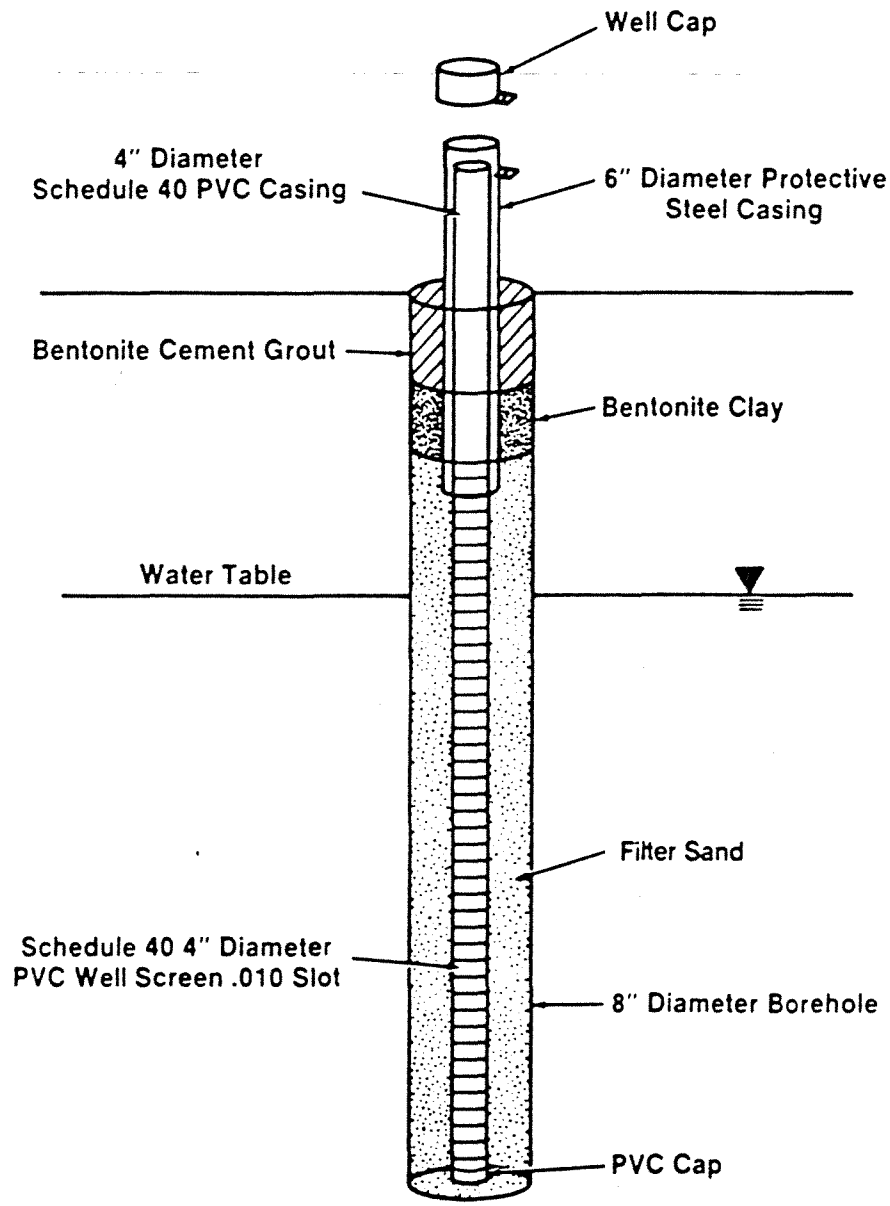

FIGURE 2-3 TYPICAL WELL CONSTRUCTION

Procedures for sampling monitor wells are as follows:

- Water level measurements will be taken to the nearest 0.01 foot with a steel tape using the chalk and tape method from the top of the well casing. The measuring devices used in the well will be thoroughly rinsed with distilled water prior to reuse. The depth to the top of the water will be subtracted from the total casing depth to determine the height and, subsequently, the volume of standing water in the casing.

- The surface of the water column will be examined for the presence of hydrocarbons; if hydrocarbons are present, the thickness of the hydrocarbons layer will be measured and sampled using a clear, acrylic graduated bailer.

- A polyetheylene ground cover is placed around the wells to keep sampling equipment free of surface contaminants.

- To ensure collection of samples representative of groundwater quality, a centrifugal pump or bailer will be used to remove a quantity of water from the well equal to a minimum of three to five times the calculated volume of water in the well casing. In the event that an extremely low yield well is to be sampled then purging shall continue until a steady conductivity reading is achieved for the groundwater in the well casing.

- To collect representative groundwater samples where floating hydrocarbons are present, a "thief sampler" or other point sampler, constructed of teflon or stainless steel, will be used to minimize the influence of free product. Otherwise, samples will be obtained using a Teflon bailer. A separate sample will be obtained to determine temperature, pH, specific conductance, in the field. Samples will be collected for insitu parameters and volatile organic compounds analyses immediately after purging is complete.

- All samples for chemical analyses will be placed in laboratory-prepared bottles. The bottles will be filled to the top and capped securely. Each sample bottle will be placed in an insulated cooler chest immediately after sampling.

The collected groundwater samples will be analyzed for the parameters outlined in Table 2-1. All sampling equipment will be decontaminated or discarded after use. All bailers will be decontaminated in accordance with the procedure set forth in Section 2.3.4. The bailer line, pump suction hose and ground cover will be discarded after use. The pump suction hose will be constructed of teflon or polyetheylene and dedicated to each well. The bailer line shall be made of polyethylene, teflon coated wire, stainless steel or polypropylene monofilament.

2.3.2 Sediment/Surface Water Samples

Four sediment samples will be taken at the Stores Yard. Two samples will be taken from the storm water sewer and two will be taken along the bank at the storm water sewer outfall. Of the two samples collected from the storm water sewer, one will be collected at the invert and the second one at the outfall. A stainless steel scoopula attached to a long handle will be used to collect a sediment sample from below the invert. These samples will be placed in a decontaminated stainless steel bucket and homogenized. The collected sediment will be placed in laboratory-prepared sample bottles and analyzed for TCL compounds plus petroleum hydrocarbons. A short handled trowel will be utilized to collect sediment from near the outfall. Two other sediment samples collected along the bank of the Old Place Creek, under the outfall, will be collected using a decontaminated hand auger or dedicated trowels. The sample will be placed into a decontaminated bucket and homogenized with the sampling trowel or scoopula. All twigs, rocks, vegetation and debris will be removed from the samples prior to placement in the sample containers.

A surface water sample will be collected within the storm water sewer near the outfall. The surface water sample will be collected before the sediment samples by submerging the sample bottles beneath the water surface. If the bottle contains a preservative, a clean separate bottle will be used to transfer the sample from the sewer to the sample bottle. If the storm water sewer is dry then no surface water will be taken.

2.3.3 Soil Samples

Soil samples from the soil borings will be collected using steel split barrel samplers. The samplers will be decontaminated between uses according to the procedure established in Section 2.3.4.

One soil sample from each soil boring will be collected with the exception of borings 2, 8, and 13, where two samples will be collected. Soil samples shall be collected in a decontaminated bucket and homogenized by mixing with the sampling scoopula. Sample material will then be placed in the sample jars. Chemical analysis will be achieved following the protocol in Table 2-2. Samples collected for analysis will be selected based on visual observations of staining, sheens, or other evidence of contamination and/or PID reading.

2.3.4 Decontamination Procedure

All sampling and ancillary equipment will arrive on-site in a clean condition. The following is a recommended procedure for equipment decontamination.

2.3.4.1 Drilling Equipment Decontamination

Prior to the start of drilling, all drill equipment (augers, split barrel samplers, rods, tools) will be steam cleaned at a designated area. If the well casing and screens are not wrapped in plastic, they too will be cleaned prior to installation. All drilling equipment will be steam cleaned between soil boring or monitor well locations to prevent the possibility of cross-contamination and ensure the integrity of the samples.

2.3.4.2 Well Development Equipment Decontamination

Down hole equipment used for the well development will be washed with a non-phosphate soap solution and steamed, if not a disposal item.

2.3.4.3 Water Level

Steel tapes, water, soil and sediment sampling equipment used to measure water levels will be wiped dry between well locations, and cleaned with a non-phosphate soap solution and distilled water rinse prior to and after use.

Bailers, split barrel samplers, hand augers, buckets, pans and scoopulas will be decontaminated between uses according to the following procedure.

- Place used equipment on Polyethylene ground sheet
- Wash in a non-phosphate soap solution
- Rinse with potable water
- Rinse with 10% HNO_3(ultrapure) or 1% $HNO_3$for carbon steel split spoons
- Rinse with potable water
- Rinse with pesticide grade acetone
- Rinse with distilled water (demonstrated analyte-free)
- Allow to air dry
- Sampling equipment used to collect samples for volatile organic analysis will be wrapped in aluminum foil after decontamination and prior to its next use.

2.3.5 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.

2.3.5.1 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. The containers provided are those described in 40 CFR Part 136, No. 209, 26 October 1984, page 28. 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 records (see Subsection 1.6). These chain-of-custody records will be completed by the field sampling personnel and returned with the samples.

2.3.5.2 Sample Preservation

The preservatives required for all analyses will be provided by WESTON with the sample containers. The required preservation methods for target analyses are listed in 40 CFR Part 136, No. 209, 26 October 1984.

2.3.5.3 Holding Times

Holding times for analytes will be those given in the EPA -CLP SOW's for organics and inorganics. The holding time for petroleum hydrocarbons is 28 days from sample receipt.

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.

2.3.6 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 Tables 2-1 and Table 2-2. 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 bottles, and handled as a sample. One trip blank will be sent to the laboratory with every cooler containing VOA samples for both soils and water.

Ambient condition blanks will be collected where water samples are collected for VOA analyses. These samples will be collected by pouring ASTM Type II reagent water into a sample bottle. These blanks will be handled as samples and shipped back to the laboratory with the other VOA samples from that site or zone.

Equipment blanks will be collected every day of groundwater and

soil sampling and analyzed for the same parameters as the groundwater. 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 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. Collection procedures for field duplicates are identical to those for the original samples.

Field replicates will be collected for soil/sediments samples only in those cases where sample volumes are adequate and the samples do not require analysis for VOAs or BNAs. The number of field replicates will be equal to 10 percent of the total number of samples. Replicates will be collected by placing the soil in a stainless steel tray and dividing the soil into two equal parts with a stainless steel trowel. One-half of the soil is placed in the appropriate jars labeled for the soil sample, and the other half is placed in the appropriate jars labeled for the replicate sample.

Duplicate groundwater samples will be collected from alternating bailerfuls of groundwater extracted from the same well after pumping. In split-spoon soil sampling, duplicate soil samples will be collected from the same split-spoon by dividing apart and sealing two separate, adjacent brass rings full of soil. Where grab samples of soil or sediment are being collected (from test pits, surface soil locations, or sediment sampling locations) for analysis of VOAs or BNAs, separate samples will be collected from two locations immediately adjacent to each other for field duplicates; these samples may be collected as field replicates if they will not be analyzed for VOAs or BNAs.

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).

2.4 SITE MANAGEMENT

The basic components of site management in support of the planned

field activities are described in the following subsections.

2.4.1 General Operations and Coordination with the Port Authority

The station POC on this project will be Mr. David Roach, Assistant Manager, Operations, Port Authority Marine Terminals. All coordination with other parties on-station will be performed by WESTON through the POC and the Engineer in Charge, Marvin Kirschner. All contacts from outside parties concerning the project will be made either through the POC or the Designated Coordinator, Marvin Kirschner.

The Site Manager will be responsible for day-to-day coordination of WESTON field teams and subcontractors as well as day-to-day contact with the POC. The POC 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 Site Manager in agreement with the Project Manager from among the WESTON personnel present on-station. The Field Team Leader will be responsible for coordinating the activities of his/her team, including subcontractors, and for notifying the Site Manager of progress and/or logistical problems.

2.4.2 On-Site Project Facilities

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

2.4.3 Site Access and Security

It is anticipated that all field work will be performed within the

Table 2-1

Summary of Analytical Requirements

For Surface and Groundwater Analysis

Parameter	Number of Samples	Dup/Rep	Trip Blanks	Equipment Rinsate Blanks	Ambient Condition Blanks	Total Analyses
Target Compound List Analytes	11	1	1	1	1	15
Total Petroleum Hydrocarbons	11	1	1	1	0	14
pH field measured	11	1	0	0	0	12
Temperature field measured	11	1	0	0	0	12

Table 2-2

Summary of Analytical Requirements for Sediment Analysis

Parameter	Analytical Method	Number of Samples	Method Spike	Dup/Rep	Trip Blanks	Equipment Rinsate Blanks	Total Analyses
TCL analytes	EPA CLP SOW	1	1	1	1	1	5
VOA							
BNA							
Pesticide/PCB							
Metals (TAL)							
CN							
Total Petroleum Hydrocarbons	SW9071/E418.1	1	1	1	0	1	5

Summary of Requirements for Laboratory Analysis of Soils

Parameter	Analytical Method	Number of Samples	MSD or Dup/Ref	Trip Blanks	Field Blanks	Method Spike	Total Analyses
VOC TCL	CLP SOW	22	2	0	2	2	28
BNA TCL	CLP SOW	22	2	0	2	2	28
Pesticides TCL	CLP SOW	22	2	0	2	2	28
PCB's TCL	CLP SOW	22	2	0	2	2	28
Metals	CLP SOW	22	2	0	2	2	28
CN	CLP SOW	2	2	0	2	2	8

boundaries of the Stores Yard. Access to the Stores Yard is limited to Port Authority and authorized visitors.

During actual field operations, access to working areas will be limited to WESTON and subcontractor personnel and visitors authorized by the POC. All visitors will be requested 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 Site Manager, who will notify the POC.

2.4.4 Site Logistics

All water for field operations (except where ASTM Type II reagent water is specified) will be obtained from on-station drinking water sources to be specified by the POC. In general, water for drilling operations will be supplied from the nearest station fire hydrant.

Decontamination of drilling and sampling equipment will be performed either in source areas at each site or in the centralized paved decontamination area to be designated by the station POC, whichever is logistically and technically appropriate. The centralized decontamination area will drain to an oil/water separator and through the separator to a sanitary sewer. The station POC will be responsible for arranging pickup and disposal of any waste oil that may accumulate in the separator. All decontamination will be performed using water from a station potable supply except where ASTM Type II reagent water is specified (for sampling equipment only).

Electricity will be provided to the field office and field lab trailers by the station. Electricity for all remote field operations will be provided from portable generators to be supplied by WESTON.

2.4.5 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 Task Manager and POC will be notified. Due to the nature of the contaminants found on-site it is not anticipated that a 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 (provided under separate cover) will be followed in an emergency.

Appendix A

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:

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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.

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FIGURE 2-1

WESTON ANALYTICS DIVISION ORGANIZATIONAL CHART

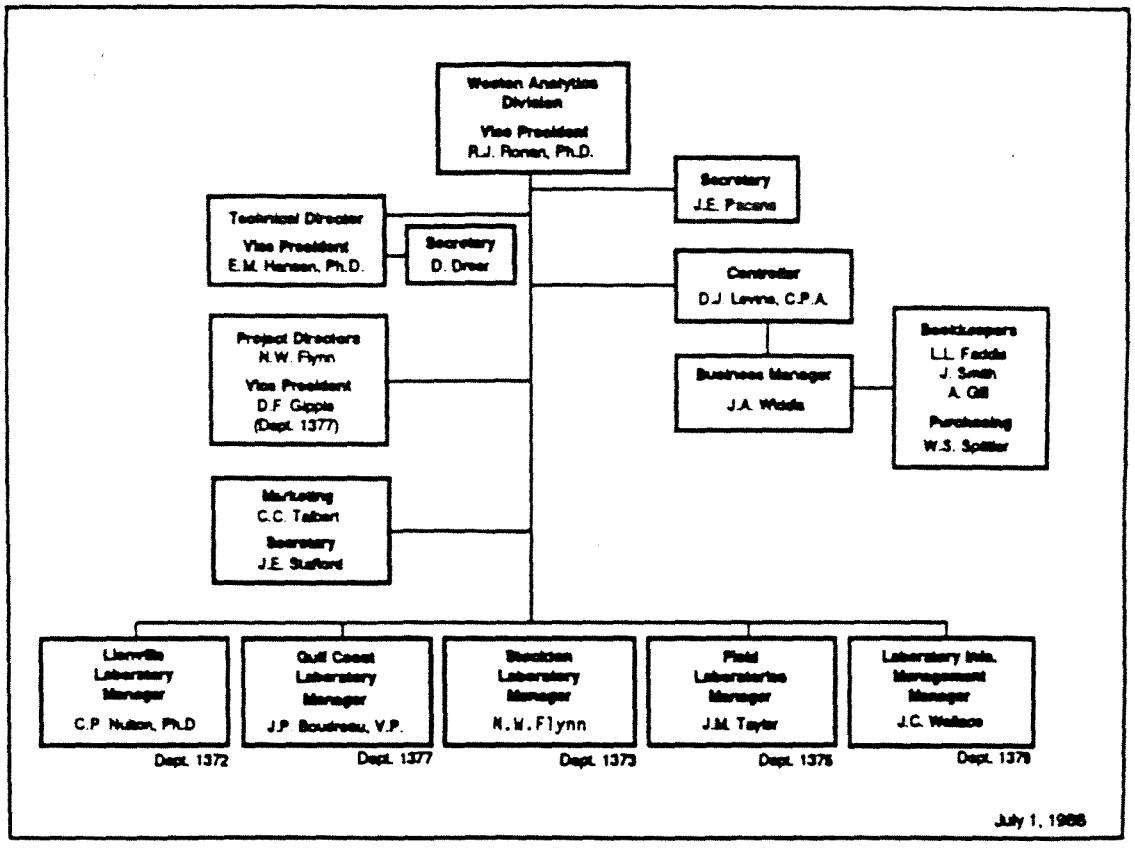

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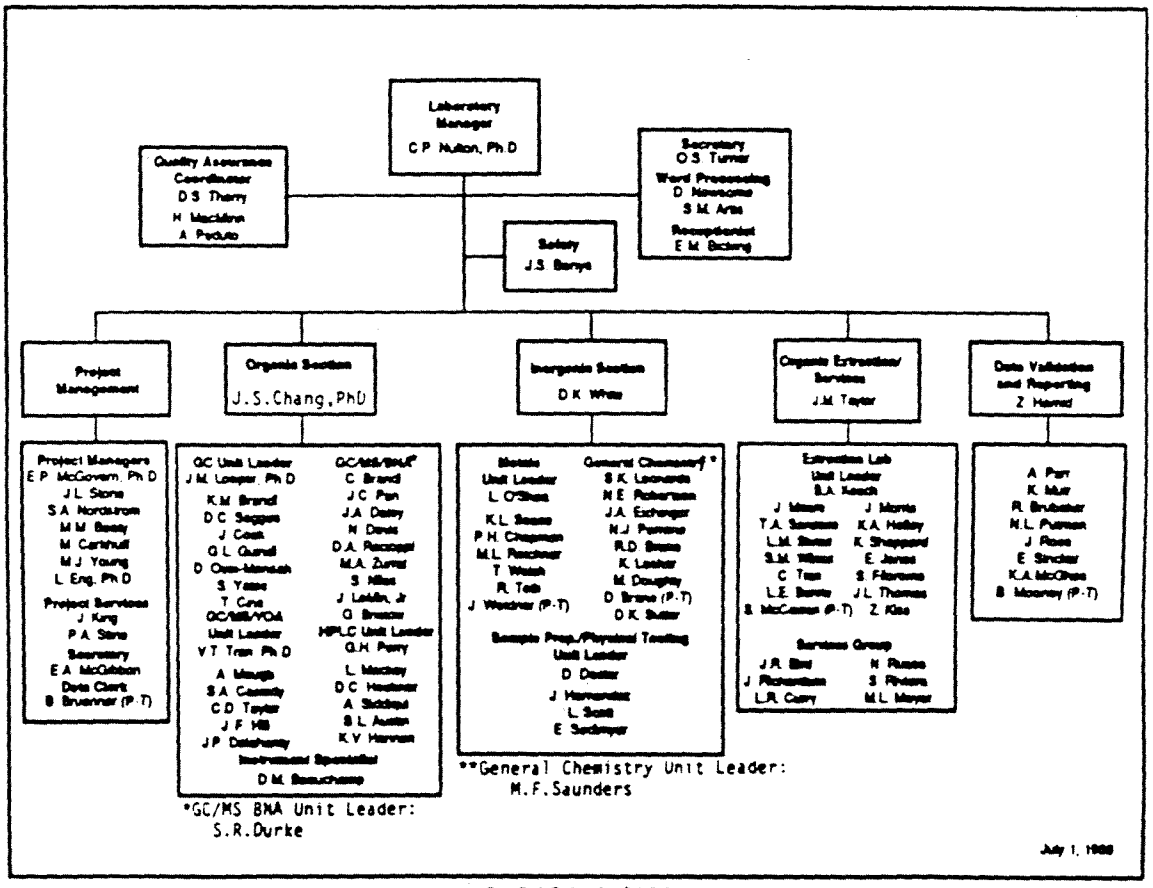
FIGURE 2-2

LIONVILLE LABORATORY ORGANIZATIONAL CHART



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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:

$$\text{Accuracy} = \%\ \text{Recovery} = \frac{A_T - A_0}{A_F} \times 100\%$$

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.

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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 $\pm$ 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.

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TABLE 3-1

QUALITY ASSURANCE OBJECTIVES FOR ACCURACY FOR ORGANIC SURROGATE ANALYSES

Fraction	Surrogate Compound	Percent Recovery Low/Medium Water	Percent Recovery 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.

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TABLE 3-2

QA OBJECTIVES FOR ACCURACY AND PRECISION FOR ORGANIC TARGET COMPOUND 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
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.

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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 Safety

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

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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.

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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	Conveyor Belt	Pipe
Free Flowing Liquids and Slurries	Coliwasa	N/A	N/A	Coliwasa	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.

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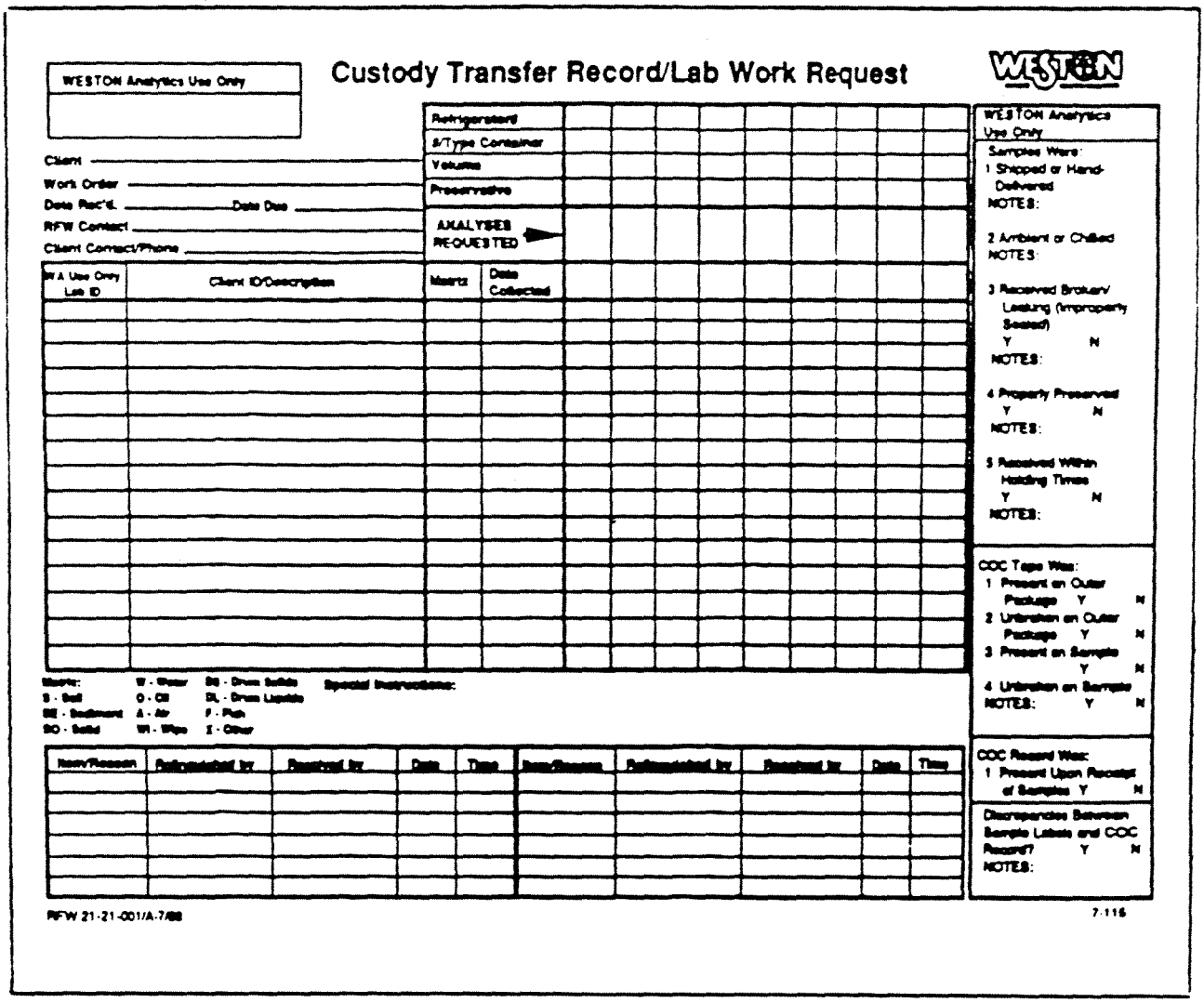
FIGURE 5-1

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

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

Matrix: W - Water, SG - Drum Solids, S - Soil, O - Oil, DL - Drum Liquids, SE - Sediment, A - Air, P - Pure, SO - Solid, WI - Wipe, 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-7/88

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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

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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

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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. $\pm$ 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.

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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.

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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).

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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.

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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 ICP: Continuing Calibration

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 ICP: Quality Control

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.

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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

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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

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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	Semivolatiles
# chloromethane	* phenol
* vinyl chloride	* 1,4-dichlorobenzene
* 1,1-dichloroethene	# N-nitroso-di-N-propylamine
# 1,1-dichloroethane	* 2-nitrophenol
* chloroform	* 2,4-dichlorophenol
* 1,2-dichloropropane	* hexachlorobutadiene
# bromoform	* 4-chloro-3-methylphenol
# 1,1,2,2-tetrachloroethane	# hexachlorocyclopentadiene
* toluene	* 2,4,6-trichlorophenol
# chlorobenzene	* acenaphthene
* ethylbenzene	# 2,4-dinitrophenol
	# 4-nitrophenol
	* N-nitrosodiphenylamine
	* pentachlorophenol
	* fluoranthene
	* di-N-octylphthalate
	* benzo-a-pyrene

* = calibration check compounds
# = system performance check compounds

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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).

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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.

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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.

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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

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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:

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

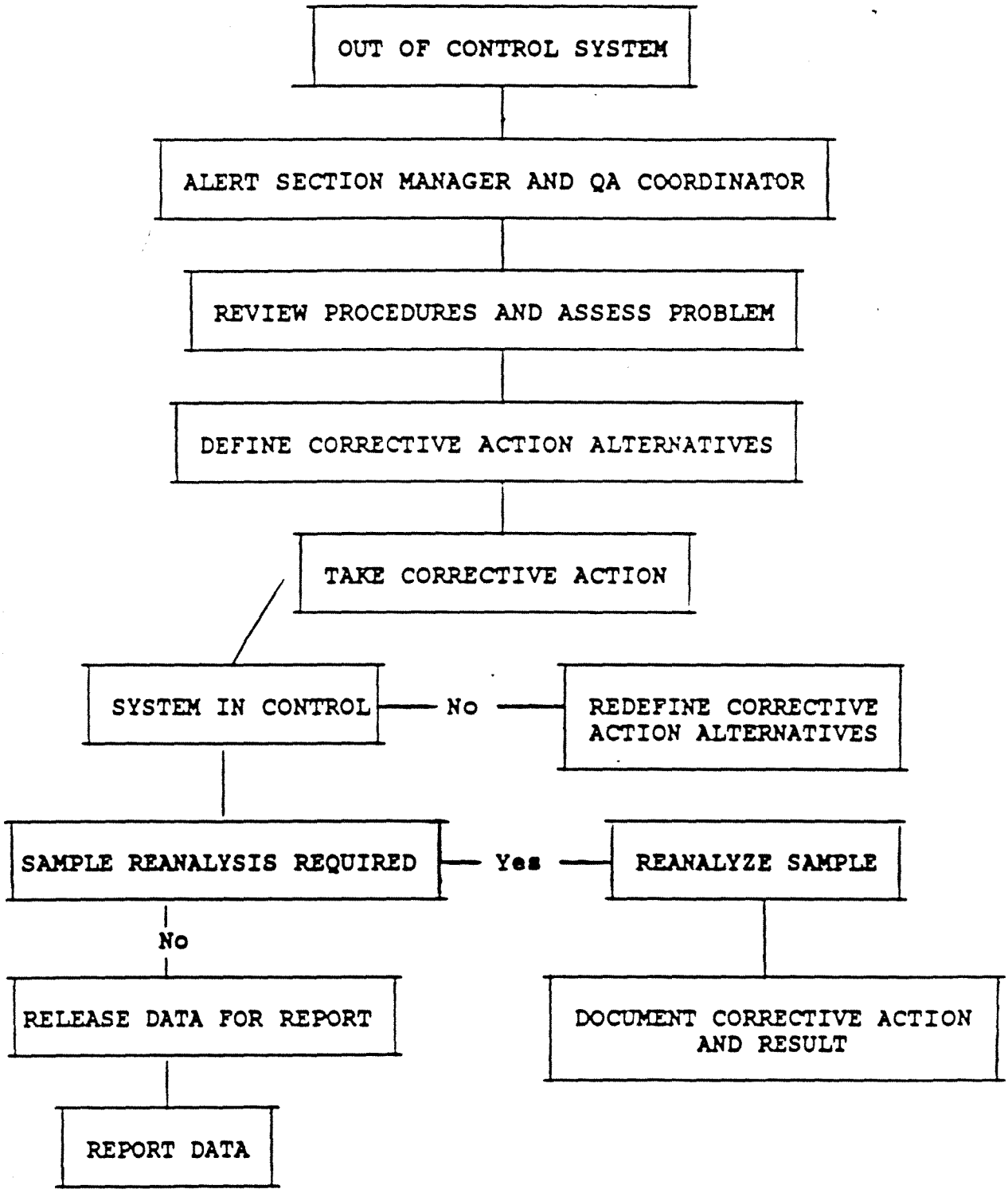
When the appropriate corrective action measures have been defined and the analytical system is determined to be "in control", the analyst documents the problem, and the corrective action. Copies of the form summarizing these actions are provided to the Section Manager and QA Coordinator.

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



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14.0 Quality Assurance Reports to Management

The QA Coordinator provides quarterly and annual reports to the 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 recommendation for revision in laboratory procedures to improve the analytical systems. The Project Manager will be notified immediately of laboratory QA situations requiring immediate corrective action.

Appendix B

APPENDIX B

ANALYTICAL METHODS, PARAMETERS, AND LIMITS OF DETECTION

LIST OF ANALYTICAL METHODS AND DETECTION LIMITS

	WATER		SOIL	
	Method	Detection Limit	Method	Detection Limit
VOAs	EPA SOW *	(a)	EPA SOW *	(a)
TCL Metals	EPA SOW *	(b)	EPA SOW *	(b)
BNAs	EPA SOW *	(a)	EPA SOW *	(a)
Pesticides/PCB	EPA SOW *	(a)	EPA SOW *	(a)
Petroleum Hydrocarbons	E418.1	1 mg/L	SW9071/E418.1	10 mg/kg
Oil & Grease	NR	-	SW90171/E413.1	50 mg/kg
pH	EPA 150.1	NA	NR	---
Specific Conductivity	EPA 120.1	0.5 umhos/cm	NR	---

(a) Organics TCL List - See attached Table 1.

(b) Inorganics TCL List - See attached Tables 2,3,4.

* USEPA CLP Statement of Work for Organics Analysis Multi-Media, Multi-Concentration, 2/88 with revisions.

** USEPA CLP Statement of Work for Inorganics Analysis Multi-Media, Multi-Concentration, 7/88 with revisions.

INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	Contract Required Detection Limit (1,2) (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

(1) Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:

Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 220
Contract Required Detection Limit (CRDL) = 5

Table 2

Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

Volatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[d] ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-34-3	5	5
10. 1,2-Dichloroethene (total)	544-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,2-Dichloropropane	78-87-5	5	5
19. cis-1,3-Dichloropropene	10061-01-5	5	5
20. Trichloroethene	79-01-6	5	5
21. Dibromochloromethane	124-48-1	5	5
22. 1,1,2-Trichloroethane	79-00-5	5	5
23. Benzene	71-43-2	5	5
24. trans-1,3-Dichloropropene	10061-02-6	5	5
25. Bromoform	75-25-2	5	5
26. 4-Methyl-2-pentanone	108-10-1	10	10
27. 2-Hexanone	591-78-6	10	10
28. Tetrachloroethane	127-18-4	5	5
29. Toluene	108-88-3	5	5
30. 1,1,2,2-Tetrachloroethane	79-34-5	5	5

(continued)

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Volatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[a] ug/Kg
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Xylenes (Total)	1330-20-7	5	5

[a]Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 100 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Table 3

Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/Kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl) ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-di-n-dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic acid	65-85-0	50	1600
52. bis(2-Chloroethoxy) methane	111-91-1	10	330
53 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Naphthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600

(continued)

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/Kg
65. Dimethylphthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl-phenylether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butylbenzylphthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660
90. Benzo(a)anthracene	56-55-3	10	330
91. Chrysene	218-01-9	10	330
92. bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93. Di-n-octylphthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330

(continued)

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/Kg
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

[b]Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

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Table 4

Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

Pesticides/PCBs	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[c] ug/Kg
100. alpha-BHC	319-84-6	0.05	8.0
101. beta-BHC	319-85-7	0.05	8.0
102. delta-BHC	319-86-8	0.05	8.0
103. gamma-BHC (Lindane)	58-89-9	0.05	8.0
104. Heptachlor	76-44-8	0.05	8.0
105. Aldrin	309-00-2	0.05	8.0
106. Heptachlor epoxide	1024-57-3	0.05	8.0
107. Endosulfan I	959-98-8	0.05	8.0
108. Dieldrin	60-57-1	0.10	16.0
109. 4,4'-DDE	72-55-9	0.10	16.0
110. Endrin	72-20-8	0.10	16.0
111. Endosulfan II	33213-65-9	0.10	16.0
112. 4,4'-DDD	72-54-8	0.10	16.0
113. Endosulfan sulfate	1031-07-8	0.10	16.0
114. 4,4'-DDT	50-29-3	0.10	16.0
115. Methoxychlor	72-43-5	0.5	80.0
116. Endrin ketone	53494-70-5	0.10	16.0
117. alpha-Chlordane	5103-71-9	0.5	80.0
118. gamma-Chlordane	5103-74-2	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. Aroclor-1016	12674-11-2	0.5	80.0
121. Aroclor-1221	11104-28-2	0.5	80.0
122. Aroclor-1232	11141-16-5	0.5	80.0
123. Aroclor-1242	53469-21-9	0.5	80.0
124. Aroclor-1248	12672-29-6	0.5	80.0
125. Aroclor-1254	11097-69-1	1.0	160.0
126. Aroclor-1260	11096-82-5	1.0	160.0

[c]Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation Limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

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Appendix C

ENGINEERING FIELD MANUAL
FOR CONSERVATION PRACTICES

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
THIRD PRINTING JUNE 1979
pp 4-9 to 4-19

THE UNIFIED SOIL CLASSIFICATION SYSTEM

General

The Unified Soil Classification System is used by the Soil Conservation Service in classifying soils for engineering purposes. This system is based on the identification of soils according to their particle size, gradation, plasticity index and liquid limit. (ASTM D 2487, D 2488). Gradation and particle size are determined by sieve analyses. Plastic and liquid limits are determined by standard methods of laboratory testing. (ASTM D 423 and D 424).

SYMBOLS

The Unified System, which is based on the minus 3-inch fraction of the material, uses letters as symbols of the soil's properties. The soil properties and the letters that represent them are listed below.

Gravel - G	Clay - C	Organic - O
Sand - S	Silt - M	Peat - Pt

Well Graded - W	High Liquid Limit - H
Poorly Graded - P	Low Liquid Limit - L

Soils are placed in groups having similar engineering properties according to their behavior characteristics. Each group is delineated by two of the above characteristics. The most important engineering characteristic of this group is listed first and the next most important, second.

U. S. sieve sizes are used in separating some classes of materials from others. The important sieves and the size of their openings are:

Table . Sieve sizes and size of openings

U. S. Standard Sieve Sizes	Size of Opening in mm.	Size of Opening in inches
3"	--	3"
3/4"	--	3/4"
#4	4.76	1/4" (Approx.)
#10	2.00	--
#40	0.42	--
#200	0.074	--

BASIC MATERIAL BREAKDOWN

Soils are divided into coarse materials or fine materials by the #200 sieve. If more than 50 percent of the material, by dry weight, is larger than the #200 sieve, it is a coarse material. If 50 percent or more will pass the #200 sieve, it is a fine material.

Coarse Materials

Coarse material is subdivided into sand and gravel by the #4 sieve. If 50 percent or more of the coarse portion of the material by dry weight is retained on the #4 sieve, the material is classified as a gravel. If more than 50 percent passes the #4 sieve, it is classified as a sand.

Materials With Less Than 5 Percent Fines

If less than 5 percent of the total sample by dry weight is fines, there is not enough of these fines to affect its engineering properties. In this case, only the characteristics of the coarse portion are important

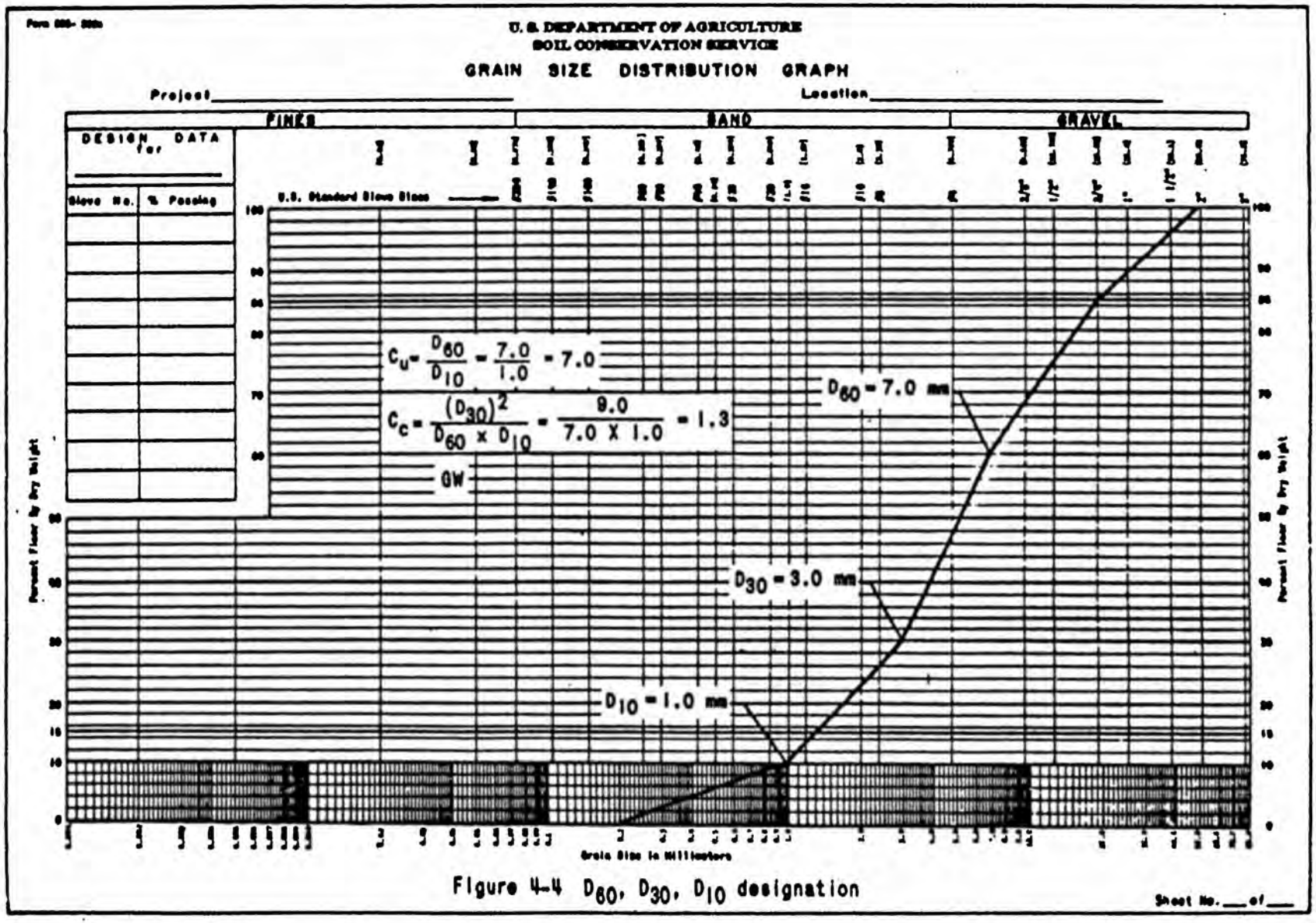

Figure 4-4 D_{60}, D_{30}, D_{10} designation

and the fines may be ignored in classifying the material. The classification as sand or gravel is the material's primary characteristic.

The secondary characteristic of material with less than 5 percent fines is its gradation (range of particle sizes). The material may consist predominantly of only one size of material; a mixture of coarse and fine materials with the intermediate sizes missing; or a mixture consisting of some of every size of particle. Materials in the first two groups are classified as poorly graded and those in the last group as well graded. The range of particle sizes may be obtained by shaking the sample through sieves. The results when plotted on a grain size distribution graph (see Figure 4-4) and analyzed will meet the following criteria if the material is well graded.

Gravels are well graded under the criteria of the Unified Classification System when:

$$C_u = \frac{D_{60}}{D_{10}} \text{ is greater than 4, and}$$

$$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ lies between 1 and 3.}$$

Sand are well graded when:

$$C_u = \frac{D_{60}}{D_{10}} \text{ is greater than 6, and}$$

$$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ lies between 1 and 3.}$$

Where:

C_u = Coefficient of uniformity

C_c = Coefficient of curvature

D = Diameter of particles determined by a sieve or hydrometer analysis

D_{60}, D_{10}, D_{30} = Diameter of particles such that 60 percent, 10 percent and 30 percent of the sample is smaller than that diameter. It is also the diameter read from a grain size distribution graph opposite 60, 10 and 30 percent finer by dry weight, respectively.

Both conditions (C_u and C_c) must be fulfilled in order to have a well graded soil. If one or both of the conditions are not fulfilled, the soil is poorly graded.

Some materials can be classified by visual inspection of the graph. When their plot is smooth and has concave curvature upwards between the 10 percent and 60 percent lines on a grain size distribution graph, they are well graded.

All other combinations of material with less than 5 percent fines are poorly graded.

There are four classifications of coarse materials where the percent of fines is less than 5 percent. They are well graded gravels (GW), poorly graded gravels (GP), well graded sands (SW), and poorly graded sands (SP).

Classifications of the coarse materials described above are based on sieve analysis only.

Materials With 12 to 50 Percent Fines

If the soil is a coarse material (either sand or gravel) but has a fines content of from 12 to 50 percent, the behavior characteristic of the portion smaller than the #40 sieve will determine the secondary characteristic of the material. If this portion of the material is clayey (can readily be molded), the material is coarse grained with clayey fines. If not, it is coarse grained with silty fines. To determine whether the material is classed as clay or silt, the plastic limit and liquid limit are measured.

A Plasticity Chart, Figure 4-5, is made with the LL as the abscissa and PI as the ordinate. On this chart, a line known as the "A" line has been plotted such that it lies approximately parallel to the plot of many basic geologic materials and originates at PI = 4, LL = about 25. For purposes of classification, all materials that plot above this line are designated as clay and all that plot below as silt. A small (cross hatched) area having a PI between 4 and 7 percent extending from the "A" line toward zero percent LL has a special dual designation and may be considered as an extension of the "A" line in separating materials.

There are four breakdowns of coarse materials where the percent of fines is over 12 percent. They are gravels with clayey fines (GC), gravels with silty fines (GM), sands with clayey fines (SC), and sands with silty fines (SM).

Materials With 5 to 12 Percent Fines

Materials with a fines content between 5 and 12 percent do not have separate classification breakdowns. They have a dual classification which consists of both the zero to 5 percent and the over 12 percent groups. The dual classification means that the material is borderline in its most significant engineering characteristics.

Fine Materials

Material is designated as being fine when 50 percent or more by weight passes the #200 sieve.

Clay or Silt

Plasticity is the most important engineering property of a fine grained soil. Therefore a fine grained material is classified first according to its plasticity.

The plasticity of the fine grained soils is determined on that portion of the soil which passes the #40 sieve. The material whose plot of the liquid limit and plasticity index falls above the "A" line (Figure 4-5) is classed as a fine grained clayey material. If it plots below the "A" line the material is classed as a fine grained silty material.

Under the Unified Classification System, "clay" or "clayey" is designated as any material that plots above the "A" line. "Silt" or "silty" is any material that plots below the "A" line. The break is the "A" line and is based on the PI.

High or Low Liquid Limit

The second most important characteristic in classifying fine grained material is its liquid limit.

Soil that has a liquid limit over 50 has a high liquid limit and may be either a clayey or silty high liquid limit material. Soil that has a liquid limit less than 50 has a low liquid limit and may be either a clayey or silty low liquid limit material.

There are four breakdowns of fine grained materials: Clayey material with low liquid limit (CL), clayey material with high liquid limit (CH), silty material with low liquid limit (ML) and silty material with high liquid limit (MH).

Organic Material

Materials containing a large percent of organic matter usually can be identified by their color and odor. The characteristics of organic materials are such that they have no easily definable boundaries. They are poor construction materials and need special consultation from an engineer, if used in construction. Some of these materials can be designated as organics of high liquid limit and organics of low liquid limit when tested by a laboratory. Fibrous organics that do not lend themselves even to laboratory tests are called peats. There are three breakdowns of organics: Organics with high liquid limit (OH), organics with low liquid limits (OL) and peats (Pt).

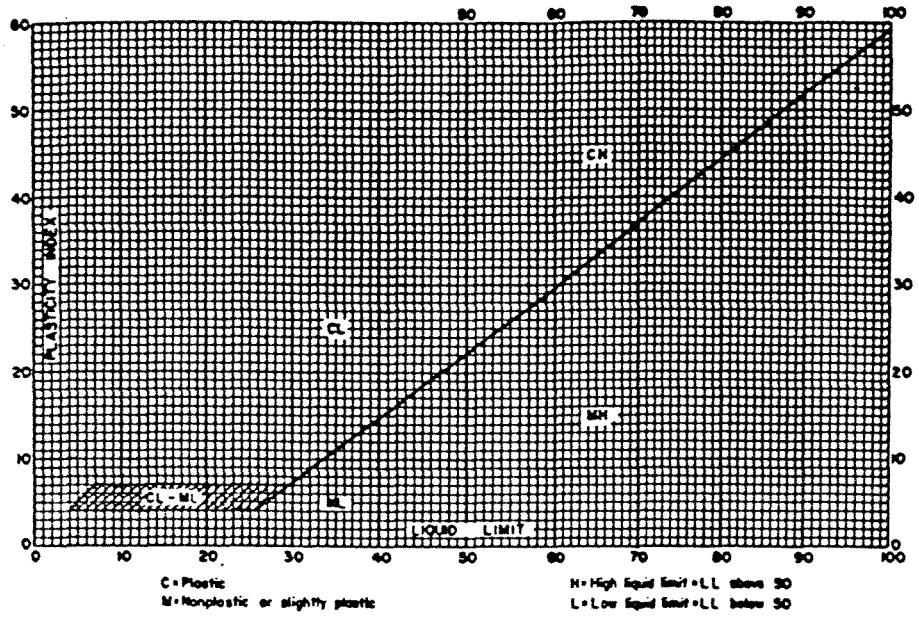

Figure 4-5 Plasticity chart

SUMMARY

Figure 4-6 gives the basic outline of the Unified Classification System.

The Unified Classification System has several outstanding features:

1. It is simple. There are 12 materials with which techicians are normally concerned--four coarse grained materials, four fine grained materials and four combined materials. In addition, there are three organics that require special attention, 15 in all.

2. It provides important physical characteristics, such as size, gradation, plasticity, strength, brittleness, consolidation potential, etc.

3. It is reliable. Engineering properties inferred by the classification are realistic.

TYPICAL NAMES	IMPORTANT PROPERTIES						UNIFIED SOIL CLASSES
	SHEAR STRENGTH	COMPRESS-IBILITY	WORKABILITY AS CONSTRUCTION MATERIAL	PERMEABILITY			
				WHEN COMPACTED	K CM. PER SEC.	K FT. PER DAY	
Well graded gravels, gravel-sand mixtures, little or no fines.	Excellent	Negligible	Excellent	Pervious	$K > 10^{-2}$	$K > 30$	GW
Poorly graded gravels, gravel-sand mixtures, little or no fines.	Good	Negligible	Good	Very Pervious	$K > 10^{-2}$	$K > 30$	GP
Silty gravels, gravel-sand-silt mixtures.	Good to Fair	Negligible	Good	Semi-Pervious to Impervious	$K = 10^{-3}$ to 10^{-6}	$K = 3$ to 3×10^{-3}	GM
Clayey gravels, gravel-sand-clay mixtures.	Good	Very Low	Good	Impervious	$K = 10^{-6}$ to 10^{-8}	$K = 3 \times 10^{-3}$ to 3×10^{-5}	GC
Well graded sands, gravelly sands, little or no fines.	Excellent	Negligible	Excellent	Pervious	$K > 10^{-3}$	$K > 3$	SW
Poorly graded sands, gravelly sands, little or no fines.	Good	Very Low	Fair	Pervious	$K > 10^{-3}$	$K > 3$	SP
Silty sands, sand-silt mixtures	Good to Fair	Low	Fair	Semi-Pervious to Impervious	$K = 10^{-3}$ to 10^{-6}	$K = 3$ to 3×10^{-3}	SM
Clayey sands, sand-clay mixtures.	Good to Fair	Low	Good	Impervious	$K = 10^{-6}$ to 10^{-8}	$K = 3 \times 10^{-3}$ to 3×10^{-5}	SC
Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	Fair	Medium to High	Fair	Semi-Pervious to Impervious	$K = 10^{-3}$ to 10^{-6}	$K = 3$ to 3×10^{-3}	ML
Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Fair	Medium	Good to Fair	Impervious	$K = 10^{-6}$ to 10^{-8}	$K = 3 \times 10^{-3}$ to 3×10^{-5}	CL
Organic silts and organic silty clays of low plasticity.	Poor	Medium	Fair	Semi-Pervious to Impervious	$K = 10^{-4}$ to 10^{-6}	$K = 3 \times 10^{-1}$ to 3×10^{-3}	OL
Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Fair to Poor	High	Poor	Semi-Pervious to Impervious	$K = 10^{-4}$ to 10^{-6}	$K = 3 \times 10^{-1}$ to 3×10^{-3}	MH
Inorganic clays of high plasticity, fat clays.	Poor	High to Very High	Poor	Impervious	$K = 10^{-6}$ to 10^{-8}	$K = 3 \times 10^{-3}$ to 3×10^{-5}	CH
Organic clays of medium to high plasticity, organic silts.	Poor	High	Poor	Impervious	$K = 10^{-6}$ to 10^{-8}	$K = 3 \times 10^{-3}$ to 3×10^{-5}	OH
Peat and other highly organic soils.	NOT SUITABLE FOR CONSTRUCTION						Pt

SHEET 1 OF 4

Figure 4-6 Unified classification and properties of soils

EMBANKMENTS								UNIFIED SOIL CLASS
COMPACTION CHARACTERISTICS	STANDARD PROCTOR UNIT DENSITY LBS. PER CU. FT.	TYPE OF ROLLER DESIRABLE	RELATIVE CHARACTERISTICS: PERMEABILITY	RELATIVE CHARACTERISTICS: COMPRESSIBILITY	RESISTANCE TO PIPING	ABILITY TO TAKE PLASTIC DEFORMATION UNDER LOAD WITHOUT SHEARING	GENERAL DESCRIPTION & USE	
Good	125-135	crawler tractor or steel wheeled & vibratory	High	Very Slight	Good	None	Very stable, pervious shells of dikes and dams.	GW
Good	115-125	crawler tractor or steel wheeled & vibratory	High	Very Slight	Good	None	Reasonably stable, pervious shells of dikes and dams.	GP
Good with close control	120-135	rubber-tired or sheepsfoot	Medium	Slight	Poor	Poor	Reasonably stable, not well suited to shells but may be used for impervious cores or blankets.	GM
Good	115-130	sheepsfoot or rubber-tired	Low	Slight	Good	Fair	Fairly stable, may be used for impervious core.	GC
Good	110-130	crawler tractor & vibratory or steel wheeled	High	Very Slight	Fair	None	Very stable, pervious sections, slope protection required.	SW
Good	100-120	crawler tractor & vibratory or steel wheeled	High	Very Slight	Fair to Poor	None	Reasonably stable, may be used in dike with flat slopes.	SP
Good with close control	110-125	rubber-tired or sheepsfoot	Medium	Slight	Poor to Very Poor	Poor	Fairly stable, not well suited to shells, but may be used for impervious cores or dikes.	SM
Good	105-125	sheepsfoot or rubber-tired	Low	Slight	Good	Fair	Fairly stable, use for impervious core for flood control structures.	SC
Good to Poor Close control essential	95-120	sheepsfoot	Medium	Medium	Poor to Very Poor	*Very Poor	Poor stability, may be used for embankments with proper control. *Varies with water content.	ML
Fair to Good	95-120	sheepsfoot	Low	Medium	Good to Fair	Good to Poor	Stable, impervious cores and blankets.	CL
Fair to Poor	80-100	sheepsfoot	Medium to Low	Medium to High	Good to Poor	Fair	Not suitable for embankments.	OL
Poor to Very Poor	70-95	sheepsfoot	Medium to Low	Very High	Good to Poor	Good	Poor stability, core of hydraulic fill dam, not desirable in rolled fill construction.	MH
Fair to Poor	75-105	sheepsfoot	Low	High	Excellent	Excellent	Fair stability with flat slopes, thin cores, blanket & dike sections.	CH
Poor to Very Poor	65-100	sheepsfoot	Medium to Low	Very High	Good to Poor	Good	Not suitable for embankments.	OH
DO NOT USE FOR EMBANKMENT CONSTRUCTION								Pt

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Figure Unified classification and properties of soils

TENTATIVE
FOR TRIAL USE ONLY

CHANNELS		FOUNDATION					UNIFIED SOIL CLASSES
LONG DURATION TO CONSTANT FLOWS.		FOUNDATION SOILS, BEING UNDISTURBED, ARE INFLUENCED TO A GREAT DEGREE BY THEIR GEOLOGIC ORIGIN. JUDGEMENT AND TESTING MUST BE USED IN ADDITION TO THESE GENERALIZATIONS.					
RELATIVE DESIRABILITY			RELATIVE DESIRABILITY		REQUIREMENTS FOR SEEPAGE CONTROL		
EROSION RESISTANCE	COMPACTED EARTH LINING	BEARING VALUE	SEEPAGE IMPORTANT	SEEPAGE NOT IMPORTANT	PERMANENT RESERVOIR	FLOODWATER RETARDING	
1	-	Good	-	1	Positive cutoff or blanket	Control only within volume acceptable plus pressure relief if required.	GW
2	-	Good	-	3	Positive cutoff or blanket	Control only within volume acceptable plus pressure relief if required.	GP
4	4	Good	2	4	Core trench to none	None	GM
3	1	Good	1	6	None	None	GC
6	-	Good	-	2	Positive cutoff or upstream blanket & toe drains or wells.	Control only within volume acceptable plus pressure relief if required.	SW
7 if gravelly	-	Good to Poor depending upon density	-	5	Positive cutoff or upstream blanket & toe drains or wells.	Control only within volume acceptable plus pressure relief if required	SP
8 if gravelly	5 erosion critical	Good to Poor depending upon density	4	7	Upstream blanket & toe drains or wells	Sufficient control to prevent dangerous seepage piping.	SM
5	2	Good to Poor	3	8	None	None	SC
-	6 erosion critical	Very Poor, susceptible to liquefication	6, if saturated or pre-wetted	9	Positive cutoff or upstream blanket & toe drains or wells.	Sufficient control to prevent dangerous seepage piping.	ML
9	3	Good to Poor	5	10	None	None	CL
-	7 erosion critical	Fair to Poor, may have excessive settlement	7	11	None	None	OL
-	-	Poor	8	12	None	None	MH
10	volume 8 change critical	Fair to Poor	9	13	None	None	CH
-	-	Very Poor	10	14	None	None	OH
-	-	REMOVE FROM FOUNDATION					Pt

No. 1 is best numerical rating.

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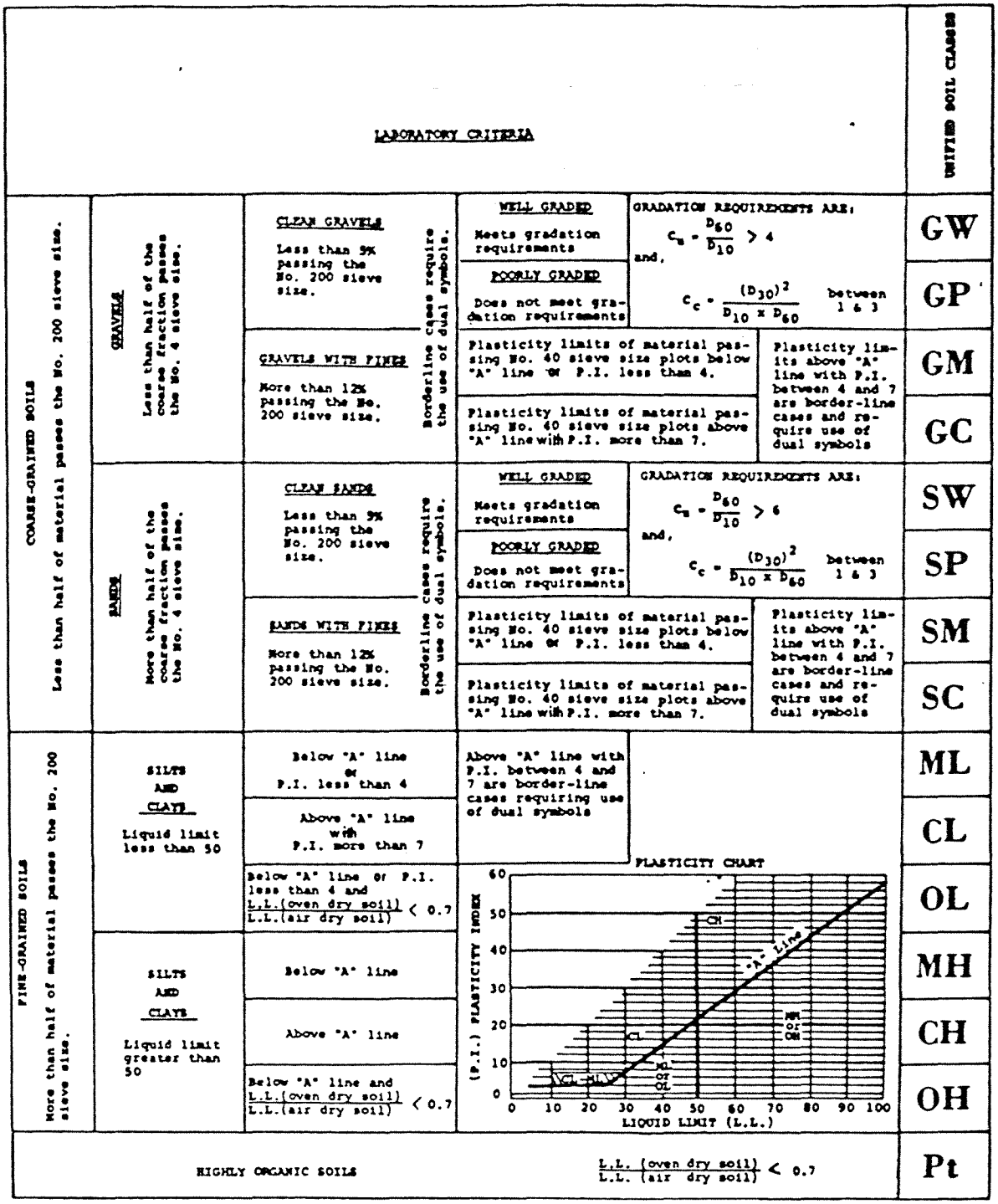
Figure Unified classification and properties of soils



SHEET 4 OF 4

Figure ' Unified classification and properties of soils

THE ACTUAL DOCUMENT IS AVAILABLE
FOR REVIEW IN THE

Howland Hook Marine Terminal

SITE FILE

SITE FILES ARE LOCATED AT:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
REMOVAL RECORDS CENTER
BUILDING 205
2890 WOODBRIDGE AVENUE
EDISON, NEW JERSEY
08837