US EPA Region 2
Division of Environmental Science & Assessment
Monitoring & Assessment Branch

Standard Operating Procedures for Field Activities

December 2006

U.S. Environmental Protection Agency
Region 2
2890 Woodbridge Avenue
Edison, New Jersey 08837

SOP4FA

TABLE of CONTENTS

SECTION 12

SECTION 13

SECTION 14

SECTION 15

SECTION 16

SECTION 17

SECTION 18

SECTION 19

APPENDIX A

APPENDIX B

APPENDIX C

SECTION 1
PREFACE

1.1 Introduction

This document, the US Environmental Protection Agency - Region 2 - Standard Operating Procedures for Field Activities, contains the standard operating and field quality assurance procedures used by Region 2 field investigators in the Edison, New Jersey field office. The model for this manual was derived from the US EPA Region 4 office document entitled *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual,* as revised in November 2001. The specific procedures outlined in this manual are based on the knowledge and experiences of Region 2 field investigators, and/or documents referenced at the end of each section.

This manual will be provided to each employee in the Region 2 - Edison, New Jersey office of the Division of Environmental Science and Assessment, Monitoring and Assessment Branch, Monitoring Operations Section, who are responsible for conducting field investigations for activities contained in these Standard Operating Procedures (SOP's). Each employee is expected to read and be familiar with each section of the SOP. This is intended to be a dynamic document, and will be revised and added to periodically, as needed. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.2 Performance Objectives

Performance objectives have been included at the beginning of sections and subsections, where applicable. The performance objective lists the minimum requirements necessary for meeting the intent of the procedures that follow in the section. The purpose of the performance objective is to allow flexibility within field procedures where appropriate; however, any deviations from the procedures in the SOP should be approved by the appropriate authority and thoroughly documented.

1.3 Section Objectives

Section objectives are included at the beginning of sections where performance objectives are not applicable. Section objectives provide a brief summary of the intention and content of the section.

SECTION 2
INVESTIGATIONS, INSPECTIONS, AND OVERVIEW ACTIVITIES SECTION

PERFORMANCE OBJECTIVES:

- Define the standard types of investigations, inspections, and field studies conducted.

- Outline the general requirements for study plans and reports for standard types of investigations, inspections and field studies.

- List available agency guidance and special requirements for the standard types of investigations, inspections, and field studies.

2.1 Introduction

The investigations, inspections, and overview activities conducted can be broadly categorized as either enforcement or non-enforcement related.

Enforcement related activities include criminal investigations, Resource Conservation and Recovery Act (RCRA) case development inspections, RCRA Compliance Evaluation Inspections (CEI'S), RCRA comprehensive ground water monitoring evaluations, water enforcement case preparation studies, National Pollutant Discharge Elimination System (NPDES) and pretreatment compliance monitoring, diagnostic evaluations of municipal wastewater treatment plants, investigations of Superfund hazardous waste sites, contractor overviews, investigations and monitoring of spills, and investigations of toxic episodes and spills.

Non-enforcement activities include investigations and technical assistance studies at municipal wastewater treatment plants, pollution prevention audits at industrial facilities, studies involving water quality and permitting issues, studies and inspections of abandoned hazardous waste sites, and a broad range of studies for national programs, as well as technical assistance studies for state and local agencies. However, studies and data derived from non-enforcement type investigations could be used for enforcement purposes. Field investigations include all environmental media (i.e., surface and ground water, air, soils, sediments) and wastes.

2.2 Potable Water Supply Investigations

Potable water supply investigations are usually conducted as part of a larger investigation such as a spill, leaking tanks, nearby superfund site, etc. However, an investigation may be conducted independently of a potential contamination source. Potable water supply investigations may include collecting samples from wells, surface waters, distribution systems, private residential wells, etc. In addition, sampling for lead in the drinking water at public schools are also performed at the request of the program office. Special procedures apply when a sample is collected from a private or public potable water supply. Investigators should always obtain the following information from the residents and/or owners in the event contaminants are detected in the sample:

- resident's and/or owners' name;

- resident's and/or owner's mailing address; and
- resident's and/or owner's home and work telephone numbers.

Immediately upon receipt of analytical data, the project leader should carefully examine the data. Web sites listed at the bottom of this section may be useful in an evaluation of the data. If any of the primary or secondary drinking water standards are exceeded, or any priority pollutants, RCRA 40 CFR 261 Appendix VIII compounds, or the CERCLA 40 CFR 302 list of hazardous substances are detected, the project leader will immediately provide the information listed below to the appropriate individuals in the Division of Enforcement and Compliance Assistance (DECA) - Water Compliance Branch (WCB). The DECA/WCB primary contact is the Public Water Supply Team Leader; the secondary contact is the Chief of the WCB.

- the analytical data;
- the name, address (including zip code) and telephone numbers of the residents and/or owners;
- the site name and location; and
- the EPA site identification number (if applicable).

Investigators should not release potable water supply data to anyone before providing it to Division of Enforcement and Compliance Assistance (DECA) - Water Compliance Branch (WCB), Public Water Supply Team.

Web sites that may be useful include:

The web site contains the current list of drinking water contaminants and Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) with potential health effects and sources is:

http://www.epa.gov/safewater/contaminants/index.html

For a summary of drinking water health advisories:

http://www.epa.gov/waterscience/criteria/drinking/

Also available are the following resources on the internet:

Region 3 Risk Assessment tables: http://www.epa.gov/reg3hwmd/risk/human/index.htm
Region 9 Risk Assessment tables: http://www.epa.gov/region09/waste/sfund/prg/index.htm
NCEA (ORD-Cinn.) web page: http://cfpub.epa.gov/ncea/
Oak Ridge National Laboratory risk assessment page: http://risk.lsd.ornl.gov/index.shtml

EPA's Integrated Risk Information System (reference doses and slope factors):
http://www.epa.gov/iriswebp/iris/index.html

2.3 Civil Enforcement Investigations and Studies

2.3.1 Introduction

This SOP covers the field and operational aspects of conducting field investigations; however, it is beyond the scope of this manual to cover all aspects of enforcement activities. Each enforcement investigation must be tailored to meet the needs of the anticipated enforcement action. The lead attorney and compliance specialists should be consulted on a continuing basis during the planning, conducting, and report writing phases of enforcement investigations.

Civil investigations are conducted for the Division of Enforcement and Compliance Assistance (DECA), the Division of Environmental Planning and Protection (DEPP), the Emergency and Remedial Response Division, and the Caribbean Environmental Protection Division (CEPD) to determine if a facility, site, or project is meeting the terms of a Consent Decree, order, permit, etc. These investigations are conducted under a number of environmental laws which include:

- The Clean Water Act (CWA, PL 92-500), as amended
- The Resource Conservation and Recovery Act (RCRA, PL 94-580), as amended
- The Hazardous and Solid Waste Amendments (HSWA) of 1984
- The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
- The Superfund Amendments and Re-authorization Act (SARA) of 1986
- The Toxic Substances Control Act (TSCA, PL 94-469), as amended

2.3.2 Facility Entry

Authority - Various federal environmental statutes grant EPA enforcement personnel authority to enter and inspect facilities. The authority granted in each statute is similar to that stated below in Section 308 of the Clean Water Act:

- "(a)(B) the Administrator, or his authorized representative, upon presentation of his credentials (i) shall have a right of entry to, upon, or through any premises in which an effluent source is located or in which any records required to be maintained. . .are located, and,
- (ii) may at reasonable times have access to and copy any records, inspect any monitoring equipment or method required. . . , and sample any effluents which the owner or operator of such source is required to sample. . ."

For the specific requirements for conducting inspections and collecting data pursuant to a particular Act, see: Section 308 of the Clean Water Act; Section 9 of the Federal Insecticide, Fungicide, and Rodenticide Act; Section 3007 of the Resource Conservation and Recovery Act; Section 8 of the Toxic Substances Control Act; Section 1445 of the Safe Drinking Water Act; Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund); and Titles I, III, and IV of the Clean Air Act.

2.3.3 Unreasonable Search and Seizure

EPA authority under the various Acts is subject to the "unreasonable search and seizure" provisions of the Fourth Amendment to the Constitution. The prohibition is not against all searches and seizures, but only those which are unreasonable, or for which valid consent, if required, has not been given. Consent, in this context, means the intentional foregoing of the right to privacy, which is not the result of either fear, ignorance, or trickery.

To comply with the requirements of the Acts and avoid any "unreasonable search" or procedural problems, a facility should be entered in the following manner:

1. The facility premises should be entered through the main gate, or through the entrance designated by the source, if in response to an inspection notification letter (a 308 letter for example).

2. The employee shall introduce herself/himself in a dignified, courteous manner to a responsible plant official. A responsible plant official may be the owner, operator, officer, or agent in charge of the facility, including the plant environmental engineer. Identification credentials shall always be presented.

3. If only a guard is present at the entrance, employees shall present their credentials and suggest that the guard contact their superior. If the field investigators know the name of the responsible official they are to see, they should request that the guard call this individual directly.

4. If the company provides a general sign-in sheet, it is acceptable to sign it. Field investigators shall not sign a release of liability (waiver) when entering a facility under the authority of Federal law.

5. If entry is refused, field investigators shall not contest the issue with the facility representative, but will immediately do the following:

- Obtain the name and position of the individual denying entry to the facility, and record the date and time.

- Cite the appropriate EPA authority to conduct the inspection, ask if the individual denying entry heard and understood the reason for your presence, and record the answer and any reasons given for denial of entry.

- Leave the premises immediately.

After leaving the facility, the field investigators shall, at the earliest possible time, inform their immediate supervisor and the Office of Regional Counsel, by telephone of the events which took place and seek guidance on how to proceed.

2.3.4 Requesting Information

The various laws and statutes under which EPA operates address the protection of trade secrets and confidential information. As a general policy, field investigators should not accept confidential information unless it is necessary for carrying out Agency functions under a particular Act. As a matter of practice, requests for confidential information can only be signed by an Agency employee who has had the appropriate Confidential Business Information (CBI) training and certification. In compliance with EPA regulations, an EPA request for company information, pursuant to statutory authority, will contain a statement allowing the facility to designate all or part of the information requested by the Agency as confidential by marking it according to: Code of Federal Regulations, Title 40, Part 2, Section 203.41; or Federal Register, 41 FR 36902. In addition to citing the appropriate regulations, the request for confidential information will state that:

> 1. The company may, if it desires, assert a business confidentiality claim covering part or all of the information in the manner described by [the applicable regulation], and that information covered by such a claim will be disclosed by EPA only to the extent, and by means of the procedures, set forth in [the applicable regulations]; and that,
>
> 2. If no such claim accompanies the information when it is received by EPA, it may be made available to the public by EPA without further notice to the company.

If the collection of confidential information is required to carry out the responsibilities of the Branch, personnel should consult carefully with the appropriate operating Division staff and the Office of Regional Counsel attorneys. In general, when such information is needed by Branch personnel, the request should state that this information will be transmitted directly to the Office of Regional Counsel. In general, Branch personnel shall not accept confidential information when conducting a plant evaluation, inspection, or reconnaissance. When Branch personnel must collect or observe confidential information, a separate logbook shall be maintained. When confidential information is entered into an inspector's logbook, the entire logbook and each page containing confidential information, shall be marked "CONFIDENTIALITY CLAIM." Upon returning to the EPA Region 2 facility, all such information shall be maintained in a locked filing cabinet. The confidential information should be returned to the originator, or destroyed, and the ultimate disposition of the material should be carefully documented. All field investigators conducting investigations or inspections should be familiar with the inspection provisions of these acts, i.e., CWA (Section 308), RCRA (Section 3007), CERCLA (Section 104), and TSCA (Section 11).

2.3.5 Photographs

The inspector’s standard equipment list should include a camera, which should be used to document sample collection and any possible compliance issues. Upon entry, the inspector should inform facility personnel the inspector’s equipment does include a camera, and that photographs may be taken. Some facilities may object because of concerns that confidential business information may be compromised. The inspector should attempt to overcome the facility’s objection with the following assurances:

- Photographs of process operations and equipment will be avoided, unless necessary to document compliance issues.

- Facility personnel will be notified when photos are taken.

- Copies of all photographs will be given to the facility personnel for review. Until the facility review is complete the inspector will treat the photos as confidential information. Such claims will be subject to the same standard procedures applicable for all claims of business confidentiality.

- Undeveloped film, negatives, and media storage devices are government property, and will not be surrendered under any circumstances.

If the above assurances fail to overcome the facility's objections, the inspector should indicate politely to facility personnel that the inspector does not have the authority to accept limitations on entry (with respect to photographs), beyond those listed above. At this point the inspector should contact his/her supervisor for further instruction.

2.3.6 Split Samples

The inspection provisions of RCRA (Section 3007) and CERCLA (Section 104) require that, "If the officer or employee obtains any samples, prior to leaving the premises, he shall give to the owner, operator, or agent in charge a receipt describing the samples obtained and, if requested, a portion of each such sample equal in volume or weight to the portion retained." As a matter of policy, an offer will be made to the owner, operator, or agent in charge to split all samples collected on facility property.

2.3.7 Inspections at Federal Facilities

Inspections that are to be performed at Federal Facilities require that contact be made with the Region's Federal Facility Program Manager (FFPM) before the inspection is conducted. The current Federal Facility Program Manager, should be notified at least seven days prior to the inspection. If significant violations are discovered, or denial of entry problems occur, the FFPM must be notified as soon as possible. A copy of the inspection report should be provided to the FFPM, as well as any information request letters, and the associated responses. The FFPM should be added to the concurrence sign-off list and copied on all enforcement actions taken against a federal facility. The FFPM should also be invited to attend any meeting(s) that are held with the representatives from the federal facility, and any enforcement settlement negotiations.

2.4 Criminal Investigations and Studies

At the request of the Criminal Investigations Division (CID), and with the written concurrence (an email will satisfy this requirement) of the appropriate program office Branch or Section chief and the DESA/MAB Branch chief or DESA/MAB/MOS Section chief, technical support for criminal investigations is provided. Only experienced personnel with adequate training (such as that received during on-site supervision by senior investigators or the Criminal Investigations Course offered by the Federal Law Enforcement Training Center) should be project leaders during such investigations. Technical support shall be provided at the request of the CID Special Agent-in-Charge, through the National Enforcement Investigations Center (NEIC) - Regional Technical Coordinator (RTC). The RTC in Region 2 is David Dugan, who is located in Trenton, New Jersey [telephone number (609) 656-2728]. Detailed procedures for providing support on criminal cases is provided in Appendix F of this document.

2.5 Clean Water Act Compliance Monitoring Inspections

2.5.1 Introduction

The term "compliance monitoring" covers all activities undertaken to ascertain a permittee's (or discharger's) compliance status. This includes, but is not limited to, Clean Water Act (CWA) compliance monitoring inspections and compliance reviews, e.g., the review of Discharge Monitoring Reports (DMR's) or compliance schedule reports. The main functions of CWA compliance monitoring inspections are to verify the integrity of the self-monitoring information, as well as to develop the basis for possible follow-up compliance or enforcement actions. All compliance monitoring inspections shall be conducted as though an enforcement action would result. General guidance for conducting NPDES related compliance monitoring inspections is found in the US EPA, NPDES Compliance Inspection Manual. Compliance monitoring inspections are usually requested through the Division of Enforcement and Compliance Assistance, Water Compliance Branch.

A number of different types of compliance monitoring inspections have been defined including: compliance evaluation inspections (CEI), compliance sampling inspections (CSI), toxic sampling inspections (XSI), compliance biomonitoring inspections (CBI), performance audit inspections (PAI), diagnostic evaluations (DE), reconnaissance inspections (RI), pretreatment compliance inspections (PCI), sludge inspections (SI), legal support inspections (LSI), and municipal wastewater treatment plant technical assistance (TA) studies.

Activities associated with a visit to any facility for a compliance inspection shall not be double counted. Thus, a single visit cannot be counted as both a CSI and a CEI; it must be reported as one or the other. However, a single visit that encompasses separate activities (e.g., a PAI or legal support investigation) will be reported and counted as two separate activities. A compliance monitoring inspection (all types) is not considered complete until the appropriate portions of the Compliance Inspection Report Form (EPA Form 3560-3) have been completed and the information from the coding section is entered into the integrated compliance information system (ICIS), and the permit compliance system (PCS), if applicable. Some inspections are conducted over several consecutive 24-hour periods (i.e., 7-day CSI surveys). A separate inspection shall be entered into ICIS and PCS for each 24-hour period that the inspection was conducted.

Inspection Notification

Generally, CSIs and CEIs are conducted unannounced, unless there is a reason to conduct the inspection on an announced basis. Routine PAI's and DE's are typically announced inspections due to the complexity of the logistics involved in these types of investigations. Sampling at sludge facilities and CSI’s at industrial pretreatment facilities requires the gathering of information related to the nature and frequency of the land application and/or discharge. Specifics pertaining to the sludge treatment and disposal operations are needed in order to schedule sampling inspections. For industrial pretreatment facilities, the specific process operations of interest, the number of outfalls, flow monitoring practices and equipment, the location of the sampling points, and the day(s) and hours that the discharge occurs is vital information to have in order to plan successful sampling activities. This information should be used to determine if the inspection is to be announced or unannounced.

2.5.2 CWA Inspection Types

Compliance Evaluation Inspection (CEI)

The CEI is a non-sampling inspection designed to verify permittee compliance with applicable permit self-monitoring requirements, effluent limits, and compliance schedules. This inspection involves records reviews, visual observations, and evaluations of the treatment facilities, laboratories, effluents, receiving water, etc. The CEI examines both chemical and biological self-monitoring and forms the basis for all other inspection types, except the Reconnaissance Inspection. Guidance for conducting CEIs is given in the NPDES Compliance Inspection Manual.

Compliance Sampling Inspections (CSI)

CSI's are conducted where representative sample(s) of a permittee's influent and/or effluent are collected and analyzed to (1) verify the accuracy of the permittee's discharge monitoring reports, (2) determine the quantity and quality of the effluent, (3) develop permits, and/or (4) where appropriate, as evidence for enforcement proceedings. This activity also includes the same objectives listed for CEI's, and where appropriate, may serve to gather detailed information for the possible institution of legal action against the permittee. Guidance for conducting CSI's is given in the NPDES Compliance Sampling Inspection Manual. Pretreatment CSI's are also conducted at industrial facilities that discharge to Publicly Owned Treatment Works (POTW's). These pretreatment sampling inspections are performed in order to determine if the wastewater being discharged is in compliance with federal categorical standards and limitations, and if the facility as regulated under an EPA approved pretreatment program, the local permit limitations.

Toxic Sampling Inspections (XSI)

The XSI has the same objectives as a conventional CSI. However, it places increased emphasis on toxic substances regulated by the NPDES permit. The XSI covers priority pollutants other than heavy metals, phenols, and cyanide, which are typically included in a CSI (if regulated by the NPDES permit). An XSI uses more resources than a CSI because highly sophisticated techniques are required to sample and analyze toxic pollutants. An XSI may also evaluate raw materials, process operations, and treatment facilities to identify toxic substances requiring controls.

Compliance Biomonitoring Inspection (CBI)

A CBI is an inspection utilizing a static, or flow-through, bioassay, in lieu of, or in addition to, the collection of samples for toxic compounds. The objectives of this inspection are to:

- Identify those permittees which may be meeting the minimum technology based requirements of the CWA, but whose level of treatment is not sufficient to ensure the biological integrity of the receiving waters;

- Identify those permittees which may have potential toxic substances in their discharge(s) that have not been identified or included in their NPDES permit; and

- Evaluate compliance with acute or chronic toxicity permit limit requirements.

In those instances where biomonitoring reveals the presence of toxic substances not addressed in the issued permit, the permittee may be required, through the 308 process, to chemically and/or physically characterize the composition of the discharge to identify and quantify the toxic substance or substances (CWA Section 308). Guidance for conducting these inspections is given in the Compliance Biomonitoring Inspection Manual.

Performance Audit Inspection (PAI)

The PAI is used to evaluate the permittee's self-monitoring program. As with a CEI, the PAI is used to verify the permittee's reported data and compliance through a records check. However, the PAI provides a more resource-intensive review and evaluation of the permittee's self-monitoring program and evaluates the permittee's procedures for sample collection, flow measurement, chain-of-custody, laboratory analyses, data compilation, reporting, and other areas related to the self-monitoring program. During a CEI, the inspector makes a cursory visual observation of the treatment facility, laboratory, effluents, and receiving waters. During a PAI, the inspector determines if the permittee performing the self-monitoring process is properly collecting, preserving and analyzing the samples in accordance with EPA approved procedures. The evaluation follows the sample from the point and time of its collection, including flow measurement, through sample preservation, compliance with applicable sample holding time(s), the laboratory analyses, data work-up, and reporting phases. The PAI does not include the collection of samples by the inspector. However, the inspector may require the permittee to analyze performance samples for laboratory evaluation purposes.

Diagnostic Evaluations (DE)

The DE is a detailed performance evaluation that focuses primarily on municipal Publicly Owned Treatment Works (POTWs), which are not in compliance with permit requirements. The DE is designed to evaluate the POTW's design, operations, and influent/effluent wastewater characteristics, and to provide a comprehensive evaluation of the reasons why the facility is not meeting permit limits. The final product consists of a formal report with data, data interpretation, and recommendations suitable for use in technical assistance, negotiations, and enforcement actions.

Reconnaissance Inspection (RI)

The RI is used to obtain a preliminary overview of a permittee's compliance program. The inspector performs a brief visual inspection of the permittee's treatment facility, effluent, and receiving waters. The RI is intended to obtain a broad coverage of permittees of unknown status with a minimum amount of resources.

Pretreatment Compliance Inspection (PCI)

The PCI evaluates the POTWs implementation of its approved pretreatment program. It includes a review of the POTWs records on monitoring, inspections, and enforcement activities for its industrial users. The PCI is usually conducted concurrently with another NPDES inspection of the POTW.

Sludge Inspection (SI)

The SI is primarily conducted at POTWs. Waste sludge generation and disposal practices are evaluated under the 40 CFR Part 503 regulations. The SI includes a review of the sludge monitoring records, sludge handling facilities, and sludge disposal practices. Samples are taken and analyzed in order to determine if the permittee is in compliance with the Part 503 and State regulations.

Legal Support Inspection (LSI)

The LSI is an inspection conducted to satisfy a specific enforcement related problem. An example of this type of inspection may be an enforcement request to inspect a permittee to see if it is appropriate to terminate an enforcement order, or to gather data to support a planned action.

2.5.3 Study Plans

Routine NPDES inspections (e.g., PAIs, CSIs, etc.) do not require a written study plan. Detailed investigations, such as diagnostic evaluations, water quality studies, and other large scale technical evaluations may require a written study plan, which should include the following minimal information:

- Introduction - The name and location of the project, study dates, requestor, reason for request (e.g., NPDES compliance problems), project leader, and a list of EPA and other appropriate study contacts and telephone numbers.
- Study Objectives - A detailed description of the primary objectives of the project.
- Sampling Schedule - A detailed table showing all projected sampling stations, sampling parameters, and the total number of samples to be analyzed.

The study plan may include more detailed information depending on the nature and complexity of the project.

2.5.4 Procedures for Obtaining NPDES Permits and Facility Related Information, and for Notifying the State(s) of Upcoming Inspection(s)

Each lead inspector is responsible for obtaining their own NPDES permit related information. The States (their regional offices) must also be formally notified (by phone call and/or by letter) of the upcoming NPDES inspection(s) at least two weeks before being the inspection is performed. This also provides an opportunity to discuss the facility with the State inspector, and get some insight into the problems they perceive they may be having with the facility.

Contact the State, Territory and/or Commonwealth offices listed below, and you will be referred to the appropriate enforcement official for that permit. The states are divided into regions for all information required, as described below. Contact the appropriate office for the inspection being performed. A current list of contacts can be found in the file located at:
G:user/share/DESADIV/MAB/MOS/SOPs/contacts.doc

For the State of New Jersey

- **NJDEP Northern Bureau** of Water Compliance & Enforcement (Somerset, Hunterdon, Morris, Passaic, Sussex, Warren, Bergen, Essex, and Hudson counties).
- **NJDEP Central Bureau** of Water Compliance & Enforcement (Union, Mercer, Middlesex, Monmouth, and Ocean counties)
- **NJDEP Southern Bureau** of Water Compliance & Enforcement (Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Salem counties)
- **NJDEP Bureau of Pretreatment & Residuals**

For New York State

The NYS DEC Regional Water Engineer contacts to use for DEC Regions 1,2 3, 4, 5, 6, 7, 8 and 9 can be found in the file located at: **G:user/share/DESADIV/MAB/MOS/SOPs/contacts.doc**

For Puerto Rico

In order to obtain copies of permits and facility information you must contact appropriate personnel in the Water Compliance Branch and in the Carribean Environmental Protection Division, and provide the facility name(s) and permit number(s).

Once a schedule has been approved by management in DESA, a letter is sent from the Division Director of DESA to the President/Chairman of the Puerto Rico Environmental Quality Board. The tentative schedule is attached to the letter. The current address for EQB is found at: **G:user/share/DESADIV/MAB/MOS/SOPs/contacts.doc**

A carbon copy of the letter is sent to the EQB Director of the Water Quality Area, and blind copies are provided to the EPA Regional Administrator, the Deputy Regional Administrator, and the Division Directors for DECA, CEPD and DEPP, Deputy Division Directors for DECA and CEPD, Branch Chiefs for the CEPD ESB and DECA WCB, and other appropriate EPA personnel.

Simultaneously, an EPA Memorandum is sent from the Division Director of DESA to the Division Director of CEPD, with blind copies sent to the EQB Director of the Water Quality Area, the EPA Regional Administrator, the Deputy Regional Administrator, and the Division Directors for DECA, CEPD and DEPP, Deputy Division Directors for DECA and CEPD, Branch Chiefs for the CEPD ESB and DECA WCB and other appropriate EPA personnel.

For the US Virgin Islands

In order to obtain copies of permits and facility information you must contact appropriate personnel in the Water Compliance Branch and in the Carribean Environmental Protection Division, and provide the facility name(s) and permit number(s).

Once a schedule has been approved by management in DESA, a letter is sent from the Division Director of DESA to the Director of the US Virgin Islands Department of Planning and Natural Resources. The current address for DPNR is found at: **G:user/share/DESADIV/MAB/MOS/SOPs/contacts.doc**

Blind copies are provided to the EPA Regional Administrator, the Deputy Regional Administrator, and the Division Directors for DECA, CEPD and DEPP, Deputy Division Directors for DECA and CEPD, Branch Chiefs for the CEPD ESB and DECA WCB, the EPA US Virgin Islands liaison (currently Jim Casey), and other appropriate EPA personnel.

Simultaneously, an EPA Memorandum is sent from the Division Director of DESA to the Division Director of CEPD, with blind copies sent to the EPA Regional Administrator, the Deputy Regional Administrator, and the Division Directors for DECA, CEPD and DEPP, Deputy Division Directors for DECA and CEPD, Branch Chiefs for the CEPD ESB and DECA WCB, the EPA US Virgin Islands liaison (Jim Casey), and other appropriate EPA personnel.

2.5.5 CWA and NPDES Compliance Inspection Reports

The results of all compliance inspections requires a complete written report, which includes the NPDES Compliance Inspection Report Form (EPA Form 3560-3). A copy of this form is attached at the end of this chapter. The completed report (including EPA Form 3560-3), and a transmittal memorandum constitute a compliance inspection report for all routine compliance inspections conducted by Branch personnel. The reports are sent to the appropriate personnel, as specified in Appendix H.

If self-monitoring deficiencies are revealed during the inspection, a Deficiency Notice is to be sent via Certified mail (with a return receipt requested) directly to the permittee. If violations of permit limitations are determined to have occurred during the inspection, consultation with the program office (DECA - Water Compliance Branch) shall occur before a Notice of Non-Compliance is sent directly to the permittee.

Permittees/facilities are given 45 days to respond to theses notices, and to provide the EPA with the specific measures they choose to take to correct the deficiencies or non-compliance issues found at their facilities. The completed inspection reports, copies of the Deficiency Notices and the Notices of Non-Compliance are transmitted to the appropriate EPA program office personnel as shown in Appendix H. The program office forwards copies of these reports and notices to state program office. In cases where EPA is involved in litigation with a permittee, no reports will be sent to the permittee without permission from legal counsel.

Completion of NPDES Compliance Inspection Report Form (EPA Form 3560-3). General instructions for completing EPA Form 3560-3 are printed on the back of the form. The forms shall be signed by the inspector/investigator and dated on the day that the form is completed (not the inspection date). The name of the State inspector should be included for joint inspections. All routine compliance inspections forms shall be reviewed by the DESA-MAB Branch Chief, who will sign and date the 3560-3 form in the "Reviewed By" section.

2.6 RCRA Inspections, Investigations, and Overview Activities

2.6.1 Introduction

RCRA field activities include comprehensive ground water monitoring evaluations (CME), RCRA facility assessments (RFAs), case development investigations/evaluations (CDIE) for the RCRA programs and field investigations for the Criminal Investigations Division (CID), and on-site field overviews (OV) of State, RCRA contractor, and federal facility personnel.

2.6.2 RCRA Investigation Types

<u>Comprehensive Ground Water Monitoring Evaluation (CME)</u>

The CME is an overall review of a facility's compliance with all applicable RCRA requirements to determine adequacy of the ground water monitoring system. It includes an on-site examination of records and other documents and an evaluation of the facility's compliance with applicable RCRA requirements. Also evaluated is the effectiveness of the ground water monitoring system and the facility's hydrogeological conditions. Sampling and analysis of the ground water are usually conducted. Guidance for conducting CMEs is included in the RCRA

Ground Water Monitoring Technical Guidance Document.

RCRA Facility Assessment (RFA)

The RFA is an agency lead activity which is the first step in a corrective action program. The purpose of the RFA is to identify known, and/or probable, releases of hazardous wastes or other constituents at solid waste management units (SWMUs) and at previously unaddressed regulated units. It includes a "desk-top" review of information submitted by the owner/operator to EPA and State agencies. The RFA also consists of an on-site visit, and potentially, a subsequent sampling investigation (confirmatory sampling) to determine whether or not releases of hazardous wastes, or constituents, have occurred. Guidance for conducting the RFA is in the RCRA Facility Assessment Guidance.

Case Development Investigation/Evaluation (CDIE)

These include all RCRA field investigations other than CME's and RFA's, including field sampling investigations, closure/post closure investigations, environmental investigations, trial burns, delisting investigations, etc. The type of investigation dictates the specific field methodology. The CDIE is conducted to gather information on the composition/characteristics of wastes and/or areas impacted by the operation of a RCRA facility. The CDIE may also include verification of a sampling and analysis plan, collection of information on facility design and operation, verification of manifest descriptions, or other unanticipated needs or requests necessary for case development.

Compliance Evaluation Inspection

The CEI is a detailed inspection of a hazardous waste generator, transporter, or treatment, storage and disposal facility (TSDF) to evaluate compliance with the requirements of RCRA. CEIs are used to gather information to determine compliance with RCRA regulations, to support enforcement actions, and to identify and bring non-notifiers into the RCRA regulatory program. A CEI involves a review of facility records, an on-site evaluation of hazardous waste generation, treatment and storage, or disposal practices. The results of a CEI may be used to support initiation of a CDIE.

Overviews (OV)

Overviews of State RCRA compliance inspections or RCRA contractor inspections are conducted to evaluate their capability to conduct RCRA field investigations. The details provided in the site-specific Quality Assurance Project Plan (QAPP) would supply the criteria for the overview. A written report presenting the overview findings is completed and transmitted to the appropriate EPA regional office RCRA official.

2.6.3 Planning for Field Investigative Support

Periodic meetings are held between representative(s) of DESA and the RCRA Branch staff to discuss proposed initiatives and specific investigation needs. These meetings are usually conducted in October for yearly planning, and more frequently for quarterly planning. Based on the priorities agreed upon, a tentative field investigation schedule is prepared and updated.

2.6.4 Requests for RCRA Studies

RCRA investigations are prioritized by the Region 2 RCRA Programs branch, based on their need for field investigative support. Requests for field investigative support are coordinated with the RCRA Team Supervisor, or their designee(s). A memorandum with a request form is recommended prior to commencement of the investigation.

2.6.5 Investigation Study Plans

Study plans are prepared for all RCRA investigations, and issued at least one week prior to the investigation. A copy of the draft study plan should be provided to the RCRA program requestor to ensure that the investigation will meet the enforcement or permitting objectives. As a general rule, the Data Quality Objective (DQO) process should be consulted during the study plan preparation phase. The study plan would include, as appropriate:

1 Introduction - The name and location of the project, study dates, requestor, reason for request (e.g., RCRA compliance problems), project leader, and a list of EPA and other appropriate study contacts and telephone numbers.

2 Background - Facility compliance history, manufacturing processes, types of wastes produced, waste treatment methods, etc.

3 Scope - A discussion of the study design including the number and locations of the samples to be collected. Information which will be obtained and records to be reviewed.

4 Logistics - The travel, study dates and personnel.

5 Methodology - Analyses to be conducted and who will conduct analyses, field and laboratory SOP references, and when samples will be received by the laboratory.

2.6.6 Investigation Reports

Reports will be completed after each investigation and will contain the following, as appropriate:

1 Introduction - When the investigation was conducted; EPA, state, or other regulatory agency participation; facility representatives and what their participation included; who requested the investigation; and the objectives.

2 Background - Study area descriptions, manufacturing process and waste handling practices, results of previous investigations, etc.

3 Summary - A brief summary of the key results and conclusions of the study.

4 Discussion - All aspects pertinent to the investigation, e.g., sampling, figures, photographs, analytical results, RCRA deficiencies, etc.

5 Methodology - What information was obtained and from whom, what sampling procedures were used, etc. A statement indicating that this SOP was followed and/or reasons for deviations, and whether or not samples were split and with who

6 Conclusions - At the discretion of the investigator, a conclusions section for complex investigations.

7 Reference and Appendices - Raw data, checklists, etc.
If the study was a CME, the following information should be included where appropriate:

- A discussion of site hydrology.
- An evaluation of the monitoring well system.
- An evaluation of the assessment plan.
- A site map showing monitoring well locations, SWMU's, topography, ground water flow direction, etc.
- Well depth, ground water elevations.

Internal Peer Review and Report Recipients

All RCRA plans and reports will be reviewed internally. Final copies of the plan/report will be sent to the requestor. If the facility or State personnel request a copy of the report, this will be indicated in the report transmittal memorandum.

2.7 References

1. NPDES Compliance Inspection Manual, United States Environmental Protection Agency, July 2004. Available as a PDF file at: http://www.epa.gov/compliance/resources/publications/monitoring/cwa/inspections/npdesinspect/npdesmanual.html

2. US-EPA, NPDES Compliance Evaluation Inspection Manual, MCD-75, United States Environmental Protection Agency, Washington, D.C., 1981.

3. US-EPA, NPDES Compliance Sampling Inspection Manual, MCD-51, United States Environmental Protection Agency, Washington, D.C., 1979.

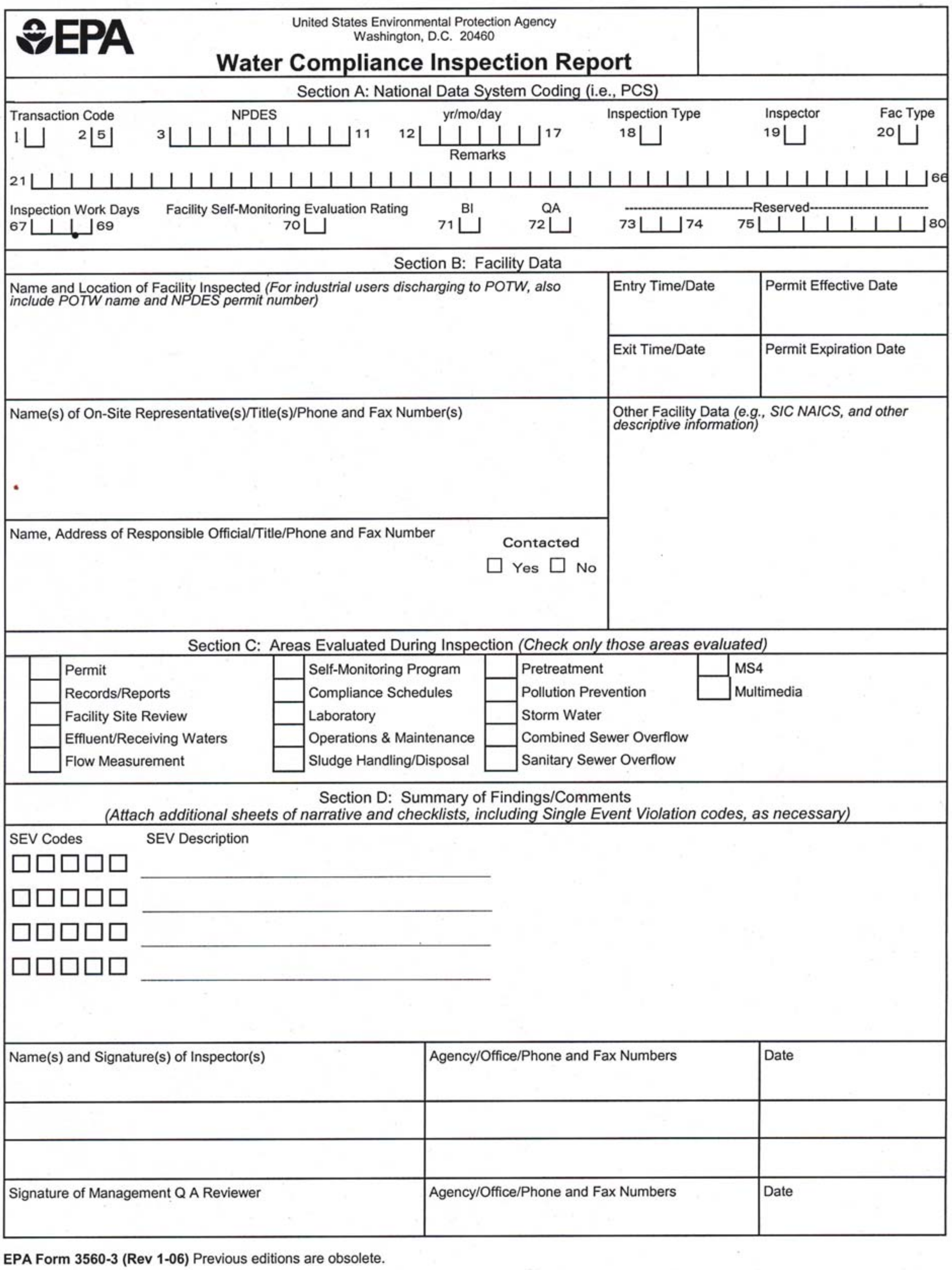
4. EPA ORDER 3500.1 A1 Training and Development for Individuals Who Lead Compliance Inspections/Field Inspections, December 23, 2002.

5. Compliance Biomonitoring Inspections Manual, MCD-62, United States Environmental Protection Agency, Washington, D.C., 1981.

6. RCRA Ground-Water Monitoring Technical Guidance Document, United States Environmental Protection Agency, Office of Solid Waste, Washington, D.C., (EPA/530/R-001) November 1992. This document is available on the internet as a PDF file, and may be found at: http://www.epa.gov/correctiveaction/resource/guidance/sitechar/gwmonitr/rcra_gw.pdf#search='RCRA%20GroundWater%20Monitoring%20Technical%20Guidance%20Document'

7. RCRA Facility Assessment Guidance, United States Environmental Protection Agency Office of Solid Waste, Washington, D.C., (PB87-107769) October, 1986.

EPA Form 3560-3 - page 1



United States Environmental Protection Agency
Washington, D.C. 20460

Water Compliance Inspection Report

Section A: National Data System Coding (i.e., PCS)

Transaction Code	NPDES	yr/mo/day	Inspection Type	Inspector	Fac Type
1 ☐ 2 5	3 ☐☐☐☐☐☐☐☐☐ 11	12 ☐☐☐☐☐☐ 17	18 ☐	19 ☐	20 ☐

Remarks
21 ☐☐ 66

Inspection Work Days	Facility Self-Monitoring Evaluation Rating	BI	QA	Reserved	
67 ☐☐.☐ 69	70 ☐	71 ☐	72 ☐	73 ☐☐ 74	75 ☐☐☐☐☐☐ 80

Section B: Facility Data

Name and Location of Facility Inspected *(For industrial users discharging to POTW, also include POTW name and NPDES permit number)*	Entry Time/Date Exit Time/Date	Permit Effective Date Permit Expiration Date
Name(s) of On-Site Representative(s)/Title(s)/Phone and Fax Number(s)	Other Facility Data *(e.g., SIC NAICS, and other descriptive information)*	
Name, Address of Responsible Official/Title/Phone and Fax Number Contacted ☐ Yes ☐ No		

Section C: Areas Evaluated During Inspection *(Check only those areas evaluated)*

- ☐ Permit
- ☐ Records/Reports
- ☐ Facility Site Review
- ☐ Effluent/Receiving Waters
- ☐ Flow Measurement
- ☐ Self-Monitoring Program
- ☐ Compliance Schedules
- ☐ Laboratory
- ☐ Operations & Maintenance
- ☐ Sludge Handling/Disposal
- ☐ Pretreatment
- ☐ Pollution Prevention
- ☐ Storm Water
- ☐ Combined Sewer Overflow
- ☐ Sanitary Sewer Overflow
- ☐ MS4
- ☐ Multimedia

Section D: Summary of Findings/Comments

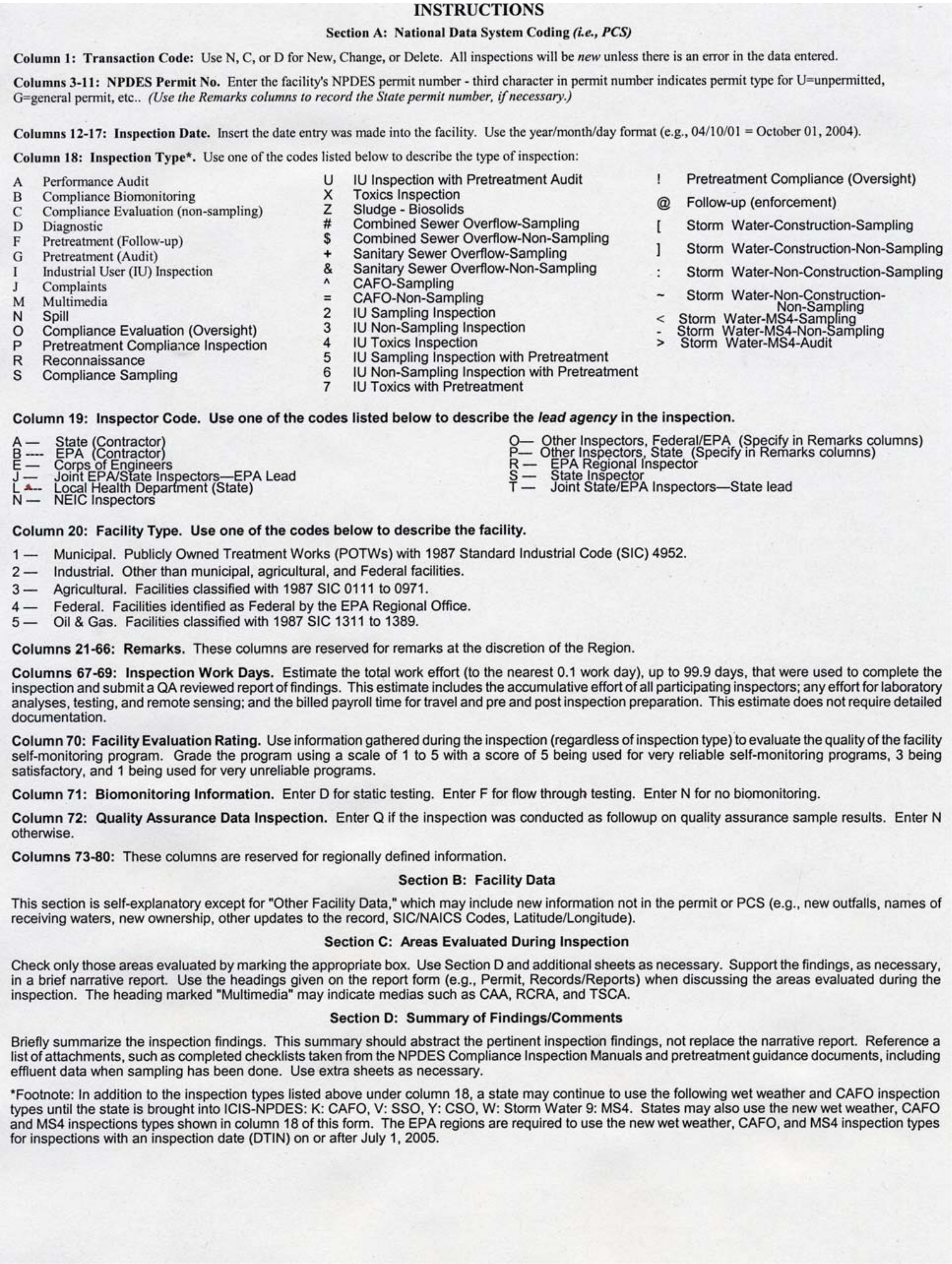
(Attach additional sheets of narrative and checklists, including Single Event Violation codes, as necessary)

SEV Codes	SEV Description
☐☐☐☐☐	______________________
☐☐☐☐☐	______________________
☐☐☐☐☐	______________________
☐☐☐☐☐	______________________

Name(s) and Signature(s) of Inspector(s)	Agency/Office/Phone and Fax Numbers	Date
Signature of Management Q A Reviewer	**Agency/Office/Phone and Fax Numbers**	**Date**

EPA Form 3560-3 (Rev 1-06) Previous editions are obsolete.

EPA Form 3560-3 - page 2



INSTRUCTIONS

Section A: National Data System Coding *(i.e., PCS)*

Column 1: Transaction Code: Use N, C, or D for New, Change, or Delete. All inspections will be *new* unless there is an error in the data entered.

Columns 3-11: NPDES Permit No. Enter the facility's NPDES permit number - third character in permit number indicates permit type for U=unpermitted, G=general permit, etc.. *(Use the Remarks columns to record the State permit number, if necessary.)*

Columns 12-17: Inspection Date. Insert the date entry was made into the facility. Use the year/month/day format (e.g., 04/10/01 = October 01, 2004).

Column 18: Inspection Type*. Use one of the codes listed below to describe the type of inspection:

A	Performance Audit
B	Compliance Biomonitoring
C	Compliance Evaluation (non-sampling)
D	Diagnostic
F	Pretreatment (Follow-up)
G	Pretreatment (Audit)
I	Industrial User (IU) Inspection
J	Complaints
M	Multimedia
N	Spill
O	Compliance Evaluation (Oversight)
P	Pretreatment Compliance Inspection
R	Reconnaissance
S	Compliance Sampling
U	IU Inspection with Pretreatment Audit
X	Toxics Inspection
Z	Sludge - Biosolids
#	Combined Sewer Overflow-Sampling
$	Combined Sewer Overflow-Non-Sampling
+	Sanitary Sewer Overflow-Sampling
&	Sanitary Sewer Overflow-Non-Sampling
^	CAFO-Sampling
=	CAFO-Non-Sampling
2	IU Sampling Inspection
3	IU Non-Sampling Inspection
4	IU Toxics Inspection
5	IU Sampling Inspection with Pretreatment
6	IU Non-Sampling Inspection with Pretreatment
7	IU Toxics with Pretreatment
!	Pretreatment Compliance (Oversight)
@	Follow-up (enforcement)
[	Storm Water-Construction-Sampling
]	Storm Water-Construction-Non-Sampling
:	Storm Water-Non-Construction-Sampling
~	Storm Water-Non-Construction-Non-Sampling
<	Storm Water-MS4-Sampling
-	Storm Water-MS4-Non-Sampling
>	Storm Water-MS4-Audit

Column 19: Inspector Code. Use one of the codes listed below to describe the *lead agency* in the inspection.

A — State (Contractor)
B ---- EPA (Contractor)
E — Corps of Engineers
J — Joint EPA/State Inspectors—EPA Lead
L --- Local Health Department (State)
N — NEIC Inspectors
O— Other Inspectors, Federal/EPA (Specify in Remarks columns)
P— Other Inspectors, State (Specify in Remarks columns)
R — EPA Regional Inspector
S — State Inspector
T — Joint State/EPA Inspectors—State lead

Column 20: Facility Type. Use one of the codes below to describe the facility.

1 — Municipal. Publicly Owned Treatment Works (POTWs) with 1987 Standard Industrial Code (SIC) 4952.
2 — Industrial. Other than municipal, agricultural, and Federal facilities.
3 — Agricultural. Facilities classified with 1987 SIC 0111 to 0971.
4 — Federal. Facilities identified as Federal by the EPA Regional Office.
5 — Oil & Gas. Facilities classified with 1987 SIC 1311 to 1389.

Columns 21-66: Remarks. These columns are reserved for remarks at the discretion of the Region.

Columns 67-69: Inspection Work Days. Estimate the total work effort (to the nearest 0.1 work day), up to 99.9 days, that were used to complete the inspection and submit a QA reviewed report of findings. This estimate includes the accumulative effort of all participating inspectors; any effort for laboratory analyses, testing, and remote sensing; and the billed payroll time for travel and pre and post inspection preparation. This estimate does not require detailed documentation.

Column 70: Facility Evaluation Rating. Use information gathered during the inspection (regardless of inspection type) to evaluate the quality of the facility self-monitoring program. Grade the program using a scale of 1 to 5 with a score of 5 being used for very reliable self-monitoring programs, 3 being satisfactory, and 1 being used for very unreliable programs.

Column 71: Biomonitoring Information. Enter D for static testing. Enter F for flow through testing. Enter N for no biomonitoring.

Column 72: Quality Assurance Data Inspection. Enter Q if the inspection was conducted as followup on quality assurance sample results. Enter N otherwise.

Columns 73-80: These columns are reserved for regionally defined information.

Section B: Facility Data

This section is self-explanatory except for "Other Facility Data," which may include new information not in the permit or PCS (e.g., new outfalls, names of receiving waters, new ownership, other updates to the record, SIC/NAICS Codes, Latitude/Longitude).

Section C: Areas Evaluated During Inspection

Check only those areas evaluated by marking the appropriate box. Use Section D and additional sheets as necessary. Support the findings, as necessary, in a brief narrative report. Use the headings given on the report form (e.g., Permit, Records/Reports) when discussing the areas evaluated during the inspection. The heading marked "Multimedia" may indicate medias such as CAA, RCRA, and TSCA.

Section D: Summary of Findings/Comments

Briefly summarize the inspection findings. This summary should abstract the pertinent inspection findings, not replace the narrative report. Reference a list of attachments, such as completed checklists taken from the NPDES Compliance Inspection Manuals and pretreatment guidance documents, including effluent data when sampling has been done. Use extra sheets as necessary.

*Footnote: In addition to the inspection types listed above under column 18, a state may continue to use the following wet weather and CAFO inspection types until the state is brought into ICIS-NPDES: K: CAFO, V: SSO, Y: CSO, W: Storm Water 9: MS4. States may also use the new wet weather, CAFO and MS4 inspections types shown in column 18 of this form. The EPA regions are required to use the new wet weather, CAFO, and MS4 inspection types for inspections with an inspection date (DTIN) on or after July 1, 2005.

SECTION 3
SAMPLE CONTROL, FIELD RECORDS, AND DOCUMENT CONTROL

SECTION OBJECTIVES

- Present standard procedures for sample identification.
- Present standard procedures for sample control.
- Present standard procedures for chain-of-custody.
- Present standard procedures for maintenance of field records and document control.

3.1 Introduction

Sample identification, Chain-Of-Custody/Field Data Forms, receipt for sample forms, and field records should be recorded with waterproof, non-erasable ink. If errors are made in any of these documents, corrections should be made by crossing a single line through the error and entering the correct information. All corrections should be initialed. If possible, all corrections should be made by the individual making the error. Sample information can be entered onto sample labels or tags, logbooks, or sample containers using permanent ink or permanent markers. Information for sample containers may be written directly on the container using a permanent marking pen, or using weatherproof stick-on labels (i.e., Avery label # 5520 or 5522) with indelible ink (ink from a laser printer is waterproof), or self-sticking tape and a permanent marking pen. Labels should never be placed over previously recorded information.

3.2 Definitions

Following are definitions of terms used in this section:

Project Leader: The individual with overall responsibility for conducting a specific field investigation in accordance with this SOP.

Field Sample Custodian: Individual responsible for maintaining custody of the samples and completing the sample labels and Chain-of-Custody forms.

Record Sample Team Leader: An individual designated by the project leader to be present during, and responsible for, all activities related to the collection of samples by a specific sampling team.

Sampler: The individual responsible for the actual collection of a sample.

Transferee: Any individual who receives custody of samples subsequent to release by the field sample custodian.

Laboratory Sample Custodian: Individual responsible for accepting custody of samples from the field sample custodian or a transferee.

One individual may fulfill more than one of the roles described above.

3.3 Sample and Evidence Identification

PERFORMANCE OBJECTIVES:

- To accurately identify samples and evidence collected.
- To adequately ensure that chain-of-custody was maintained.

3.3.1 Sample Identification

The method of sample identification used depends on the type of sample collected. In-situ field samples are those collected for specific field analysis, or measurement, where the data are recorded directly in bound field logbooks, or on the Chain-Of-Custody/Field Data Form (see Figure 3-1), with identifying information, while in the custody of the sampling team. Examples of in-situ field measurements and analyses include: pH, temperature, total and free residual chlorine, salinity, settleable solids, dissolved oxygen and conductivity. Samples other than those collected for in-situ analysis are identified by placing the appropriate sample information onto sample labels, which can be written directly on the container using a permanent marking pen, or using weatherproof stick-on labels (i.e., Avery label # 5520 and 5520) with indelible ink (ink from a laser printer is waterproof), or self-sticking tape and a permanent marking pen.

The following information should be included on the sample label using waterproof, non-erasable ink:

- Project name or Site name;
- Unique Sample ID (i.e., **Sample ID:**);
- date of sample collection;
- designation of the sample as a grab or composite;
- how the sample is preserved;
- the specific analyses to be performed.

Two examples of a sample label are provided below:

Smith Company 1 of 3
Sample ID: DSN04GRAB
Oil & Grease Grab
4/1/2006 w/H_2SO_4 & ICE

Smith Company
Sample ID: DSN04GRAB
Oil & Grease Grab (1 of 3)
4/1/2006
Pres. w/H_2SO_4 & ICE

The first line on the sample label really needs to be the Project name/Site name. With a CWA or RCRA survey, this would most likely be the name of the facility. However, with larger ambient projects that may span several months, a single project name would be used to link many sample locations.

The Sample ID needs to be clearly identified on the label. Whenever possible, it would be useful for the Sample ID to reflect the actual sample location. Some rules for specifying a Sample ID include:

- The Sample ID may be any combination of letters and numbers (up to 15 characters in length).
- Spaces should not be used, but you can use an underscore (Outfall_001).
- You **cannot** use characters such as, @, #, $, & or *
- Containers filled with the same matrix, from the same location, that were taken at the same time (within 15 minutes), and in the same manner i.e., grab, automatic composite, manual composite), should have the **SAME** Sample ID. If any one component (matrix, time, location, collection method) is different, the container must have a **DIFFERENT** Sample ID.

If a sample is split with a facility, state regulatory agency, or other representative, the recipient should be provided with enough sample volume for their laboratory to perform the analyses (if enough sample is available).

3.3.2 Photographs, Digital Still Images and Video Identification Photographs

When photographs or digital images are taken, a record of each exposure or image shall be kept in a bound field logbook. The following information shall be recorded in the logbook: an accurate description of what the photograph or image shows, including the name of the facility or site; the date and time that the photograph or image was taken; the name of the individual who took the photograph or digital image.

When photographs are used in technical reports or placed in the official files, the film shall be developed with the uncut negatives supplied. The identifying information that was recorded in the field logbook shall be entered on the back of the prints. For criminal investigations, the negatives must be maintained with the bound field logbook in the project file and stored in a secured file cabinet. The EPA has issued a final policy statement on the use of Digital cameras (dated August 3, 2006). The digital camera policy guidance is entitled Digital Camera Guidance for EPA Civil Inspections and Investigations (EPA 305-F-06-002), and is available at:

www.epa.gov/Compliance/resources/publications/monitoring/cwa/inspections/npdesinspect/npdesinspectapph.pdf

When digital images are used in technical reports or placed in the official files, the disk with the original, unaltered file of the images or a printed copy of the unaltered images shall be placed in the official files as well. If printed copies of the images are used, each image shall be identified using the information that was recorded in the field logbook. For enforcement cases, it is imperative that the individual who took the image be identified in the field logbook in the event their testimony is required.

When a video tape is made for use as evidence in an enforcement case, the following information should be recorded in a bound field logbook: the date and time that the video was recorded; a brief description of the subject of the video tape; the name of the person recording the video. A label shall be placed on the video tape with the appropriate identifying information (i.e., project name, date, location etc.). In the event testimony regarding a video tape recording is required for an enforcement case, one individual should be responsible for recording the video for each case.

The original, unaltered tape shall be placed in the official files.

3.3.3 Identification of Physical Evidence

Physical evidence, other than samples, shall be identified by using a sample label or tag, or by recording the necessary information on the evidence, or on the evidence bag. When samples are collected from vessels or containers which can be moved (drums for example), the vessel or container should be marked with a field identification number, or sample station number, for future identification, when necessary. The vessel or container may be labeled with an indelible marker (e.g., paint stick or spray paint). The vessel or container need not be marked if it already has a unique marking or serial number; however, these numbers shall be recorded in the bound field logbooks. In addition, it is suggested that photographs of any physical evidence (markings, etc.) be taken and the necessary information recorded in the field logbook. Occasionally, it is necessary to obtain recorder and/or instrument charts from facility owned analytical equipment, flow recorders, etc., during field investigations and inspections. Mark the charts and write the following information on these charts while they are still in the instrument or recorder: starting and ending time(s) and date(s) for the chart; an instantaneous measurement of the media being measured by the recorder shall be taken and entered at the appropriate location on the chart along with the date and time of the measurement; a description of the location being monitored and other information required to interpret the data such as type of flow device, chart units, multiplier factors, etc. After the chart has been removed, the field investigator shall indicate on the chart who the chart (or copy of the chart) was received from and enter the date and time.

Documents such as technical reports, laboratory reports, etc., should be marked with the date, and from whom they were received. Confidential documents should not be accepted, except in special circumstances such as process audits, hazardous waste site investigations, etc.

3.4 Chain-of-Custody Procedures

PERFORMANCE OBJECTIVE:

- To maintain and document the possession of samples (or other evidence) from the time of collection until they, or the data derived from the samples, are introduced into evidence.

3.4.1 Introduction

Chain-of-custody procedures are comprised of maintaining custody of samples (or other evidence), and the documentation of the chain-of-custody. To document chain-of-custody, an accurate record must be maintained to trace the possession of each sample, or other evidence, from the moment of collection to its introduction into evidence.

3.4.2 Sample Custody

A sample, or other physical evidence, is in custody if it is in the actual possession of an investigator; it is in the view of an investigator after being in their physical possession; it was in the physical possession of an investigator and then they secured it to prevent tampering; and/or it is placed in a designated secure area.

3.4.3 Use of the Chain-of-Custody Sample Seals

Sample Seals - The use of custody seals may be waived if field investigators keep the samples in their custody from the time of collection until the samples are delivered to the laboratory analyzing the samples. Chain-of custody seals must be used whenever samples are no longer under the control (see Sample Custody, above) of the investigator. For example, when samples are shipped to a Laboratory they are no longer under the control of the investigator, and chain-of-custody seals must be used to determine if the samples, or the cooler in which the samples were shipped, were tampered with. In Region 2, translucent fiber strapping tape is used to seal each cooler. The strapping tape is applied so that it is wrapped completely around the cooler along one side of the cooler, and back onto itself. Then the chain-of-custody seal is applied to the strapping tape, and finally the strapping tape is wrapped one more time around the cooler covering the chain-of-custody seal, before being cut. Taping the cooler in this manner seals the chain-of-custody tape under the last wrap of the fiber tape, and it allows it to be visible through the last wrap of the fiber tape. The chain-of-custody tape must be signed and dated by the inspector in indelible ink, or with a permanent marker. Now the other side of the cooler is taped in the same manner. Chain-of-custody seals must be placed so that they can be seen through the last wrap of the strapping tape, and so that it can be determined if the cooler was tampered with. At least one chain-of-custody label must be placed over each side of the lid of the cooler.

Chain-Of-Custody/Field Data Form - The field Chain-Of-Custody/Field Data Form (see Figure 3-1) is used to record the custody of all samples collected and maintained by investigators. All sample sets shall be accompanied by a Chain-Of-Custody/Field Data Form. This Chain-Of-Custody/Field Data Form documents the transfer of custody of samples from the sample custodian to another person, to the laboratory, or other organizational elements. To simplify the Chain-Of-Custody/Field Data Form and eliminate potential litigation problems, as few people as possible should have custody of the samples, or physical evidence, during the investigation. This form shall not be used to document the collection of split samples where there is a legal requirement to provide a receipt for samples. The Chain-Of-Custody/Field Data Form also serves as a sample logging mechanism for the laboratory sample custodian. A separate Chain-Of-Custody/Field Data Form should be used for each final destination or laboratory used during the investigation. All information must be supplied in the indicated spaces to complete the field Chain-Of-Custody/Field Data Form. The person responsible for the samples must sign in the designated signature block. Figure 3-1 shows a blank Chain-Of-Custody/Field Data Form. On the page following the blank Chain-Of-Custody/Field Data Form are detailed instructions on how to fill out the form. Figure 3-2 shows an example of a filled out. The sample custodian and subsequent transferee(s) should document the transfer of the samples listed on the Chain-Of-Custody/Field Data Form. The person who originally relinquishes custody should be the sample custodian. Both the person relinquishing the samples and the person receiving them must sign the form. The date and time that this occurs should be documented in the proper space on the Chain-Of-Custody/Field Data Form. Once the Chain-Of-Custody/Field Data Form is completed, it becomes an accountable document and must be maintained in the Laboratory's project file. The suitability of any other form for chain-of-custody should be evaluated based upon its inclusion of all of the above information in a legible format.

If chain-of-custody is required for documents received during investigations, the documents should be placed in large envelopes, and the contents should be noted on the envelope. The envelope shall be sealed and an EPA custody seal placed on the envelope such that it cannot be opened without breaking the seal. Any time the EPA seal is broken, that fact shall be noted and a new seal affixed. The information on the seal should include the sample custodian's initials and the date.

Physical evidence such as video tapes or other small items shall be placed in Zip-Loc® type bags or envelopes and an EPA custody seal should be affixed so that they cannot be opened without breaking the seal. Any time the EPA seal is broken, that fact shall be noted and a new seal affixed. The information on the seal should include the field sample custodian's initials and the date. EPA custody seals can be used to maintain custody of other items when necessary by using similar procedures as those previously outlined in this section. Samples should not be accepted from other sources unless the sample collection procedures used are known to be acceptable, can be documented, and the sample chain-of-custody can be established. If such samples are accepted, the sample should be properly labeled, and it must contain all relevant information. A Chain-Of-Custody/Field Data Form shall be completed for each set of samples.

3.4.4 Transfer of Custody with the Shipment of Samples

All samples shall be accompanied by the Chain-Of-Custody/Field Data Form. The first page of the Form (the original) will be placed in a plastic bag inside the secured shipping container if samples are shipped. The project leader should retain the copy (second page) of the Chain-Of-Custody/Field Data Form, in case problems arise during transport to the Laboratory. When shipping samples via common carrier, the "Relinquished By" box should be filled in(i.e., signed); however, the "Received By" and “Date” boxes should be left blank. The laboratory sample custodian is responsible for receiving custody of the samples and will fill in the "Received By" and “Date” sections of the Chain-Of-Custody/Field Data Form. The original Chain-Of-Custody/Field Data Form will be kept by the laboratory. A copy of the signed Form can be obtained from the Laboratory after the project leader returns from the field.

If sent by mail, the package shall be registered with return receipt requested. If sent by common carrier, an Air Bill should be used. Receipts from post offices and Air Bills shall be retained as part of the documentation of the chain-of-custody. The Air Bill number, or registered mail serial number, shall be retained in the project file.

3.5 Chain-of-Custody Procedures (Part 2)

3.5.1 Introduction

Section 3007 of the Resource Conservation and Recovery Act (RCRA) of 1976 and Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) of 1980 require that a "receipt" for all facility samples collected during inspections and investigations be given to the owner/operator of each facility before the field investigator departs the premises. The Toxic Substances Control Act (TSCA) contains similar provisions. These laws do not require that homeowners or other off-site property owners be given this form.

3.5.2 Receipt for Samples

The Chain-Of-Custody/Field Data Form may be used as the Receipt for Samples only if the words Chain-Of-Custody/Field Data Form are lined out and replaced with the words Receipt for Samples. This will now satisfy the receipt for samples provisions of RCRA, CERCLA, and TSCA. Whether or not the split samples were offered, and either "Received" or "Declined" by the owner/operator of the facility or site, or the facility or site representative, being investigated should be documented in the investigators’ notebook.

- The sample custodian must sign the form.

- Each sample collected from the facility or site must be documented. The appropriate sample information should be on each sample container, including; the site name or sample station number; the date of sample collection, the designation of the sample as a grab or composite, a very brief description of the sampling location, how the sample is preserved, and the specific analyses to be performed.

- The total number of sample containers for each sample must be entered.

- The site operator, or the site representative, must sign the Receipt for Samples form upon acceptance of the split samples. The operator must give their title, telephone number, and the date and time they signed the form. If the operator refuses to sign the form, the sampler(s) should note this fact in the operator's signature block and initial this entry.

The Receipt for Samples form becomes an accountable document after it is completed. A copy of the form is to be given to the facility or site owner/operator. The original form must be maintained in the project files.

3.6 Field Records

PERFORMANCE OBJECTIVE:

- To accurately and completely document all field activities.

To accurately and completely document all field activities, a bound field logbook should be used. For inspections that may result in civil litigation, the lead inspector can choose to use one logbook to enter several inspections, or he/she may have a separate logbook for different types of inspections (i.e., one for water discharges, another one for sludge inspections, another one for drinking water inspections, etc.), or he/she can choose to have one logbook for each inspection conducted. For any inspection that will, or has a good potential to, result in criminal litigation, the lead inspector should use a separate dedicated logbook.

The project leader's name, address and phone number should be entered on the outside and/or inside front cover of the logbook. For each inspection conducted, the date(s) of the inspection, the name of the facility, the address of the facility (including the street address, mailing address, town, state and zip code), and relevant permit number (if any) should be entered in the logbook. The names of the inspection team, and the names and titles of facility representatives should be entered into the logbook. The arrival and departure times should be noted, and an entry should be made documenting that EPA official credentials were presented.

All entries should be legible and contain accurate and inclusive documentation of an individual's project activities. At the end of all entries for each day, or at the end of a particular event, if appropriate, the investigator should draw a diagonal line indicating the conclusion of the entry and initial the page. Since field records are the basis for later written reports, language should be objective, factual, and free of personal feelings, or other terminology which might prove inappropriate. Field logbooks are accountable documents and must be retained by the inspector, or in the project file. All aspects of sample collection and handling, as well as visual observations, shall be documented in the field logbooks. The following is a list of information that should be included in the logbook: sample collection equipment (where appropriate); field analytical equipment, and equipment utilized to make physical measurements shall be identified; calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment; identification numbers of any sampling equipment used (if available); sampling station identification; time of sample collection; description of the sample location; description of the sample; who collected the sample; how the sample was collected; how the sample was preserved; diagrams of processes; maps/sketches of sampling locations; and weather conditions that may affect the sample (e.g., rain, extreme heat or cold, wind, etc.).

3.7 Document Control

Document control refers to the maintenance of inspection and investigation project files. All information listed below shall be kept in project files. Investigators may keep copies of reports in their personal files, however, all official and original documents relating to inspections and investigations shall be placed in the official project files. The following documents shall be placed in the project file, if applicable:

- copy of the quality assurance project plan
- copy of the Chain-Of-Custody/Field Data Forms
- copy of the Receipt for Sample forms
- records obtained during the investigation (unless designated confidential)
- complete copy of the analytical data and memorandums transmitting analytical data
- official correspondence received by or issued by the Branch relating to the investigation including records of telephone calls
- photographs and negatives associated with the project
- copies of any e-mail correspondence related to the project
- one copy of the final report, and
- relevant documents related to the original investigation/inspection or follow-up activities related to the investigation/inspection.

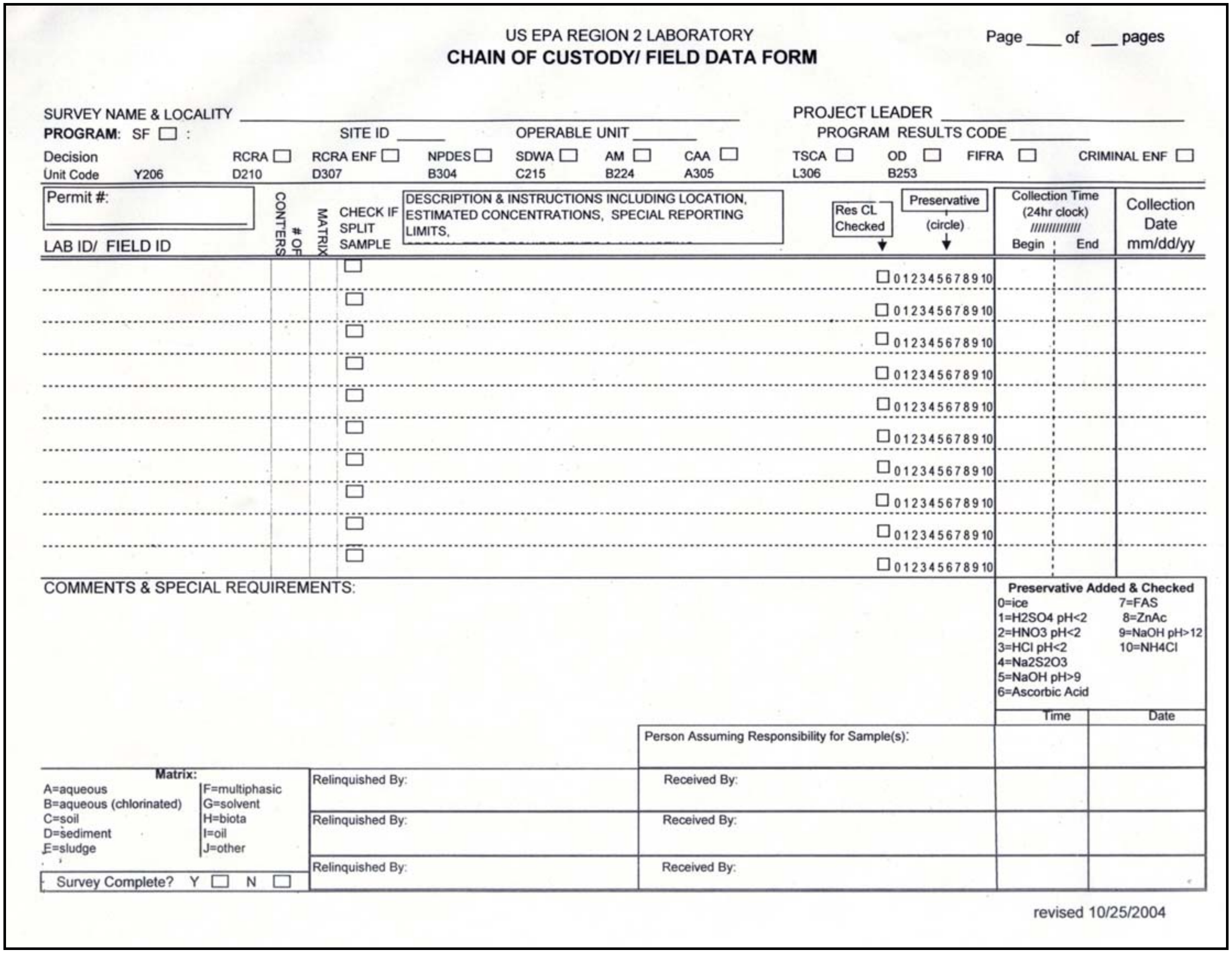
Inappropriate personal observations and irrelevant information should not be placed in the official project files. At the conclusion of the project, the project leader shall review the file to ensure that it is complete.

3.8 Disposal of Samples or Other Physical Evidence

Disposal of samples or other physical evidence obtained during investigations is conducted on a case-by-case basis. The following general guidance is offered for the disposal of samples or other physical evidence:

- For samples collected to support a criminal case - No samples, physical evidence, or any other document associated with a criminal investigation shall be disposed of without written permission from EPA's Criminal Investigations Division.

- Samples associated with routine inspections may disposed by the Laboratory Branch following their standard operating procedures.



US EPA REGION 2 LABORATORY

CHAIN OF CUSTODY/ FIELD DATA FORM

Page ____ of ___ pages

SURVEY NAME & LOCALITY ______________________

PROJECT LEADER ______________________

PROGRAM: SF ☐ :

SITE ID ______

OPERABLE UNIT ________

PROGRAM RESULTS CODE __________

Decision Unit Code Y206	RCRA ☐ D210	RCRA ENF ☐ D307	NPDES ☐ B304	SDWA ☐ C215	AM ☐ B224	CAA ☐ A305	TSCA ☐ L306	OD ☐ B253	FIFRA ☐	CRIMINAL ENF ☐

Permit #: ______

LAB ID/ FIELD ID	# OF CONT'ERS	MATRIX	CHECK IF SPLIT SAMPLE	DESCRIPTION & INSTRUCTIONS INCLUDING LOCATION, ESTIMATED CONCENTRATIONS, SPECIAL REPORTING LIMITS,	Res CL Checked ↓	Preservative (circle) ↓	Collection Time (24hr clock) ////////////// Begin	End	Collection Date mm/dd/yy
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			

COMMENTS & SPECIAL REQUIREMENTS:

Preservative Added & Checked

0=ice	7=FAS
1=H2SO4 pH<2	8=ZnAc
2=HNO3 pH<2	9=NaOH pH>12
3=HCl pH<2	10=NH4Cl
4=Na2S2O3	
5=NaOH pH>9	
6=Ascorbic Acid	

Matrix:

A=aqueous	F=multiphasic
B=aqueous (chlorinated)	G=solvent
C=soil	H=biota
D=sediment	I=oil
E=sludge	J=other

Survey Complete? Y ☐ N ☐

		Time	Date
	Person Assuming Responsibility for Sample(s):		
Relinquished By:	Received By:		
Relinquished By:	Received By:		
Relinquished By:	Received By:		

revised 10/25/2004

Figure 3-1

A Blank Chain-Of-Custody/Field Data Form

Instructions for Filling Out the Chain-Of-Custody/Field Data Form

SURVEY NAME & LOCALITY: Fill in the project name (this should be the first line on all of the labels that are on your sample containers). Also, fill in the locality, if the entire survey took place at a single location. Otherwise, the locality can be omitted.

PROJECT LEADER: Enter the name of the the person who is designated to receive the laboratory data.

LAB ID/FIELD ID: Enter the Sample ID from the container (or set of containers). The lab ID is a separate identification number, which will be designated later by the laboratory.

NUMBER OF CONTAINERS: This is the total number of containers with the Sample ID listed in the first column.

MATRIX: Enter the letter code from the table in the lower left. Be sure to note the difference between aqueous and aqueous (chlorinated).

DESCRIPTION: Enter the number of containers, container size and type, and the analysis requested.. For example: “3-40 ml vials / VOA.” If additional containers have the same Sample ID, list them on succeeding lines.

RESIDUAL CHLORINE: Check this box where appropriate.

PRESERVATION: Check this box where appropriate.

COLLECTION TIME: Collection time(s) should be entered for each container listed in a 24-hour format. For example: 1:00 PM is entered as 13:00. For grab samples, the time of collection is entered in the “END” column, and the “BEGIN” column is left blank. For 24-hour time composite samples, the beginning time is the time that the first aliquot was collected, and the ending time is 24 hours later. For manual grab composite samples, the beginning time is the time that the first aliquot was collected, and the ending time is time the last aliquot was collected. The time(s) that the grab composite aliquots were collected in between these times must be entered in the field notebook, and may be entered in the COMMENTS section of the form

COLLECTION DATE: The sample collection date should be entered for each container listed on the Form. For composite samples, the collection date is the date when the last aliquot was collected. This is because the sample holding times are calculated from the end of the compositing period.

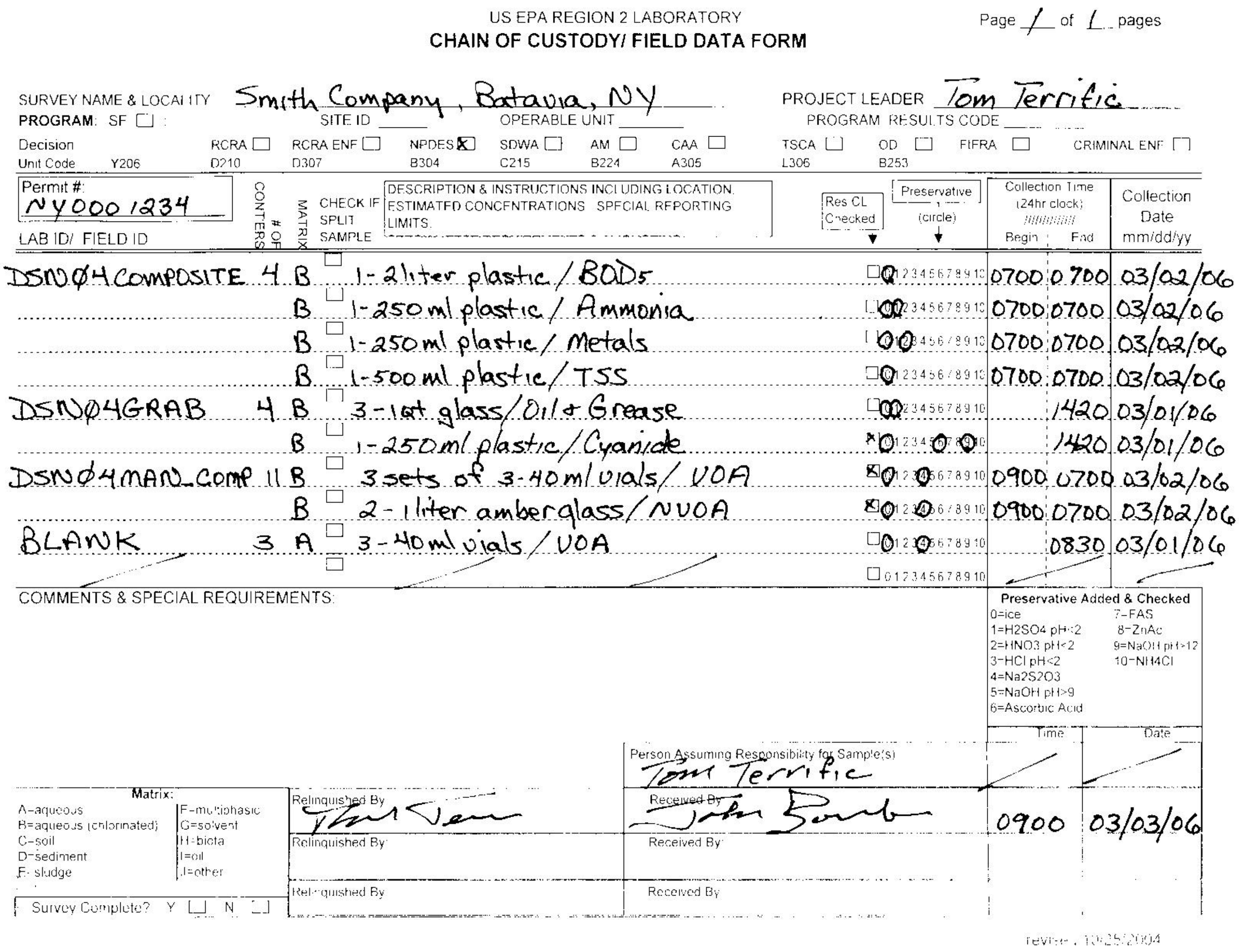
COMMENTS: Indicate any special requests, or provide alerts to the analysts, such as:

- Sampled which are to be lab composited,
- Specific compounds of interest,
- Reporting limit requests,
- Expected range(s) of sample concentrations, especially for any sample concentrations that are unusual, or unexpected, and
- Alerts about known interferences or analytical complications.

PERSON ASSUMING RESPONSIBILITY: The name of the person who assumed responsibility of the samples immediately after they were collected should be entered.
NOTE: There should be no blank lines on the Chain-Of-Custody/Field Data Form. If there are blank lines on the form, draw a line through them.

Figure 3-2

Example of a Filled out Chain-Of-Custody/Field Data Form



US EPA REGION 2 LABORATORY

CHAIN OF CUSTODY/ FIELD DATA FORM

Page 1 of 1 pages

SURVEY NAME & LOCALITY Smith Company, Batavia, NY

PROJECT LEADER Tom Terrific

PROGRAM: SF ☐ SITE ID ____ OPERABLE UNIT ____ PROGRAM RESULTS CODE ____

Decision Unit Code Y206	RCRA ☐ D210	RCRA ENF ☐ D307	NPDES ☒ B304	SDWA ☐ C215	AM ☐ B224	CAA ☐ A305	TSCA ☐ L306	OD ☐ B253	FIFRA ☐	CRIMINAL ENF ☐		

Permit #: NY0001234

LAB ID/ FIELD ID	# OF CONTERS	MATRIX	CHECK IF SPLIT SAMPLE	DESCRIPTION & INSTRUCTIONS INCLUDING LOCATION, ESTIMATED CONCENTRATIONS SPECIAL REPORTING LIMITS.	Res CL Checked	Preservative (circle)	Collection Time (24hr clock) Begin	Collection Time (24hr clock) End	Collection Date mm/dd/yy
DSN04COMPOSITE	4	B	☐	1-2liter plastic / BOD5	☐	[✓ 0] 1 2 3 4 5 6 7 8 9 10	0700	0700	03/02/06
		B	☐	1-250ml plastic / Ammonia	☐	[✓ 0] [✓ 1] 2 3 4 5 6 7 8 9 10	0700	0700	03/02/06
		B	☐	1-250ml plastic / Metals	☐	[✓ 0] 1 [✓ 2] 3 4 5 6 7 8 9 10	0700	0700	03/02/06
		B	☐	1-500ml plastic / TSS	☐	[✓ 0] 1 2 3 4 5 6 7 8 9 10	0700	0700	03/02/06
DSN04GRAB	4	B	☐	3-1qt glass / Oil & Grease	☐	[✓ 0] [✓ 1] 2 3 4 5 6 7 8 9 10		1420	03/01/06
		B	☐	1-250ml plastic / Cyanide	☒	[✓ 0] 1 2 3 4 5 [✓ 6] 7 8 [✓ 9] 10		1420	03/01/06
DSN04MAN_COMP	11	B	☐	3 sets of 3-40ml vials / VOA	☒	[✓ 0] 1 2 3 [✓ 4] 5 6 7 8 9 10	0900	0700	03/02/06
		B	☐	2-1liter amberglass / NVOA	☒	[✓ 0] 1 2 3 [✓ 4] 5 6 7 8 9 10	0900	0700	03/02/06
BLANK	3	A	☐	3-40ml vials / VOA	☐	[✓ 0] 1 2 3 [✓ 4] 5 6 7 8 9 10		0830	03/01/06
			☐		☐	0 1 2 3 4 5 6 7 8 9 10			

COMMENTS & SPECIAL REQUIREMENTS:

Preservative Added & Checked

0=ice
1=H2SO4 pH<2
2=HNO3 pH<2
3=HCl pH<2
4=Na2S2O3
5=NaOH pH>9
6=Ascorbic Acid
7=FAS
8=ZnAc
9=NaOH pH>12
10=NH4Cl

Person Assuming Responsibility for Sample(s) Tom Terrific

Relinquished By	Received By	Time 0900	Date 03/03/06
Relinquished By	Received By		
Relinquished By	Received By		

Matrix:

A=aqueous	F=multiphasic
B=aqueous (chlorinated)	G=solvent
C=soil	H=biota
D=sediment	I=oil
E=sludge	J=other

Survey Complete? Y ☐ N ☐

revise , 10/25/2004

SECTION 4
MONITORING OPERATIONS SECTION SAFETY PROTOCOLS

SECTION OBJECTIVE:

- To present safety protocols in order to ensure that all operations are conducted in a manner which protects worker safety and meets compliance with all OSHA regulations and EPA safety policies.

4.1 Introduction

The following parts of this section define safety protocols that are to be used by Monitoring Operations Section investigators while conducting field operations. This section also covers the necessary training, equipment, and experience that is needed to conduct safe environmental investigations at hazardous waste sites. The Sections'safety program is jointly coordinated by a Division Safety, Health and Environmental Manager (SHEM) coordinator; and the Monitoring Operations Section Chief. The employees' immediate supervisor is responsible for ensuring that their employees meet training and medical monitoring requirements. Specific projects may include a Site Safety Officer (SSO) whose responsibility is to ensure that the site safety plan is adhered to during the course of work.

The responsibility for the safe conduct of site operations is ultimately the responsibility of each individual worker. Field investigators will not be required to participate in any operation that they believe will be unsafe, or which violates OSHA and EPA regulations/guidance. The safety protocols in this section are written in accordance with those defined by the following regulations, guidance documents, and manuals.

<u>29 CFR Part 1910.120, Hazardous Waste Operations and Emergency Response</u>: These OSHA regulations govern workers at hazardous waste sites and include requirements for training, equipment, and practices involved in handling of hazardous materials.

<u>29 CFR Part 1910.1200, Hazard Communication</u>: These OSHA regulations govern workers handling hazardous materials and include requirements for training, labeling, and documentation involved in handling hazardous materials.

<u>29 CFR Part 1910.134, Respiratory Protection</u>: These OSHA regulations govern the use and maintenance of respiratory protection equipment used by personnel handling hazardous wastes. Occupational Safety and Health Guidance Manual for Hazard Waste Activities: This NIOSH, OSHA, USCG, and EPA guidance manual is for those who are responsible for occupational safety and health programs at hazardous waste sites. It assumes a basic knowledge of science and experience in occupational safety and health. It is the product of four Agencies (NIOSH, OSHA, USCG, and EPA) mandated by CERCLA section 301 (f) to study the problem of protecting the safety and health of workers at hazardous waste sites.

<u>Edison Health and Safety Manual: USEPA, Region II, (April 21. 1995)</u>: This manual covers safety involved in all field activities performed in Region 2. It includes regional policy regarding training requirements, medical monitoring, and personal protection.

<u>EPA ORDER 3500.1 A1 Training and Development for Individuals Who Lead Compliance Inspections/Field Investigations, (December 23, 2002)</u>: The Order establishes Agency wide training and development programs for employees leading environmental compliance

inspections/field investigations, to ensure that they have a working knowledge of regulatory requirements, inspection methodology, and health and safety measures. Incorporated by reference are:

- EPA Order 1440.1, Safety, Health and Environmental Program (SHEMP) and associated guidelines.
- EPA Order 1440.2, Health and Safety Requirements for Employees Engaged in Field Activities.

4.2 Hazard Communication Procedure

4.2.1 Introduction

The purpose of this hazard communication procedure is to ensure that the hazards of all chemicals used by the Section are evaluated, and that information concerning their hazards are transmitted to Section personnel. The transmittal of information is to be accomplished by means of a comprehensive hazard communication program which includes container labeling and other forms of warning, material safety data sheets (MSDS), and employee training.

4.2.2 Scope

This hazard communication procedure covers activities involving the use and storage of hazardous chemicals.

4.2.3 Labels and Other Forms of Warnings

Personnel responsible for receiving and storage of hazardous chemicals from manufacturers and suppliers will ensure that the containers are marked with the following information:

- Identity of the hazardous chemical(s);
- Appropriate hazard warnings; and
- Name and address of the chemical manufacturer, importer, or other responsible party.

Containers of hazardous chemicals generated during field investigations will be labeled with the following information:

- Identity of the hazardous chemical(s) contained therein; and
- Appropriate hazard warnings.

Exempt from labeling requirements are any containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for use by the person who performs the transfer during the same work day in which the transfer is made. Labels on containers or hazardous chemicals will not be removed, or in any way defaced. Labels for containers of hazardous chemicals will be provided. Information on the labels will be in

English. Information in other languages may be added as long as the information presented in English is in no way obscured.

4.2.4 Material Safety Data Sheets (MSDSs)

Personnel responsible for receiving hazardous chemicals from manufacturers or suppliers will ensure that MSDSs are obtained for each shipment received. Receipt of hazardous chemicals will be contingent upon both the provision of MSDSs and compliance of the MSDS with requirements set forth in OSHA's Hazardous Communication Final Rules, part (g). Copies of MSDSs are keep in the Laboratory Branch, and in the Division Safety, Health and Environmental Manager (SHEM) coordinator’s office (in Building 205). MSDSs can also be found online at:

www.msds.com

4.3 Safety Protocols

4.3.1 Site Safety Officer Duties

The following is a list of duties that are required for an individual designated to be a Site Safety Officer (SSO). Section safety protocols are to be administrated by the SSO, as well as each individual that is a part of the investigation. Safety during hazardous waste site investigations begins with the individual. However, it is the responsibility of the SSO to plan and coordinate the following during an investigation:

1. Ensure that each member of the investigative team is up to date on their site field safety training (i.e., Annual Safety Refresher, CPR and First Aid).

2. Meet with the project leader to gain knowledge of site operations and sampling strategies.

3. Prepare and enforce the site safety plan.

4. Make sure that necessary project specific safety equipment is available and operational. This includes checking out air monitoring instruments to ensure that they are fully operational, charged, and calibrated; for Level B operations filling and checking self-contained breathing apparatus (SCBA) air tanks and/or the airline system.

5. The SSO is also responsible for oversight of safety during the investigation. This oversight can include the following duties - safety sweep with air monitoring instruments at the commencement of the site investigation, directing the set-up of the command post and work zones (decontamination, exclusion, and contaminant reduction zones), and calibrating (or verifying calibration) and operating air monitoring instruments during the investigation, and conducting monitoring for heat stress throughout the operation.

4.3.2 Safety Equipment

Investigators will be provided with the following safety equipment as appropriate:

- rain suit
- protective work gloves (chemical resistant as needed)
- safety glasses (prescription if necessary)
- hearing protection
- hard hat
- safety boots with steel toe, or equivalent (leather and rubber)
- first aid supplies

Field investigators will be responsible for properly operating and maintaining the safety equipment in the field. Should the safety equipment malfunction or be broken, field investigators are responsible for replacing the equipment as soon as possible. Field investigators will not operate any equipment for which they have not received training or have insufficient familiarity to conduct safe operations. Activities which will require a familiarization exercise for personnel prior to the actual execution of the work include:

- Enclosed area entry;
- Level A, B, or C operations;
- Drilling or power auguring;
- Drum openings;
- Boat operations;
- Generator operations; and
- Steam cleaning.

4.3.3 OSHA Confined Space Entry

According to 29 CFR Part 1910.146, an individual must have a permit to enter a space that meets the following definition for a confined space. Confined space means a space that is: 1) large enough and so configured that an investigator can bodily enter and perform assigned work; 2) has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, or pits are spaces that may have limited means of entry); and 3) is not designed for continuous occupancy. Field investigators **shall not enter** a space if it meets this definition.

4.3.4 Entry into Enclosed Areas

When conducting hazardous waste site investigations in areas that do not meet the definition in OSHA 29 CFR Part 1910.146, or that are enclosed (areas that could potentially trap explosive vapors and/or have depleted oxygen), field investigators should monitor the atmosphere of the area to identify immediately dangerous to life and health (IDLH) and other dangerous conditions. Examples of dangerous conditions that may be encountered when working around enclosed areas (other than those listed in 29 CFR Part 1910.146) include areas that may support flammable or explosive atmospheres, oxygen-deficient environments, and highly toxic levels of airborne contaminants. Some examples of enclosed areas that field investigators may enter after conducting appropriate air monitoring include, building interiors (if possible the field investigator(s) should attempt to ventilate the enclosed area by opening doors and windows), trenches (less than 3 feet deep), low lying areas in tank farms, tractor trailers, sumps, and behind barriers, such as tall buildings or tanks. At a minimum, field investigators should use direct reading instruments such as the combustible gas indicator (CGI), oxygen meter, and an organic vapor analyzer (OVA) to monitor the atmosphere in areas that may unexpectedly trap harmful vapors or have a depleted oxygen supply.

4.3.5 Training Status Tracking System

An Excel spreadsheet is used for tracking the status of required safety training for all personnel involved in hazardous waste field operations within the Division. The name and path of the file is: **G:\USER\share\DESADIV\MAB - Monitoring & Assessment Branch\MOS Training.xls**. The file tracks the following safety training:

- Medical monitoring physical (annual renewal);
- 40-hour hazardous waste training (no required renewal);
- 8-hour refresher training (annual renewal);
- Cardio-pulmonary resuscitation (CPR) certification (bi-annual renewal);
- First aid certification (tri-annual renewal);
- Fit testing (required to be fit tested within one year of field use)
- Trailer Towing Safety Training (no required renewal)

It is the responsibility of the Division safety officer to notify field investigators, or their supervisor, when renewals of required training are due. Scheduling training will be the responsibility of the Division safety officer. Upon successful completion of training, the Division safety officer will provide the Branch Administrative Assistant with the certificate of completion. A copy will be made for inclusion in the individuals Branch personnel folder, and the original is forwarded to the individual.

In the event that a field investigator's OSHA required training has lapsed by more than 90 days, the individual will not be allowed to perform field activities, or enter onto a hazardous waste site. The individual, and their supervisor, will be notified of the change in status by the Division safety officer. Upon successful completion of the required training, the individual and their supervisor will be notified of their return to prior status.

4.3.6 Site Operations

Upon initial entry at a hazardous waste site, a site survey will be conducted. In a facility that has active working employees, the site survey may be conducted in Level D accompanied by air monitoring. At sites that do not have active working employees, the SSO/Project leader must use discretion when choosing the level of protection that will be used while conducting an initial site survey. All initial site surveys should be conducted using appropriate air monitoring instruments that detect explosive vapors (CGI), oxygen content, and organic vapors (OVA). The purpose of an initial site survey is to accomplish one or both of the following objectives:

- Determine the hazards that may exist which could affect site personnel.
- Verify existing information, or obtain new information, about the site.

To accomplish the first objective, an assessment of real or potential dangers from fire, explosion, airborne contaminants, radiation, and oxygen deficient atmospheres must be made. This assessment will be made as follows:

- Combustible Gases - The atmosphere in any location capable of containing or generating a combustible concentration of gases will be monitored with a combustible gas meter. Response of the meter in excess of 25% of the lower explosive limit (LEL) will cause an immediate evacuation of the site. A response of the meter in excess of 10% of the LEL requires further investigation. Notify the Site Safety Officer, before proceeding with caution.

- Oxygen Deficiency - A location capable of containing or generating an oxygen deficiency either by depletion or displacement will be monitored with an oxygen meter. Any reading less than 19.5% oxygen will result in the use of self-contained breathing apparatus (SCBA).

- Organic Vapors and Gases -- The atmosphere will be monitored with a photoionization detector (PID) and/or a flame ionization detector (FID). When appropriate, cyanide gas and halogenated vapors will also be monitored. Any response above background concentrations will cause an upgrade to Level C respiratory protection. Any response above 5 ppm when contaminants are not known, will cause an upgrade to Level B respiratory protection. A response above 200 ppm when contaminants are not known will cause an upgrade to Level A protection.

- Inorganic Vapors and Gases -- There are only a few direct reading instruments with the capability to detect and quantify non-specific inorganic vapors and gases. PIDs have a very limited capability in this area. If specific inorganics are known or suspected of being present, an attempt should be made to provide appropriate monitoring if possible. In the absence of a monitoring capability, always assume a worst case scenario, and upgrade the level of protection (see below) to a level that gives respiratory and skin protection that is appropriate to a worst case assumption.

- Radiation -- A radiation survey will be conducted of the site. The primary survey instrument will be a Geiger counter/detector for gamma radiation. Any response above background will result in evacuation of the area.

Following the initial survey, monitoring will be repeated when new areas of the site are entered, or when operations likely to cause a release are being conducted.

Levels of Personal Protection

Personal protective equipment is divided into four categories based on the degree of protection afforded. The following table compares the relative protection for each level.

	Level A	Level B	Level C	Level D
Respiratory	Maximum	Maximum	Moderate	Minimum
Skin	Maximum	High	Moderate	Minimum
Eye	Maximum	High	Moderate	Minimum

The relationship between air monitoring results and levels of protection (LOP) is shown in the following table.

Instrument	Response	LOP
PID/FID	Background	D
PID/FID	Less than 5 ppm above background	C
PID/FID	5 ppm to 200 ppm	B
PID/FID	greater than 200 ppm	A
Oxygen	Less than 19.5 %	B
CN	Greater than 0 ppm, and less than 10 ppm	B
CN	10 ppm or greater	A

NOTE: Measurements from direct-reading air monitors are only one consideration for LOP decisions. If contaminants are known, protection can be achieved at a lesser LOP.

The four levels of protection (ranked from least protective Level D to most protective Level A) and a description of the situations for which each is appropriate is as follows:

Level D	
REQUIRED	Shirt, long pants or coveralls
	Boots with steel toes
OPTIONAL	Gloves
	Rubber boots with steel toe and shank
	Boot covers (disposable)
	Safety glasses, goggles, or face shield (not for chemical splash protection)
	Hard hat
	Thermal/weather protection (coat, overalls, sweater, hat, and rain gear)
LEVEL D is used when:	The atmosphere contains no known or anticipated hazard.
	Work conditions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Level C	
REQUIRED	LEVEL D (modified to require chemical resistant boots with steel toe)
	Full-face Air Purifying Respirator (APR) - NIOSH approved
	Disposable chemical-resistant coveralls
	Chemical resistant gloves (inner and outer)
	Emergency Life Support Apparatus (ELSA) (for enclosed area initial entry)
OPTIONAL	Boot covers (disposable)
	Hard hat
	Face shield
	ELSA (for other than initial operations)
	Thermal/weather protection (coat, overalls, sweater, hat, and rain gear)
LEVEL C is used when:	The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin.
	The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants.
	All criteria for the use of air-purifying respirators are met.

NOTE 1: Level C operations require decontamination of personnel and equipment. Also, zones of protection are required.

NOTE 2: Level C is not considered hazardous duty because adequate safety precautions have been taken to reduce the degree of risk.

MODIFIED Level C	
REQUIRED	LEVEL C (modified to include chemically resistant splash suit and triple glove system)
	Splash shield
	ELSA (for other than initial operations)
OPTIONAL	Boot covers (disposable)
	Hard hat
	ELSA (for other than initial operations)
Modified LEVEL C is used when:	All requirements for atmospheric contaminants and APR use related to normal Level C have been met.
	Materials being handled require a high degree of splash or contact protection

NOTE 1: Modified Level C operations require decontamination of personnel and equipment. Also, zones of protection are required.

Modified Level C is not normally considered hazardous because adequate safety precautions have been taken to reduce the degree of risk to a negligible level. Modified Level C could be considered hazardous in a situation where atmospheric contamination was not the determining factor.

NOTE 2: When wearing a chemically resistant splash suit (Level B):

- Careful monitoring for heat stress is required when wearing a chemically resistant suit for more than 30 minutes and the temperature is 80 °F to 90 °F.

- Careful monitoring for heat stress is required when wearing an chemically resistant suit for more than 15 minutes and the temperature is above 90 °F.

Level B	
REQUIRED	MODIFIED LEVEL C (without the requirement for splash shield, and APR)
	Positive pressure, full-face piece self-contained breathing apparatus (SCBA)/airline system
OPTIONAL	Boot covers (disposable)
	Hard hat
	ELSA
	Splash shield
LEVEL B is used when:	The type and concentration of atmospheric contaminants have been identified and require the maximum level of respiratory protection, but only a high level of skin protection.
	The atmosphere contains less than 19.5 percent oxygen.
	The presence of incompletely identified vapors or gases is indicated by direct-reading detecting equipment, but the concentrations of contaminants are not suspected of posing a hazard through skin contact.
	The work involves opening containers suspected of containing concentrated wastes where a likelihood of an air release is possible. In this situation, Level B is the initial protection and can be upgraded or downgraded as more information on the nature of the wastes is gathered.

NOTE 1: Level B operations require decontamination of personnel and equipment. Also, zones of protection are required.

Level B operations may qualify as hazardous duty because the risk of fire/explosion cannot be mitigated.

NOTE 2: When wearing a chemically resistant suit (Level B):

- Careful monitoring for heat stress is required when wearing a chemically resistant suit for more than 30 minutes and the temperature is 80 °F to 90 °F.
- Careful monitoring for heat stress is required when wearing an chemically resistant suit for more than 15 minutes and the temperature is above 90 °F.

Level A	
REQUIRED	LEVEL D (with chemical resistant rubber boots with steel toe)
	Totally-encapsulating chemical-protective suit
	Positive pressure, full-face piece self-contained breathing apparatus (SCBA)/airline system
OPTIONAL	Boot covers (disposable)
	Hard hat
LEVEL A is used when:	The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system.
	Measurements by direct-reading detecting equipment show concentrations high enough to pose a hazard through skin contact.
	Operations are being conducted in confined, poorly ventilated areas not normally intended for human occupation, and conditions requiring a lower level of protection have not been determined (i.e., Levels B, C, or D).

NOTE 1: Level A operations require decontamination of personnel and equipment. Also, zones of protection are required.

Confined space operations require special training and compliance with OSHA permit-required confined space entry procedures.

Level A operations may qualify as hazardous duty because the risk of fire/explosion cannot be mitigated.

NOTE 2: When wearing a chemically resistant suit (Level A):

- Careful monitoring for heat stress is required when wearing a chemically resistant suit for more than 30 minutes and the temperature is 80 °F to 90 °F.
- Careful monitoring for heat stress is required when wearing an chemically resistant suit for more than 15 minutes and the temperature is above 90 °F.

Stress

Field personnel on hazardous waste sites are exposed to both psychological and physiological stress. Psychological stress is countered with adequate training and job proficiency. Physiological stress is primarily due to exposure of the worker to extremes of heat and cold.

Heat Stress

Heat stress can be the result of working during hot weather or wearing protective clothing that inhibits natural ventilation. It can occur even under moderate temperature conditions. Whenever possible, work should be scheduled during cooler parts of the day or night. The following protocols are to be used to counter heat stress:

- Allow workers to replace lost body fluids, water will be available at the site. Liquids for electrolyte replenishment should also be made available.

- Workers must monitor their own vital signs. If you **begin** to feel light headed, dizzy or disoriented, let someone on the site know immediately, and take a break. Heat stress must be addressed immediately so that it does not evolve into something more serious.

- Adequate shade will be provided to shelter workers from direct exposure to the sun during rest periods.

- Work teams will be rotated so that an individuals time on stressful jobs is minimized.

- Field personnel are encouraged to maintain their physical fitness.

- Intake of diuretics (caffeine or alcohol) should be minimized prior to field work.

Cold Stress

Exposure to extreme cold can result in hypothermia and/or frost bite. Field work during periods of low temperatures and high winds should be conducted to minimize the possibility of hypothermia and/or frost bite. The following protocols are to be followed:

- Workers will dress as warmly as possible using the principle of layering their clothing to maximize protection.

- Gloves should be worn, especially when handling metal equipment.

- Work tours should be limited to minimize exposure to the cold.

- Warm shelter will be made available for workers during breaks. Care should be exercised when using vehicles for warm shelter, due to the potential of carbon monoxide exposure.

- Workers must be aware of the first signs of hypothermia or frostbite and take action immediately to prevent long lasting damage.

Site Control

Site control serves to minimize exposure to contaminants and is accomplished by: 1) providing site security to exclude unnecessary personnel; 2) limiting the number of workers and equipment on-site to the minimum required for effective operations; 3) conducting operations to reduce personal exposure and minimize the potential for airborne dispersion; and 4) implementing decontamination procedures.

Work Zones

To control access of personnel and equipment to possible contaminants, the site will be divided into work zones. Three categories of zones and one command post are utilized. For all operations except Level D, work zones will be designated as follows:

1. Support Zone - Along with the command post, this is the outermost boundary of the site. Contamination of personnel and equipment in this area is unlikely.

2. Contamination Reduction Zone - This area serves as a corridor between the exclusion zone and the support zone. All personnel and equipment passing through this corridor from the exclusion zone to the support zone must undergo appropriate decontamination.

3. Exclusion Zone - This is an area within the support zone, where actual operations are being conducted. Access to this area is limited to personnel and equipment being utilized at that particular time. The risk of contamination in this area is high.

Decontamination

Prior to exiting a hazardous waste site, all personnel and equipment (as needed) must undergo a thorough decontamination. The purpose of this decontamination is twofold. First, it minimizes the transportation of hazardous wastes from a site. Second, it protects workers from exposure which may occur while they are removing their protective equipment.

Decontamination must be conducted in an organized, stepwise manner. If certain pieces of the protective equipment are removed prior to the elimination of potential problems by decontamination, the worker may suffer damage due to inhalation or skin contact with contaminants. It is therefore important that persons doing the decontamination work know the proper procedures, and the order in which to perform them, to insure that such potential personal injuries do not occur. It is also important that site workers avoid contaminating themselves until after they have been cleared to exit the contamination reduction zone.

Decontamination procedures will generate a quantity of hazardous waste (e.g., contaminated solvents, disposable equipment, etc.). This material must be handled and disposed of in accordance with proper procedures. In Region 2, the amount of decontamination wastes generated will be minimized by using outer layers of disposable protective gear, such as disposable outer booties, disposable nitrile gloves (or other suitable material), and disposable Saranac protective suits. The contaminated disposable items must be properly disposed of as hazardous waste.

Level A Decontamination Procedures

Level A operations pose a possibility of hazardous exposure to decontamination workers. Due to
the nature of Level A work, personnel in the exclusion zone are likely to have contacted high concentrations of hazardous materials which remain on their protective equipment. Therefore, decontamination workers are required to perform their duties in Level B protection. Following are the Level A decontamination procedures:

1 Immediately upon leaving the exclusion zone, at a designated area provided at the first station, site workers will place all non-disposable sampling equipment into thick plastic bags. These bags will be subsequently sealed with tape, and then double bagged and sealed. Site workers will then proceed to the first decontamination area where contaminated outer layers of disposable protective gear, such as disposable outer booties and disposable nitrile (or other suitable material) gloves, will be removed and placed into appropriate waste containers. Decontamination workers may assist the site workers in removing these disposable items, but should avoid touching heavily contaminated items.

2 After the most contaminated items are removed, which are typically the site workers' boots and outer gloves, the site worker will proceed to the next station where the site workers may receive a fresh cylinder of air, new outer gloves, and new boot covers and return through the exclusion zone. If there is to be no immediate return to the exclusion zone, decontamination personnel will clean off the SCBA’s with a cleaning solution. The decontamination workers will clean the SCBA, as necessary, with paper towels wetted with cleaning solution. Decontamination workers will apply water from a pump sprayer to rinse off the SCBA’s, and this water will be collected into a washtub or bucket. Immediately following this step, the decontamination workers will discard their outer gloves and don clean ones.

3 Once cleared by the decontamination personnel, the site worker will move to the next station where the SCBA’s and the disposable protective suit, will be removed, with the assistance of the decontamination personnel.

4 The site worker will move to the support zone, which will be located a distance of at least 25 feet upwind of the last station in the contamination reduction corridor. At this location, site workers will clean their SCBA masks with a soap and water rinse, followed by cleaning the inside of the mask with an alcohol wipe. Finally, the site workers will remove their inner gloves, which will be discarded.

5 Decontamination personnel for Level A operations will themselves require decontamination prior to entering the support zone. Decontamination personnel will perform decontamination on each other. A decontamination line separate from the Level A decontamination line will be set up for this purpose. Procedures used on this decontamination line will be those given for Level B decontamination.

Level B Decontamination Procedures

Level B operations pose a limited risk of exposure to decontamination personnel. Level B site workers often exit the exclusion zone with moderate levels of contamination on their outer gloves and boots. To a lesser extent, contamination may be present on their splash suits. To protect against exposure to this contamination, decontamination workers will perform their functions in Level C protection.

1. Upon leaving the exclusion zone, at a designated area provided at the first station, site workers will place all non-disposable sampling equipment into thick plastic bags. These bags will be subsequently sealed with tape, and then double bagged and sealed. Site workers will then proceed to the first decontamination area where contaminated outer layers of disposable protective gear, such as disposable outer booties and disposable nitrile (or other suitable material) gloves, will be removed and placed into appropriate waste containers. Decontamination workers may assist the site workers in removing these disposable items, but should avoid touching heavily contaminated items.

2. After the most contaminated items are removed, which are typically the site workers' boots and outer gloves, the site worker will proceed to the next station where the site workers may receive a fresh cylinder of air, new outer gloves, and new boot covers and return through the exclusion zone. If there is to be no immediate return to the exclusion zone, decontamination personnel will clean off the SCBA’s with a cleaning solution. The decontamination workers will clean the SCBA, as necessary, with paper towels wetted with cleaning solution. Decontamination workers will apply water from a pump sprayer to rinse off the SCBA’s, and this water will be collected into a washtub or bucket. Immediately following this step, the decontamination workers will discard their outer gloves and don clean ones.

3. Once cleared by the decontamination personnel, the site worker will move to the next station where the SCBA’s and the disposable protective suit, will be removed, with the assistance of the decontamination personnel.

4. The site worker will move to the support zone, which will be located a distance of at least 25 feet upwind of the last station in the contamination reduction corridor. At this location, site workers will clean their SCBA masks with a soap and water rinse, followed by cleaning the inside of the mask with an alcohol wipe. Finally, the site workers will remove their inner gloves, which will be discarded.

5. Decontamination personnel for Level B operations will require a minimal amount of decontamination before exiting the contamination reduction zone. This decontamination will consist of the removal of outer boot covers and outer gloves. Decontamination personnel for Level B operations will themselves require decontamination prior to entering the support zone, and will assist each other. Decontamination workers can then enter the support zone where new respirator cartridges, outer gloves, and boot covers can be obtained for return to the contamination reduction corridor. If no immediate return to the corridor is anticipated, decontamination workers can remove their respirators and clean them in a soap wash and water rinse, followed by cleaning the inside of the mask with an alcohol wipe.

Level C Decontamination Procedures

Level C operations do not pose a significant risk of exposure to decontamination workers. Therefore, Level D protection is all that is required to be worn when performing decontamination functions.

1. Upon exiting the exclusion zone, site workers will place their equipment in a designated area provided at the first decontamination station. The area will be covered with disposable plastic. Following this, they will proceed to remove outer gloves and boot covers.
2. Site workers are then clear to enter the support zone where they may obtain new respirator cartridges, outer gloves, and boot covers for return to the exclusion zone. If an immediate return is not anticipated, site workers may remove their respirators. Respirators will be washed in soap solution and rinsed in water. Following this, the inside of the respirators will be cleaned with an alcohol wipe. Finally, site workers will remove and discard their inner gloves.

3. Decontamination personnel may exit the contamination reduction corridor without having to conduct any decontamination upon themselves other than to remove and discard their gloves.

Site Safety Plans

Site safety plans will be developed for every hazardous waste site project conducted. The plan will included the information in the Example Site Safety Plan listed below. MSDSs will be attached for contaminants anticipated at the site. The plan will be submitted to the Branch safety officer for approval. Prior to commencing site activities, investigators will be briefed on the contents of the safety plan. The plan's emergency instructions and directions to the closest hospital will be posted in a conspicuous location at the site command post and in each field vehicle. When there is more than one organization involved at the site, the development of the safety plan should be coordinated among the various groups.

EXAMPLE of
SITE SAFETY PLAN INFORMATION

SAFETY PLAN	
Site Name:	Contact person:
Address:	
Phone Number:	
Purpose of Visit:	
Proposed Date of Work:	
Directions to Site (and attach map):	

Site Investigation Team:

Personnel*:	Safety Category:	Responsibilities:
* All employees have been trained and medically monitored in accordance with OSHA 29 CFR 1910.120 requirements, and US-EPA Region 2 Field Health and Safety Manual, last updated April 21, 1995.		

Plan Preparation by:

Site Safety Officer:		Date:
Section Chief:		Date:
Branch Chief:		Date:

Site Status:

Active	Inactive	Unknown

EMERGENCY INFORMATION:

Local Resources:

Ambulance (Name):	Phone:
Hospital (Name):	Phone:
Police (Local or State):	Phone:
Fire Department:	Phone:
Other:	

Office Resources:

Office - Point of Contact	Work Phone Number:	Home Phone Number:
Section Safety Officer (Randy Braun)	(732) 321-6692	

EMERGENCY CONTACTS:

Poison Control Center Phone:	(800) 282-5846
National Response Ctr (ENVIRONMENTAL EMERGENCY ONLY)	(800) 424-8802

Directions to Hospital (Attach Map if Available):

SAFETY AND HEALTH RISK ANALYSIS:

Waste Types/Chemicals (Attach MSDS for each):

HAZARD EVALUATION:

Known or Suspected Hazardous/Toxic Materials (If applicable include: PEL/IDLH and/or TLV-TWA/TLV-STEL, LEL, flammability, odor, reactivity, stability, corrosivity)

OVERALL HAZARD:

Serious	Moderate	Low	Unknown

SITE PERIMETER ESTABLISHMENT:

Map/Sketch attached?	
Perimeter identified?	
Zone(s) of contamination identified?	

RECOMMENDED LEVEL(S) OF PROTECTION:

Level of Protection: (check those that apply)	Level A	Level B	Level C	Level D

Modifications:

Respiratory:	
Field Dress:	

Monitoring Procedures/Equipment*

	TVA® 1000 PID/FID		OVA® FID
	Rae® PID		MicroTip® PID
	Radiation Meter		LEL/Oxygen
	Other, Specify		

*All instruments are calibrated.

Method of Air Surveillance:
Additional Site Specific Information/Stipulations:
Site Decontamination Procedures:

Confined Space Entry (check one)	Yes _____	No _____
If yes, define procedures to be used:		
Have workers been trained?	Yes _____	No _____

DRILLING/AUGERING OPERATIONS:

Underground Utilities:

All underground utilities must be located prior to commencement of drilling/augering operations involving drill rigs or power augers. Complete the underground utilities checklist below and prepare a site map showing the locations of all underground utilities identified.

Utility	Locator/Contact Person	Phone Number	Date Contact Made
Power:			
Telephone*:			
Gas:			
Water:			
Sewer:			
Other:			

* Include non-AT&T lines such as Sprint, MCI, etc.

Above Ground Utilities:

All above ground utilities must be located prior to commencing drilling/augering activities. A map will be prepared showing the locations of all power lines, telephone lines, video cables, guy wires, and other objects which could pose a hazard to personnel operating the power auger, or hand auger with multiple extensions. The SSO will insure that all operations are kept well clear of such hazards.

4.3.7 Boating Operations

The Branch has several vessels that are used for sampling and conducting studies, including:

- The Clean Waters (65 feet long)
- 24' Boston Whaler
- 19' Mako
- 2 - 16' John Boats with outboard motors
- 12' Electroshocking boat
- 3-12' Row boats

- All of the vessels are operated under the requirements of the US Environmental Protection Agency Vessel Safety manual (dated August 2000), and the Edison Health and Safety Manual (dated 1995). The vessel Clean Waters also has an individual procedures manuals for Lifesaving Training and Emergency procedures (dated November 1998) and for Overboard Equipment Operations and Maintenance Procedures (dated November 1998).

The skipper must be familiar with the capabilities of their vessel (care and maintenance of engines, batteries, emergency procedures, and rules of navigation as prepared by the United States Coast Guard). The skipper is responsible for everything that happens on the vessel. When participating in field work, make sure that the Supervisor and the field party knows where you will be working, and the expected hour of your return. When deploying equipment on station make sure that it is secured and not a danger to fellow workers. When the vessel is underway all equipment should be placed in the boat and secured. Federal law prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil or hazardous substances into the waters of the United States to a distance of three miles from the coastline).

Required Equipment:

Outboard motorboats less than 26 feet in length, which are so constructed that entrapment of flammable vapors cannot occur are not required to carry fire extinguishers, but they are recommended, and should be capable of extinguishing fires involving flammable liquids and grease (class “B” fires). All EPA Region II gasoline powered vessels will carry a fire extinguisher when in use, or when being trailered.

All recreational boats less than 16 feet in length, including sailboats and rowboats, and all kayaks and canoes, carry at least one Coast Guard Approved Type I, II, III or IV Personal Flotation Device (PFD) for each person on board, and all recreational boats 16 feet or longer in length, including sailboats and rowboats, carry at least one Type I, II, or III (wearable) PFD for each person on board and one Type IV (throwable) PFD in each boat. Weather or working conditions may dictate the wearing of PFD’s. All EPA vessels shall carry a Type II for each person on board.

All recreational boats 16 feet or more, are required to be equipped with visual distress signaling devices (VDS) at all times when operating on coastal waters. Also, boats less than 16 feet long are required to carry visual distress signals when operating on coastal waters at night. Coastal waters are defined as (1) The ocean (territorial sea) (2) The Great Lakes (3) Bays or sounds that empty into those waters, and (4) Rivers over two miles across at the mouth, upstream to a point where they narrow to two miles. The simplest VDS is a bright orange flag bearing a black square and a black circle (other forms can be found in the U.S. Coast Guard Auxiliary Boating Skills and Seamanship). All EPA vessels, while in use, will carry both daytime and nighttime distress signals.

When working on open boats, or on outside decks of larger vessels (such as the Clean Waters), employees should wear life jackets. When working in the vicinity of an operating winch employees must also wear a hard hat.

All EPA vessels shall carry a VHF radio and first aid kit when on the water.

Trailering:

Trailering of boats

1. The vehicle drivers must have completed the trailer towing safety training course within the last three years.
2. Make sure to use the proper class of hitch for the weight of the trailer being towed;
3. Check to have the proper size coupler for the ball being used, and that the ball has been greased;
4. The trailer must have safety chains, which should be crossed during use;
5. A tire-pressure gauge should be used to check tire pressure before departure;
6. Running lights, brake lights and turn signals should be functioning;
7. Every unattached piece of gear in the trailered boat should be firmly secured, and the boat itself should be firmly lashed in place;

A more detailed description of boating regulations and safety can be found in the United States Coast Guard Auxiliary Manual Boating Skills and Seamanship. ISBN #0-930028-03-1 FLOAT PLAN (attached).

The attached Float Plan should be completed before going boating, and it should be left with a reliable person who can be depended upon to notify the Coast Guard, or other rescue organization, should you not return as scheduled. **<u>Do not file this plan with the Coast Guard.</u>**

FLOAT PLAN

Project Date(s)____ (if overnight, date returning)
Name __________________________ Phone Number___________________________________

BOAT MAKE / COLOR / LENGTH / ENGINES - for description of vessel
<u>(Circle one):</u>

Vessel - "Clean Waters" - 65 ft - White w/ Blue Deck / Green Blue Stripe / Blue A Frame

Vessel - "Boston Whaler" - 24 ft - White Center Console / Grey Deck / Grey T Top / Twin Outboard

Vessel - "Mako" - 19 ft - White Center Console / White Deck / Single Outboard

Vessel - "Shocking Barge"- 16 ft - Silver Center Console / Tan Deck / Square Bow / Single Outboard

Vessel - "Jon Boat" - 16ft - Olive Drab Side Console / Olive Drab Deck / Single Outboard

Vessel - "Jon Boat" - 16 ft - Olive Drab - Tiller Steering / Single Outboard

Vessel - "Skiff"- 12 ft - Silver - Tiller Steering / Single Outboard

TRIP EXPECTATIONS:

Leave at _____________(TIME) From____
Going to____
Return by_________________________________(Date & Time)
Absolutely no later than_____________________(Date & Time)
Call Coast Guard or Local Authorities at ________________________(Date & Time)
Coast Guard - Sandy Hook __________________
Coast Guard - Point Pleasant__________________
Other_______________
Local / State Police - 911
VHF Radio ____(yes) _____ (no)
Other communication____
Any other pertinent information
____
____
____

FOR SINGLE BOAT OPERATION:

Automobile License____________________ Trailer License __________________________
Where Parked
____

4.3.8 Field Procedures for Handling Pathogenic Samples

Whenever there is a possibility that water, soil or sediment may contain pathogenic materials all precautions should be taken to prevent exposure to those collecting and handling the samples.

1. Latex/neoprene/nitrile gloves shall be worn, as well as boots, waders, and respirators when necessary, for the collection of possible pathogenic samples.

2. After sample collection, gloves will be disposed of in plastic garbage bags, and boots, waders, equipment, etc. used in the sample collection will be decontaminated with soap and water. Hands will be thoroughly sanitized (with Prell®), or cleaned with soap and water, before proceeding to other tasks.

3. Sample containers shall be cleaned on the outside to help eliminate contamination of handlers in the laboratory and placed in containment if necessary.

SECTION 5
SAMPLING DESIGN AND QUALITY ASSURANCE PROCEDURES

SECTION OBJECTIVES:

- Define planning and quality assurance elements that must be incorporated in all sampling operations.
- Define sampling site selections and collection procedures for individual media.
- Define sampling quality assurance procedures

5.1 Introduction

This section discusses the standard practices and procedures used by Branch personnel during field operations to ensure the collection of representative samples. Sampling activities conducted by field investigators are conducted with the expectation that information obtained may be used for enforcement purposes, unless specifically stated to the contrary in advance of the field investigation. Therefore, correct use of proper sampling procedures is essential. Collection of representative samples depends upon:

- Ensuring that the sample is representative of the material being sampled.
- The use of proper sampling, sample handling, preservation, and quality control techniques.

5.2 Definitions

<u>Sample</u> - part of a larger lot, usually an area, a volume, or a period of time.

<u>Representative Sample</u> - a sample that reflects one or more characteristics of a population.

<u>Sample Representativeness</u> - the degree to which a set of samples defines the characteristics of a population, where each sample has an equal probability of yielding the same result.

<u>Variability</u> - the range or “distribution” of results around the mean value obtained from samples within a population. There are three types of variability which must be measured, or otherwise accounted for in field sampling.

1. Temporal Variability

Temporal variability is the range of results due to changes in pollutant concentrations over time. An example would be the range of concentrations obtained for a given parameter in wastewater samples collected at different times from an outfall where pollutant concentrations vary over time.

2. Spatial Variability

Spatial variability is the range of results due to changes in pollutant concentrations as a function of their location. An example would be the range of concentrations obtained for a given parameter in surface soil from a site where discrete "hot spots" are present due to localized releases of pollutants on otherwise uncontaminated soil.

3. Sample Handling Variability

Sample handling variability is the range of results due to the sample collection and handling by the sampler. This variability manifests itself as a positive bias due to errors such as unclean sampling equipment, cross contamination, etc., or a negative bias due to improper containers or sample preservation.

<u>Accuracy</u> - a measure of agreement between the true value and the measured value of a parameter.

<u>Precision</u> - measure of the agreement among repeated individual measurements of a sample.

<u>Bias</u> - consistent under or over-estimation of the true value due to sampling errors, sample handling errors, or analytical errors.

<u>Grab Sample</u> - an individual sample collected from a single location at a specific time, or period of time (i.e., within 15 minutes).

<u>Composite Samples</u> - a sample collected over a temporal or spacial range that typically consists of a series of discrete samples (or “aliquots”) which are combined or "composited". Four types of composite samples are listed below:

1. Time Composite (TC) - a sample comprised of a varying number of discrete samples (aliquots) collected at equal time intervals during the compositing period. The TC sample is typically used to sample wastewater or streams.

2. Flow Proportioned Composite (FPC) - a sample collected proportional to the flow during the compositing period by either a time-varying/constant volume (TVCV) or time-constant/varying volume (TCVV) method. The TVCV method is typically used with automatic samplers that are paced by a flow meter. The TCVV method is a manual method that individually proportions a series of discretely collected aliquots. The FPC is typically used when sampling wastewater.

3. Areal Composite - sample composited from individual, equal aliquots collected on an areal or horizontal cross-sectional basis. Each aliquot is collected in an identical manner. Examples include sediment composites from quarter-point sampling of streams and soil samples from within grids.

4. Vertical Composite - a sample composited from individual, equal aliquots collected from a vertical cross section. Each aliquot is collected in an identical manner. Examples include vertical profiles of soil/sediment columns, lakes, and estuaries.

Quality Control Samples

Quality control samples are collected during field studies to determine the performance of sample collection techniques. In general, the most common errors are caused by improper sampling, improper preservation, inadequate mixing during compositing and splitting of samples, and exceeding sample holding times.

The definitions for specific quality control samples are listed below:

Control Sample - typically a discrete grab sample collected to isolate a source of contamination. Isolation of a source could require the collection of both an upstream sample at a location where the medium being studied is unaffected by the site being studied, as well as a downstream control which could be affected by pollutants contributed from the site under study.

Background Sample - a sample (usually a grab sample) collected from an area, water body, or site similar to the one being studied, but located in an area known, or reasonably thought to be free from the pollutants of concern.

Split Sample - a sample which has been portioned into two or more containers from a single sample container or sample mixing container for analysis by separate laboratories. The primary purposes of a split sample is to measure sample handling variability, and to identify discrepancies in analytical techniques and procedures.

Duplicate Sample - are separate samples taken from the same source at the same time and in the same manner, and are analyzed in the same laboratory. These samples provide a check on the consistency of the sampling techniques used to collect the sample, and may also serve to estimate the variability of a given characteristic, or pollutant, associated with a source of the sample.

Trip Blanks - a sample which is collected either prior to, or during, the sampling event in the same container, preserved in the same manner as the sample, and is stored with the samples collected during the survey. They are packaged for shipment with the other samples and submitted for analysis. At no time after their preparation are trip blanks to be opened before they reach the laboratory. Trip blanks are used to determine if samples were contaminated during storage and/or transportation back to the laboratory (a measure of sample handling variability resulting in positive bias in pollutant concentration). If samples are to be shipped, trip blanks are to be provided with each shipment but not for each cooler.

Equipment Field Blanks - a sample collected using analyte-free water which has been passed through, or over sample collection equipment. These samples are used to determine if pollutants have been introduced by contact of the sample medium with sampling equipment. Equipment field blanks are often associated with collecting rinse blanks of equipment that has been field cleaned.

Temperature Blanks - a container of water shipped with each cooler of samples requiring preservation by cooling to 4 °C (wet ice). The temperature of the blanks is measured at the time of sample receipt by the laboratory. No temperature blank is necessary for samples designated as “waste”.

Field Blanks - a sample that is prepared in the field to evaluate the potential for contamination of a sample by site pollutants from a source not associated with the sample collected (for example air-borne dust or organic vapors which could contaminate a soil sample). Analyte-free water is taken to the field in sealed containers or generated on-site. The water is poured into the appropriate sample containers at pre-designated locations at the site. Field blanks should be collected in dusty environments and/or from areas where volatile organic contamination is present in the atmosphere and originating from a source other than the source being sampled.

Material Blanks - samples of sampling materials (e.g., material used to collect wipe samples, etc.), construction materials (e.g., well construction materials), or reagents (e.g., organic/analyte free water generated in the field, water from local water supplies used to mix well grout, etc.) collected to measure any positive bias from sample handling variability.

Wipe Sample Blanks - a sample of the material used for collecting wipe samples. The material is handled, packaged, and transported in the same manner as all other wipe samples with the exception that it is not exposed to actual contact with the sample medium.

5.3 Sampling Design

5.3.1 Introduction

Development of a sampling design may follow the steps outlined in the EPA publications, “US EPA Region 2 - Guidance for the Development of Quality Assurance Project Plans for Environmental Monitoring Projects”, dated April 12, 2004, EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, EPA/240/B-01/003, EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, EPA/240/R-02-009. Other EPA guidance documents available include: “Guidance for the Data Quality Objectives Process - EPA QA/G-4", and “Data Quality Objectives process for Hazardous Waste Site Investigations - EPA QA/G-4HW”. The Data Quality Objectives (DQOs) process is a logical step-by-step method of identifying the study objective, defining the appropriate type of data to collect, clarifying the decisions that will be based on the data collected, and considering the potential limitations with alternate sampling designs.

Investigations may be executed without completing the DQO process step-by-step; however, the basic elements of the DQO process should be considered by the project leader for each investigation. Sampling designs are typically either non-probabilistic (authoritative sampling designs) or probabilistic (random sampling designs) in nature. The sampling design ultimately must meet specific study objectives. The location and frequency of sampling (number of samples) should be clearly outlined in the sampling design, as well as provisions for access to all areas of the site, the use of special sampling equipment, etc. Development of the sampling design in the context of DQOs and sampling optimization are discussed in the ASTM documents "Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Development of Data Quality Objectives", and "Standard Guide for the Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation".

5.3.2 Representative Sampling

A "representative sample" is often defined as a sample that reflects one or more characteristics of the population being sampled. For example, the characteristic which is desired to be reflected by the sample may be the average, minimum, or maximum concentration of a constituent of concern. Ultimately, a representative sample is defined by the study objectives. For instance, the objective of the study may be to determine the maximum concentration of lead in the sludge from a surface impoundment. One sample collected near the inlet to the impoundment may provide that information. The collection of a representative sample may be influenced by factors such as equipment design, sampling techniques, and sample handling.

5.3.3 Stratification and Heterogeneous Wastes

Environmental media, as well as waste matrices, can be stratified, i.e., different portions of the population, which may be separated temporally or spatially, may have similar characteristics or properties which are different from adjacent portions of the population. An example would be a landfill that contains a trench which received an industrial waste contaminated with chromium. The trench would be considered a stratum within the landfill if chromium was the pollutant of concern. A special case, "stratification by component", is often observed with waste matrices when the constituent of interest is associated with one component of the matrix. An example would be slag contaminated with lead that is mixed with otherwise uncontaminated fire brick. Thus the lead is stratified by component, that being the slag. Stratified sampling designs are discussed later which incorporate independent sampling of each strata, thereby reducing the number of samples required. Some environmental and waste matrices can be, for purposes of the field investigation, homogeneous (for instance the surface water in a limited segment of a small stream). If the composition of the matrix and the distribution of pollutants are known, or can be estimated, less sampling may be necessary to define the properties of interest. An estimate of the variability in pollutant distribution may be based on knowledge, or determined by preliminary sampling. The more heterogeneous the matrix, the greater the planning and sampling requirements.

A population could also have very localized strata or areas of contamination that are referred to as "hot spots". Specific procedures for hot spot identification and characterization are available in Statistical Methods for Environmental Pollution Monitoring.

5.3.4 Specific Sampling Designs

Sampling strategies used by the Section typically fall into two general groups: **authoritative** or **probabilistic**. Authoritative (also known as directed, subjective, and/or biased) approaches typically rely on the judgement and experience of the investigators, as well as available information on the matrix of concern. Probabilistic, or "statistical" approaches may be appropriate when estimates on uncertainty and specific confidence levels in the results are required. The probabilistic approaches include: simple random sampling, stratified random sampling, and systematic grid sampling. The main feature of a probabilistic approach is that each location at the site has an equal probability of being sampled, therefore statistical bias is minimized. Professional judgement should always be used to develop both authoritative and probabilistic sampling designs.

5.3.5 Determining the Number of Samples to Collect

The number of samples to collect as part of a sampling design will typically be based on several factors, e.g., the study objectives, properties of the matrix, degree of confidence required, access to sampling points, and resource constraints. Practical guidance for determining the number of samples is included in several documents including the ASTM document Standard Guide for General Planning of Waste Sampling, the US-EPA document Characterization of Hazardous Waste Sites - A Methods Manual, Volume 1 - Site Investigations, the US-EPA document Guidance of Choosing a Sampling Design for Environmental Data Collection and Statistical Methods for Environmental Pollution Monitoring by Richard O. Gilbert.

5.3.6 Authoritative Sampling

Authoritative sampling is based on the judgement of the investigator, and does not necessarily result in a sample that reflects the average characteristics of the entire matrix. There are two types of authoritative designs: judgmental sampling and biased sampling. Judgmental sampling uses the knowledge and experience of the investigator to attempt to derive “average” conditions at a site. In contrast, biased sampling attempts to determine the maximum or minimum value for pollutant of concern. Biased sampling often focuses on "worst case" conditions in a matrix, for example, the most visually contaminated area or the most recently generated waste. The primary advantages of authoritative sampling are the designs tend to be quick and simple to implement, and the designs have relatively low costs. Authoritative sampling is ideally suited for sites where pollutants of concern greatly exceed, or are significantly below, predetermined action levels. Because the experience of the investigator is often the basis for sample collection, personal bias (depending on the study objectives) may be introduced and should be recognized as a potential problem. However, preliminary or screening investigations, and certain regulatory investigations, will correctly employ authoritative sampling.

5.3.7 Simple Random Sampling

Simple random sampling insures that each element in the population has an equal chance of being included in the sample. This is often be the method of choice when, for purposes of the investigation, the matrix is considered homogeneous, or when the population is randomly heterogeneous. If the population contains trends or patterns of contamination, a stratified random sampling or systematic grid sampling strategy would be more appropriate.

5.3.8 Systematic Sampling over Time or Space

Systematic sampling over time at the point of generation is useful if the material was sampled from a wastewater sewer, a materials conveyor belt, or being delivered via truck or pipeline. The sampling interval would be determined on a time basis, for example every hour from a conveyor belt or pipeline discharge, or from every third truck load. Systematic sampling over space might involve the collection of samples at defined intervals from a ditch, stream, or other matrix that is spatially unique.

5.3.9 Stratified Random Sampling

Stratified random sampling may be useful when distinct strata or "homogeneous sub-groups" are identified within the population. The strata could be located in different areas of the population, or the strata may be comprised of different layers. This approach is useful when the individual strata may be considered internally homogeneous, or at least have less internal variation, in what would otherwise be considered a heterogeneous population. Information on the site is usually required to establish the location of individual strata. A grid may be utilized for sampling several horizontal layers if the strata are horizontally oriented. A simple random sampling approach is typically utilized for sample collection within each strata. The use of a stratified random sampling strategy may result in the collection of fewer samples.

5.3.10 Systematic Grid Sampling

Systematic grid sampling involves the collection of samples at fixed intervals when the contamination is assumed to be randomly distributed. This method is commonly used with populations when estimating trends or patterns of contamination. This approach may not be acceptable if the entire population is not accessible, or if the systematic plan becomes "phased" with variations in the distribution of pollutants within the matrix. This approach may also be useful for identifying the presence of strata within the population. The grid and starting points should be randomly laid out over the site, yet the method allows for rather easy location of exact sample locations within each grid. Also, the grid size would typically be adjusted according to the number of samples that are required.

5.3.11 Adaptive Cluster Sampling

Adaptive sampling designs are ones in which additional decisions units or sample locations are selected depending on the interpretation of measurements or observations made during an initial survey. Additional sample locations are selected when a pollutant of concern in one or more units exceeds some predetermined action level in the initial survey. Adaptive cluster sampling is a beneficial design for sites where a pollutant of concern is sparsely distributed but highly concentrated. Simple random or systematic grid sampling can be used in conjunction with adaptive cluster sampling designs.

5.4 General Considerations for Sampling Designs

Prior to commencing work on any project, the objective of the study in terms of the purpose the data generated is to serve should be known. Some examples of uses for which data are generated include:

- RCRA waste identification investigations;
- RCRA screening investigations (presence or absence of pollutants);
- Surface water and sediment studies;
- Wastewater treatment plant evaluations;
- Monitoring investigations, and
- Special environmental characterization investigations.

The purpose of data collection is to meet the objectives of the investigation. The process of designing an investigation typically follows a logical series of steps. Proper evaluation of these steps will greatly enhance the project leader's ability to choose a design which adequately serves the purpose of the study. The DQO process may not be strictly followed, but the elements of the process are always considered during study planning. These elements include:

- State the environmental problem;
- Collection of information concerning historical data, site survey, and site history;
- Identification of the decision to be made with the data collected;
- Identification of data gaps;
- Identification of objectives, and investigation boundaries;
- Sampling design selection and design optimization;
- Sample types and number;
- Analytical requirements and limitations; and
- Data interpretation and assessment.

5.5 Soil Sampling Designs

The objectives of a soil sampling investigation must be clearly defined in terms of the purpose of the data generated. A discussion of study planning elements that include considerations specific to soil investigations follows.

5.5.1 Historical Sampling Data, Site Survey, and Site History

Investigations that are used for initial site screening purposes are one of the few cases where historical sampling data is usually not available. In this case, the purpose of the sampling effort is to determine the presence/absence of pollutants and if present, to determine their nature. Such a purpose can be served with a minimum of samples whose locations can be determined from a site survey and a review of the site history. When designing a soil sampling study for purposes other than site screening, a record of previous sampling efforts is usually available from which a relatively sound foundation of historical sampling data can be derived. The site survey is invaluable for soil sample design. Information which should be obtained during a site survey includes:

- General site layout;
- Site access;
- Soil types and depths;
- Surface water drainage pathways;

- Existing site conditions;
- Visible staining of surface soil;
- Vegetation stress; and
- Possible offsite or non-site related sources.

The site history should include factors such as previous land use both on and nearby the site, types of industrial operations conducted both on the site and on adjoining property, types of pollutants to which the site has been exposed, and locations of possible dumping/burial areas. The site history can be derived from property plots, tax records, aerial photos, and interviews with people familiar with the site. Secondary Data is discussed in section 5.10.3.

5.5.2 Data Quality Objectives (DQOs)

Consideration of the purpose which the data generated from the soil sampling effort is to serve drives the selection of DQOs. DQO selection will then be the main factor which determines the types of samples to be collected, the types of equipment to be used, and the analytical requirements for the samples.

5.5.3 Authoritative Designs for Soil Investigations

When the purpose of the investigation is to determine the presence of pollutants, a simple strategy can be used. Such a purpose is normally encountered during screening inspections, criminal investigations, and any other project where the scope is limited to gathering evidence of contamination. These cases are normally characterized by a lack of previous sampling data, thereby requiring that sample types and locations be determined by site history and a site survey. In these instances, an authoritative design is normally used.

Authoritative sampling usually involves a limited number of locations (10 to 15) from which grab samples are collected. Locations are selected where there is a good probability of finding high levels of contamination. Examples may include areas where significant releases or spillage occurred according to the site history or areas of visible staining, stressed vegetation, or surface drainage are noted in the site survey. An authoritative design usually involves the selection of at least one or two control sampling locations to measure possible pollutants migrating onto the site from adjacent sources not involved in the study. The selection of control locations is similar to the selection of other sampling locations, except that upstream or upgradient control samples are expected to be unaffected by site pollutants. Because of the biased nature of an authoritative design, the degree of representativeness is difficult to estimate. Authoritative samples are not intended to reflect the average characteristics of the site. Since determining representativeness is not an issue with this type of design, duplicate samples designed to estimate variability are not normally collected. However, some split samples may be collected to measure sample handling variability.

An interactive approach may be used in an authoritative design to determine the extent of contamination on a site when the source can be identified. Samples are typically collected using a pattern that radiates outward from the source. The direction of pollutant migration may not be known, which will result in the collection of more samples, and in this case field screening would be desirable to help in determining appropriate sampling locations.

5.5.4 Systematic Grid Sampling Designs for Soil Investigations

In cases where both the presence of pollutants and the extent of contamination needs to be determined, an authoritative design is inappropriate as site variability cannot be estimated without collecting an inordinate number of samples. A systematic design is normally used during investigations when determining the extent of contamination, such as remedial investigations and removal actions. Once a site has reached the stage where the extent of contamination becomes an issue, access to data from previous sampling efforts (screening investigations) which used an authoritative design is normally available. The Section is not normally involved in this aspect of the soil investigation, which would usually be conducted under Superfund.

5.6 Ground Water Sampling Designs

Sampling design, as it pertains to ground water, often involves the use of some form of temporary well point or direct push technology (DPT) for rapid in-field screening and plume delineation. These techniques are discussed in Section 6. Samples obtained using these techniques are usually analyzed immediately, using an on-site field laboratory, or are sent to an off-site laboratory for quick turnaround analyses.

5.6.1 Typical Ground Water Screening Devices

Listed below are numerous tools, devices, and techniques available to field investigators that can be used to effectively collect ground water samples for rapid field screening.

Temporary wells - Well casing can be installed temporarily, either inside hollow-stem augers or in an open hole after removal of hollow- or solid-stem augers. Because of the potential for cross-contamination between vertical intervals, this technique is appropriate only for screening the upper portion of the saturated zone. Samples are pumped or bailed directly from the well casing. Because turbidity is likely to be a problem using this technique, care should be taken when using the samples for metals screening. Depth of the investigation is limited only by the capability of the drill rig and cross-contamination considerations.

- Geoprobe® - Slotted steel pipe is hydraulically pushed or hammer driven to the desired sampling depth. Samples are usually acquired with a peristaltic pump. The device is subject to cross-contamination at threaded rod joints. It requires some knowledge of the saturated interval. The Geoprobe® is most useful at depths less than 30 to 40 feet below ground surface.

- Hydropunch® – A larger, more versatile device, similar to the Geoprobe®, which is pushed to sampling depths with a drill rig. It requires some knowledge of saturated intervals to use successfully. Depths of investigation with this technology are roughly correlated to the capability of the drill rig used to push the sampling device.

- Hydrocone® – This is a pressure-sealed sampling device that is hydraulically pushed to the desired sampling depth. It is capable of collecting a discrete sample from any depth at which it can be pushed. A limited volume of about 700 ml is collected and is generally turbid. This technique is mainly applicable for the screening for volatile organic compounds. A temporary well point can be driven by the same drill rig to collect samples with greater volume requirements. Samples from depths exceeding 100 feet have been obtained with this device. Routine depths obtained without special anchoring are generally within the 50-foot range, but are dependent on the geological materials being encountered.

5.7 Surface Water and Sediment Sampling Designs

5.7.1 Sampling Site Selection

The following factors should be considered in the selection of surface water and sediment sampling locations:

- Study objectives;
- Water use;
- Point source discharges;
- Nonpoint source discharges;
- Tributary locations;
- Changes in stream characteristics;
- Type of stream bed;
- Depth of stream;
- Turbulence;
- Presence of structures (weirs, dams, etc.);
- Accessibility; and
- Tidal effect (estuarine).

If the study objective is to investigate a specific water use such as a source of water supply, recreation, or other discrete use, then considerations such as accessibility, flow, velocity, physical characteristics, etc., are not critical from a water quality investigation standpoint. If the objective of a water quality study is to determine patterns of pollution, provide data for mathematical modeling purposes, conduct assimilative capacity studies, etc., where more than a small area or short stream reach is to be investigated, then several factors become interrelated and need to be considered in sampling location selection.

Before any sampling is conducted, an initial reconnaissance should be made to locate suitable sampling locations. Bridges and piers are normally good choices as sampling sites since they provide ready access and permit water sampling at any point across the width of the water body. However, these structures may alter the nature of water flow and thus influence sediment deposition or scouring. Additionally, bridges and piers are not always located in desirable locations with reference to waste sources, tributaries, etc. Wading for water samples in lakes, ponds, and slow-moving rivers and streams must be done with caution since bottom deposits are easily disturbed, thereby resulting in increased sediments in the overlying water column. On the other hand, wadeable areas may be best for sediment sampling. In slow-moving or deep water, a boat is usually required for sampling. Sampling station locations can be chosen without regard to other means of access if the stream is navigable by boat, especially in estuarine systems where boats frequently provide the only access to critical sampling locations.

Fresh water environments are commonly separated into two types:

- Flowing water, including rivers, creeks, and small to intermittent streams; and
- Water that is contained, with restricted flow including lakes, ponds, and manmade impoundments

Since these waterways differ considerably in general characteristics, site selection must be adapted to each. Estuarine environments are a special case and are discussed separately.

5.7.2 Rivers, Streams, and Creeks

In the selection of a surface water sampling sites in rivers, streams, or creeks, areas that exhibit the greatest degree of cross-sectional homogeneity should be located. When available, previously collected data may indicate if potential sampling locations are well mixed or vertically or horizontally stratified. Since mixing is principally governed by turbulence and water velocity, the selection of a site immediately downstream of a riffle area will insure good vertical mixing. These locations are also likely areas for deposition of sediments since the greatest deposition occurs where stream velocities decrease provided that the distance is far enough downstream from the riffle area for the water to become quiescent. Horizontal (cross-channel) mixing occurs in constrictions in the channel, but because of velocity increases, the stream bottom may be scoured, and therefore, a constriction is a poor location to collect sediment. Typical sediment depositional areas are located:

- Inside of river bends;
- Downstream from islands;
- Downstream from obstructions; and
- Areas of flow reversals, such as back-shoots.

Sites that are located immediately upstream or downstream from the confluence of two streams or rivers should generally be avoided since flows from two tributaries may not immediately mix, and at times due to possible backflow can upset the depositional flow patterns. When several locations along a stream reach are to be sampled, they should be strategically located:

- At the same locations if possible, when the data collected is to be compared to a previous study.
- At intervals based on time-of-water-travel, not distance, e.g., sampling stations may be located about one-half day time-of-water-travel for the first three days downstream of a waste source (the first six stations) and then approximately one day through the remaining distance.
- Whenever a marked physical change occurs in the stream channel. Example: A

stream reach between two adjacent stations should not include both a long rapids section of swift shallow water with a rocky bottom, and a long section of deep, slow-moving water with a muddy bottom. Stations at each end of the combined reach would yield data on certain rates of change, such as reaeration, that would be an unrealistic average of two widely different rates. The actual natural characteristics of the stream would be better defined by inserting a third sampling station within the reach, between the rapids and the quiet water sections.

- To isolate major discharges as well as major tributaries. Dams and weirs cause changes in the physical characteristics of a stream. They usually create quiet, deep pools in river reaches that previously were swift and shallow. Such impoundments should be bracketed with sampling stations. When time-of-water-travel through the pools are long, stations should be established within the impoundments.

Some structures, such as dams, permit overflow and cause swirls in streams that accomplishes significant reaeration of oxygen deficient water. In such cases, stations should be located short distances upstream and downstream from the structures to measure the rapid, artificial increase in dissolved oxygen, which is not representative of natural reaeration.

When major changes occur in a stream reach, an upstream station, a downstream station, and an intermediate station should be selected. Major changes may consist of:

- A wastewater discharge;
- A tributary inflow;
- Non-point source discharge (farms or industrial sites); and
- A significant difference in channel characteristics.

The use of three stations is especially important when rates of change of unstable constituents are being determined. If results from one of only two stations in a subreach are in error for some unforeseen reason, it may not be possible to judge which of the two sets of results indicate the actual rate of change. Results from at least two of three stations, on the other hand, may support each other and indicate the true pattern of water quality in the subreach.

To determine the effects of certain discharges or tributary streams on ambient water quality, stations should be located both upstream and downstream from the discharges. In addition to the upstream and downstream stations bracketing a tributary, a station should be established on the tributary at a location upstream and out of the influence of the receiving stream.

Unless a stream is extremely turbulent, it is nearly impossible to measure the effect of a waste discharge or tributary immediately downstream from the source. Inflow frequently "hugs" the stream bank due to differences in density, temperature, and specific gravity, and consequently lateral (cross-channel) mixing does not occur for some distance.

Tributaries should be sampled as near the mouth as feasible. Frequently, the mouths of tributaries are accessible by boat. Care should be exercised to avoid collecting water samples from stratified locations which are due to differences in density resulting from temperature, dissolved solids, or turbidity.

Actual sampling locations will vary with the size of the water body and the mixing characteristics of the stream or river. Generally, for small streams less than 20 feet wide, a sampling site should be selected where the water is well mixed. In such cases, a single grab sample taken at mid-depth at the center of the channel is adequate to represent the entire cross-section. A sediment sample could also be collected in the same vicinity if available.

For slightly larger streams, at least one vertical composite should be collected from mid-stream. Samples should be collected just below the surface, at mid-depth, and just above the bottom. For larger streams and rivers, at least quarter point (1/4, ½, and 3/4 width) composite samples should be collected. Dissolved oxygen, pH, temperature, and conductivity should be measured from each aliquot of the vertical composite.

For large rivers, several locations across the channel width should be sampled. Vertical composites across the channel width should be located in a manner that is roughly proportional to flow, i.e., they should be closer together toward mid-channel, where most of the flow is, than toward the banks, where the proportion of total flow is less. The number of vertical composites required and the number of depths sampled for each are usually determined in the field by the investigators. This determination is based on a reasonable balance between the following two considerations:

- The larger the number of subsamples, the more closely the composite sample will represent the water body; and
- Subsample collection is time-consuming and expensive, and increases the chance of cross-contamination.

In most circumstances, a number of sediment samples should be collected along a cross-section of a river or stream in order to adequately characterize the bed material. A common procedure is to sample at quarter points along the cross-section. When the sampling technique or equipment requires that the samples be extruded or transferred on site, they may be combined into a single composite sample. However, samples of dissimilar composition should not be combined but should be stored for separate analysis in the laboratory. Often, sediment must be collected in back-shoots or areas on the inside of bends in the stream due to scouring in the main channel.

5.7.3 Lakes, Ponds, and Impoundments

Lakes, ponds, and impoundments have a much greater tendency to stratify than rivers and streams. The relative lack of mixing generally requires that more samples be obtained. Occasionally, an extreme turbidity difference may occur where a highly turbid river enters a lake. For these situations, each layer of the vertically stratified water column needs to be considered. Since the stratification is caused by water temperature differences, the cooler, more dense river water is beneath the warmer lake water. A temperature profile of the water column as well as visual observation of lake samples can often detect the different layers which can be sampled separately.

The number of water sampling stations on a lake, pond, or impoundment will vary with the objective of the investigation as well as the size and shape of the basin. In ponds and small impoundments, a single vertical composite at the deepest point may be sufficient. Dissolved oxygen, pH, and temperature are generally measured for each vertical composite aliquot. In naturally-formed ponds, the deepest point is usually near the center; in impoundments, the deepest point is usually near the dam. In lakes and larger impoundments, several vertical subsamples should be composited to form a single sample. These vertical sampling locations are often collected along a transect or grid. The number of vertical subsamples and the depths at which subsamples are taken are usually at the discretion of the field investigators. In some cases, it may be of interest to collect separate composites of epilimnetic and hypolimnetic zones (above and below the thermocline or depth of greatest temperature change).

In lakes with irregular shapes and with several bays and coves that are protected from the wind, additional separate composite samples may be needed to adequately determine water quality. Similarly, additional samples should be collected where discharges, tributaries, land use characteristics, etc., are suspected of influencing water quality.

When collecting sediment samples in lakes, ponds, and reservoirs, the sampling site should be approximately at the center of the water mass. This is particularly true for reservoirs that are formed by the impoundment of rivers or streams. Generally, the coarser grained sediments are deposited near the headwaters of the reservoir, and the bed sediments near the center of the water mass will be composed of fine-grained materials. The shape, inflow pattern, bathymetry, and circulation must be considered when selecting sediment sampling sites in lakes or reservoirs.

5.7.4 Estuarine Waters

Estuarine areas are zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Estuaries are generally categorized into three types, dependent upon freshwater inflow and mixing properties:

- Mixed estuary -- Characterized by an absence of vertical halocline (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically this type of estuary is found in major freshwater sheetflow areas, featuring shallow depths.

- Salt wedge estuary -- Characterized by a sharp vertical increase in salinity and channelized freshwater inflow into a deep estuary. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally, back and forth, with the tidal phase.

- Oceanic estuary -- Characterized by salinities approaching full strength oceanic waters. Seasonally, freshwater inflow is small with the preponderance of the fresh and saline water mixing occurring near, or at, the shore line.

A reconnaissance investigation should be conducted for each estuarine study unless prior knowledge of the estuarine type is available. The reconnaissance should focus upon the freshwater and oceanic water dynamics with respect to the study objective. National Oceanic Atmospheric Administration (NOAA) tide tables and United States Geological Survey (USGS) freshwater surface water flow records provide valuable insights into the estuary hydrodynamics. The basic in-situ measurement tools for reconnaissance are:

- Boat;

- Recording fathometer;

- Salinometer;

- Dissolved oxygen meter; and
- Global Positioning System (GPS) equipment and charts.

These instruments coupled with the study objective or pollution source location, whether it is a point or non-point source problem, provide the focus for selecting sampling locations. More often than not, preplanned sampling locations in estuarine areas are changed during the actual study period. Because of the dynamics of estuaries, the initial sampling results often reveal that the study objective could be better served by relocating, adding, or deleting sampling locations.

Water sampling in estuarine areas is normally based upon the tidal phases, with samples collected on successive slack tides. All estuarine sampling should include vertical salinity measurements at one to five-foot increments coupled with vertical dissolved oxygen and temperature profiles. A variety of water sampling devices are used, but in general, the Van Dorn (or similar type) horizontal sampler or peristaltic pump are suitable. Samples are normally collected at mid-depth in areas where the depths are less than 10 feet, unless the salinity profile indicates the presence of a halocline (salinity stratification). In that case, samples are collected from each stratum. Depending upon the study objective, when depths are greater than 10 feet, water samples may be collected at the one-foot depth from the surface, mid-depth, and one-foot from the bottom. Generally, estuarine investigations are two phased, with study investigations conducted during wet and dry periods. Depending upon the freshwater inflow sources, estuarine water quality dynamics cannot normally be determined by a single season study.

5.7.5 Control Stations

In order to have a basis of comparison of water quality, the collection of samples from control stations is always necessary. A control station upstream from the waste source is as important as are stations down gradient, and should be chosen with equal care to ensure representative results. In some situations it is desirable to have background stations located in similar, nearby estuaries which are not impacted by the phenomena or pollutants being investigated. At times it may be desirable to locate two or three stations downstream from the waste inflow to establish the rate at which the unstable material is changing. The time of water-travel between the stations should be sufficient to permit accurate measurement of the change in the constituent under consideration.

5.8 Waste Sampling Designs

5.8.1 Introduction

Waste sampling involves the collection of materials that are typically generated from industrial processes, and therefore may contain elevated concentrations of hazardous constituents. Waste sampling in its broadest term is conventionally considered to be sampling of processed wastes or man-made waste materials. Because of the regulatory, safety, and analytical considerations, wastewater sampling should be separate from waste sampling. Environmental sampling is also different from waste sampling as it involves the collection of samples from natural matrices such as soil, sediment, groundwater, surface water, and air. It is convenient to distinguish waste management units into two types due to Branch safety protocols. The first, "open units", are units where wastes are generated, stored, or disposed, and would be open to the environment and environmental influences. Examples of open waste units are surface impoundments and waste piles. "Closed units" are waste containers/drums, tanks, or sumps where the potential for the accumulation of toxic vapors or explosive/ignitable gases exists. While both open and closed waste units are considered dangerous because of the potential exposure to concentrated hazardous constituents, closed units are regarded as high hazards due to their potential to accumulate gases and vapors.

5.8.2 Waste Investigation Objectives

Systematic planning is critical for identifying a study's objectives and conducting a successful investigation. Thorough understanding of the waste generation/management practices is required for the samples and associated data to reflect the waste population characteristic(s) of interest. Prior to sampling wastes, it is extremely important to obtain and assess all of the available information, e.g., waste generation process(es), waste handling and storage practices, previous field screening results, existing sampling and analytical data, any pertinent regulations, and permitting or compliance issues.

Common objectives in waste sampling investigations include:

- to determine if a constituent is present in a waste,
- to determine if a waste exhibits a property or characteristic,
- to determine if a material is a hazardous waste,
- to characterize a wastestream, and
- to determine if a waste material has been released into the environment.

The most frequently used objective during RCRA Case Development/Investigation Evaluations and Criminal Field Investigations involve hazardous waste determinations. For studies that are designed to determine if a release has occurred, it is recommended that samples be collected from the source as well as both the affected and the unaffected media. Waste matrices are frequently heterogenous in nature due to the physical characteristics of the material (particle size, viscosity, etc.), the distribution of hazardous constituents within the matrix, or the manner in which the material has been managed or disposed. When waste is comprised of strata that can be separated by the sampling equipment (e.g., liquid-liquid or liquid-solid phases), it is not necessary to collect a sample that is representative of the entire unit to make a waste determination. An acceptable objective would be to make a waste determination on a specific strata. For example in drums containing a liquid phase on top of solids, a glass thief or a COmposite LIquid WAste SAmpler (COLIWASA) could be used to sample only the liquid to determine if the phase of interest exhibits the characteristic of ignitability as described in 40 CFR, Part 261.21.

5.8.3 Considerations for Waste Sampling Designs

Waste sampling designs should consider the variability of the sample population in terms of the characteristic of concern, the physical size and state of items present in the population, and the ability to access all portions of the population for purposes of sampling. Elements of the sampling design should include the determination of the sample locations and the number of samples to be collected, decisions on the type of samples (grab or composite) to collect, and selection of the appropriate sampling equipment. While sample locations are usually restricted to accessible portions of a waste unit's population, the number of samples to be collected is usually determined by the objective of the study. Factors to consider when determining the appropriate number of samples are; preliminary information on the waste, the size of the sample population, field screening results, the variability of the waste, laboratory resources available, and the budget for the investigation. Composite samples are used to obtain average concentrations of waste units while grab samples are utilized to delineate hot spots or to acquire data for sample variability, or to determine compliance with Land Disposal Restrictions (LDR) treatment standards. A small wastestream that has a hazardous constituent or characteristic randomly distributed in a relatively homogeneous matrix requires fewer samples than a large wastestream that has a constituent or characteristic of concern which is non-randomly distributed in a heterogeneous matrix. For a waste with constituent of concern that is randomly distributed, an authoritative or systematic grid sampling design would be appropriate depending on the objectives. On the other-hand, a stratified sampling or very specialized design should be employed for wastes that are non-randomly distributed. Reviewing the available preliminary information should improve the effectiveness of any sampling investigation. If waste variability cannot be estimated after review of available information, then a preliminary sampling and analytical effort may be necessary. A preliminary sampling investigation would be important when the study's objective is to fully characterize a waste stream using a probabilistic or “statistical” design.

Probabilistic sampling designs similar to the ones used to characterize a site with soil contamination can be used to characterize large units such as waste piles or surface impoundments with random pollutant distributions. Note that an authoritative design is often appropriate to demonstrate the maximum degree of contamination in certain waste management units. Examples include the collection of a sludge sample for inorganic analyses at the inlet to a surface impoundment, or a sample for volatile organic compound analysis collected from the most recently generated material placed in a waste pile. A comprehensive probabilistic design may be required to fully characterize unusually complex wastestreams that have a high degree of heterogeneity. For some highly complex, heterogeneous wastes where an average concentration would not be reflected by a design of reasonable scope, an authoritative sampling design based on the sampler's experience may be the only feasible approach. For a heterogeneous waste population, it may be necessary to segregate and sample components suspected of containing constituents of concern. Background samples are not required when collecting highly concentrated waste samples.

5.8.4 Waste Sampling Equipment

An extremely important factor in the sampling strategy will be determined by the physical characteristics of the waste material. Selecting appropriate sampling equipment can be one of the most challenging tasks while planning a sampling investigation. By selecting sampling equipment that will not discriminate against certain physical characteristics (e.g., phase, particle size, etc.), sampling bias can be minimized during waste sampling. Because wastes often stratify due to different densities of phases, settling of solids, or varying waste constituents generated at different times, it also may be important to obtain a vertical cross section of the entire unit.

Other desired features of sampling equipment that should be considered; the ability to access the desired sampling locations, the ability to maintain sample integrity, the reactivity of equipment with the waste, and the ability to properly decontaminate the sampling apparatus. In addition, analytical requirements such as the sample handling and preparation to correctly analyze physical samples need to be considered. For solidified wastes, samples will often be required to undergo particle size reduction (PSR) prior to chemical analyses.

Sampling equipment should be selected to accommodate all of the known physical characteristics of concern or chosen such that the effect of any sampling bias is understood. Often because of a lack of preliminary information, varying field conditions, or waste heterogeneity, a piece of equipment selected during the investigations's planning phase may be unsuccessful for collecting a particular waste sample, and another piece of equipment will be required as a substitute. Any sampling bias or deficiencies resulting from the use of substituted equipment should be documented and explained with the data.

5.8.5 Field Screening

Field screening can be very effective in waste characterization and extremely valuable in selecting appropriate sampling locations and chemical analyses when little preliminary data exists. Field investigators routinely use observations, container labels/markings, physical characteristics, air monitoring equipment, pH meters/paper, and field flash point analyzers to confirm preliminary data or to decide on sampling locations during waste investigations. Figure 5-1 (RCRA Waste Characterization) is a flow diagram that depicts the process that field investigators may use to decide which waste containers to sample and what analyses to perform on particular samples when attempting to make RCRA Characteristic Waste determinations.

FIGURE 5-1
RCRA WASTE CHARACTERIZATION FLOW CHART

HAZARDOUS WASTE CHARACTERIZATION

DEFINITIONS

Solid Waste: Solid, liquid, or contained gaseous material that is discarded by being disposed of, burned or incinerated, or recycled.

Hazardous Waste: Solid waste that has hazardous waste characteristics or is a listed hazardous waste, and is not otherwise excluded from regulation.

APPLICABLE STANDARDS

Federal: Resource Conservation and Recovery Act (RCRA) regulations 40 CFR 261 and 262.11.

State: Most states have adopted RCRA waste characterization regulations similar to the Federal rules. However, characterization of non-hazardous solid waste varies from state to state. Some states define certain additional waste as special wastes.

CHARACTERIZATION PROCESS

RCRA solid waste is defined in detail in 40 CFR 261.2. Certain recycled and reused materials are exempt from regulation as solid waste. The RCRA regulations at 40 CFR 262.11 require all parks that generate solid waste to determine whether or not the waste is a hazardous waste (HW). Figure 2 - Definition of a Hazardous Waste (40 CFR 260 Appendix 1) is a convenient flow chart of the procedure. The methodology is outlined as follows:

1. Determine if the waste is excluded from hazardous waste regulation by reviewing 40 CFR 261.4.
2. Determine if the waste is a "listed" hazardous waste by reviewing the lists found in 40 CFR 261, Subpart D. Listed hazardous wastes include the following:

- Wastes from non-specific sources (F-coded HW).
- Wastes from specific sources (K-coded HW).
- Discarded commercial chemical products, off-specification materials, container residues, or spill residues (U- and P-coded HW).
- Mixtures of solid waste and listed hazardous waste are classified as listed HW, regardless of the relative quantities

3. Determine if the waste is a "characteristic" hazardous waste by reviewing 40 CFR 261, Subpart C .Hazardous waste characteristics and codes include:

- Ignitability - flashpoint < 140 ° F (D001).
- Corrosivity - pH < 2 or > 12 (D002).
- Reactivity - unstable under normal conditions (D003).
- Toxicity Characteristic (TC) - leaches toxic chemicals in excess of regulatory levels (D004 through D043). This is evaluated by performing the toxicity Characteristic Leaching Procedure (TCLP) test.

Determination of whether a waste is hazardous by characteristics can be made by:

- Testing the waste in accordance with the methods outlined in Subpart C, or
- Applying knowledge of the waste characteristics (e.g., material safety data sheet [MSDS] information for the products that generated the waste).

RECORDKEEPING

All waste characterization documentation, such as laboratory tests and waste analyses, must be kept on file at the park for a minimum of three years (40 CFR 262.40). It is recommended that, for potential liability issues related to RCRA compliance and offsite disposal, that these records be maintained indefinitely.

UNKNOWN WASTES

A commonly encountered problem is the characterization of "unknown" waste materials. The first step in characterizing is to determine, if possible, the activity that generated the waste. In addition, any information on the characteristics of the raw materials used in the activity should be gathered. If these steps do not result in a clear characterization of the waste, then laboratory analysis of the material should be performed.

A sampling and analysis protocol must be developed, based upon what is known about the material. The cost of this task can be minimized by performing less expensive screening tests prior to conducting more comprehensive and costly analyses. Waste disposal companies with experience in characterization can often assist in this process. However, whenever a waste disposal firm is used, it should be remembered that the generator always has the ultimate responsibility for proper characterization.

TYPICAL SOLID WASTE CHARACTERIZATION

The following list includes examples of typical characterizations of materials that are defined as solid waste:

- Used oil - If managed under federal or most state used oil management rules it is not a hazardous waste, unless it is mixed with certain types of listed hazardous waste or meets the definition of a characteristic HW [40 CFR 261.6(a)(4)].
- Batteries - Generally non-hazardous waste if managed through a recycling program.
- Solvent - Waste solvent is typically a HW for ignitability (D001) and/or is listed based upon its composition (F001 through F005).
- Solvent-based paint - Similar to solvent dependent upon the chemical composition.
- Lead paint - Dry, lead-based paint chips can be high in total lead content. A TCLP analysis should be performed to evaluate TC potential.
- Antifreeze - Typically managed as a nonhazardous waste; often managed with a park's waste oil stream.
- Asbestos - Typically managed as a special waste. Other rules outlining special handling requirements apply.
- Tires - A non-hazardous waste; however, in most states banned from land disposal and must be recycled.
- Fuel - Waste fuel is typically a hazardous waste due to ignitability.

HAZARDOUS WASTE CHARACTERIZATION CHECKLIST	
Checklist Item	**Notes**
1. Confirm that evaluations have been made to determine if wastes generated at the park are RCRA solid waste as defined by 40 CFR 262.2. (Note: Certain recycled or reused materials are exempt from RCRA regulation.)	
2. If a waste has been defined as RCRA solid waste, verify that evaluations have been made to determine whether the waste is exempt from RCRA hazardous waste regulation by 40 CFR 262.4.	
4. If a waste is not a listed hazardous waste, confirm that a determination has been made as to whether the waste is a characteristically hazardous waste under 40 CFR 262, Subpart C. This is done by knowledge of the process and material characteristics or by performing specific tests as outlined in the regulations.	
5. Ensure that waste characterization documents are complied and maintained in facility hazardous waste management files.	

5.9 Wastewater Sampling Designs

Introduction

Wastewater sampling studies focus primarily on collecting wastewater samples of the influent and/or effluent at domestic and non-domestic facilities. Sampling activities are usually conducted for National Pollutant Discharge Elimination System (NPDES) compliance, Clean Water Act compliance (for pretreatment and biosolids), compliance assistance, civil and criminal investigations, and water quality studies. The collection of wastewater samples is necessary in order to obtain reliable data that can support compliance or enforcement activities. Specific sampling criteria for the collection of wastewater samples is given in Section 9 of this SOP.

The main considerations in developing a wastewater sampling strategy are:

- Type of study (Compliance Sampling Inspection(CSI), Diagnostic Evaluation (DE), etc.).
- Temporal variability of the wastestream.
- Regulated or target pollutants in the wastewater stream to be sampled.
- Laboratory method detection level and reporting level.
- Selection of the projected sampling locations to satisfy the study objectives.
- Quality control criteria of the parameters to be sampled (oil and grease samples need to be collected as grab samples, trip blanks are taken into the field for the collection of samples for volatile organic compound analyses, etc.).

The complexity of the sampling program will vary with a number of factors. Some primary factors are:

- The number of sampling stations to be monitored. This will be dependent on NPDES permit requirements and the type of study (typically Toxic CSIs and DEs require a greater amount of sampling stations than a routine CSI).
- Process and operation criteria of the source generator (e.g., batch operation vs. continuous discharge).
- Accessibility to sampling stations.
- Special handling requirements of the target pollutants (sampling equipment for trace organic compounds require special cleaning procedures, etc.).
- Laboratory analyzing samples (may require shipping samples from the field, etc.).
- Coordination of participating organizations in the study (e.g., State assistance with the sample collection).
- The length of time for sampling activities will dictate logistical considerations (e.g., shipment of samples, additional supplies, etc.).

5.10 Quality System Policy and Planning

5.10.1 Introduction

In order to ensure that environmental programs and decisions are supported by data of the type and quality needed and expected for their intended use, EPA has established an Agency-wide Quality System. EPA Order 5360.1 CHG 2, *Policy and Program Requirements for the Mandatory Agency- Wide Quality System*, provides requirements for conducting quality management practices, including quality assurance (QA) and quality control (QC) activities for environmental data collection and environmental technology programs performed by or for EPA.

5.10.2 Routine Inspections

For routine sampling activities, such as inspections, adherence to the procedures and techniques contained in this SOP will generally satisfy QA/QC requirements. However, in the process of planning an inspection, the team leader will need to pay particular attention to the following:

- In preparing equipment lists, ensure that materials and cleaning procedures are consistent with the requirements for the particular parameters being analyzed.
- Plan for the collection of blanks, and other quality control samples recommended in Section 5.11 of this SOP.
- Discuss analytical reporting limits with the laboratory to ensure that they are compatible with permit limitations, action levels, and/or standards.
- Make logistical arrangements to ensure that samples arrive at the laboratory in time to ensure that holding times are not exceeded.

5.10.3 Quality Assurance Project Plans (QAPP)

For non-routine sampling activities, the project leader will need to prepare a Quality Assurance Project Plan (QAPP). The QAPP must be finalized and approved by the Quality Assurance Project Officer before any environmental samples are collected, and before any environmental measurements are made.

The elements of a QAPP are as follows:

1. **Cover Page** - The cover page should include the name of the project, the name of the preparer, and all approval signatures.
2. **Table of Contents** - A table of contents is recommended if the document is more than ten pages in length.
3. **Distribution List** - This includes the name of each individual who will receive a copy of the QAPP, after approval. This simplifies the distribution of later revisions, if required.

4 **Project Description/Background** - State the problem to be addressed or the decision to be made. Include background information indicating the need for the study. Indicated the intended use of the data by describing the decisions to be made along with action levels or standards, if any, that will be used. This section will ultimately represent the justification for all that follows later in the QAPP. Identify the expected users of the environmental data, and indicate how project success will be determined.

5 **Project Technical Design** - Describe and justify the sampling strategy. State what parameters will be measured, and how often. Identify which measurements are essential to the project, and which are secondary. Indicate the number of anticipated sampling points and how they will be selected. Include a map showing the site(s) and each sampling point. Discuss how locational information will be obtained, such as use of a Global Positioning System. Identify potential sources of spatial and temporal variability and how the monitoring design will account for them. State what quality control (QC) activities will occur during the project (e.g. field blanks, duplicates, QC samples, etc.).

6 **Project Organization and Task Responsibilities** - Include a list of all key individuals in charge of every major activity, and their respective responsibilities.

7 **Special Training Requirements** - Identify any special training and certification requirements needed by project personnel for field or laboratory activities. Indicate how this information will be documented and assured.

8 **Project Schedule** - Delineate the project schedule from initiation to final report submission, including all intermediate major events and actions.

9 **Field Sampling Table** - This section is intended to ensure that the sampler will collect sufficient sample volumes in a manner that meets the laboratory's needs. It also assists the laboratory in planning for the analysis of samples from the project. This information is most easily presented in tabular form and should include the following headings, at a minimum: sample matrix, analyte(s), number of samples, sample volume (headings for both QC volumes and standard volumes), sample container, sample preservation, and holding time. The number of samples should include blanks, duplicates, etc. The table should also indicate any special handling requirements that might be necessary.

10 **Field Sampling Requirements** - All sampling methods must be fully described. Where methods are already described in SOPs, reference can be made to the specific SOP (or section of a large SOP) which details the methodology to be used. Describe any deviations from these standard protocols. List all sampling equipment needed. Describe techniques or guidelines to be followed in selecting sampling points and equipment. Identify the nature of the samples, such as grab or composite. If samples will be homogenized, indicate the procedure which will be used. Describe cleaning procedures for field equipment and precautions which will be taken to prevent cross contamination. Discuss procedures for collecting field measurements (i.e. temperature, flow, pH, etc.).

11 **Sample Handling and Custody Requirements** - Describe the logistics of sample handling and the chain-of-custody procedures which will be followed in the field, the laboratory, and during transportation. Include copies of any forms which will

be used, including labels and custody forms. Identify sources of sample containers and any special cleaning procedures for the containers. State requirements for sample archiving and disposal.

12 **Analytical Method Requirements** - The analytical methods to be used must be referenced for each analyte. Indicate any selected options and any deviations from the written methodology. Discuss procedures for and/or results of validation of the modified method. Identify all required QC checks, such as reagent blanks, lab duplicates, and matrix spikes, their required frequency, and actions to be taken if control limits are exceeded.

Discuss calibration procedures and checks for field instruments.

The methods and instruments to be used must be capable of measuring each analyte at the desired detection level, and the methods must be approved for the intended sample matrices. Different methods have different levels of accuracy and certain methodologies may be required by program regulations. Provide a table which includes the following: analyte, sample matrix, analytical method reference, method detection limit, estimated accuracy, estimated precision, and required action level or standard. The analytical laboratory can assist in providing much of this information.

13 **Secondary Data (Non-direct Measurement Projects)** - For projects in which environmental data will be obtained from computer data bases or literature searches, define the types of data needed, as well as the acceptance criteria for this information. Fully discuss limitations on the use of the data. Determine how data will be qualified and how deficiencies will be resolved.

14 **Other Data Quality Indicators** - It is essential to describe the Data Quality Objectives of the project, expressing what the results of the project will be used for and the data quality necessary to support that use. Data Quality Objectives should be developed jointly by the sampling team leader and the project managers. The process should combine the manager’s need for confidence in decision-making with the practical difficulties and expense of collecting “better data.” The QAPP must specify quantitative and qualitative data quality indicators such as precision, accuracy, representativeness, completeness, comparability, and sensitivity (method detection limits). The quantitative aspects of precision, accuracy, and sensitivity have been covered in previous sections. In this section, the qualitative data indicators (representativeness, comparability, and completeness) are discussed.

Representativeness: Representativeness is the extent to which measurements represent the true system. State the goals for representativeness and how they will be achieved. Describe how the collected data will accurately represent the population or environmental parameter being measured. Discuss how the sampling design will account for spatial, temporal, and other parameter variability.

Comparability: Comparability is defined as the extent to which data from one study can be compared directly to similar studies. State the goals for achieving data comparability and how they will be attained. Describe what confidence is required in comparing results with those of other studies.

Completeness: Completeness is the fraction of the planned data that must be collected in order to fulfill the statistical criteria for the intended use of the data. State the level of completeness required, and the consequences if this level is not attained. Indicate whether sufficient resources have been allocated to ensure completion of the project.

15 **Peer Review** - Indicate whether the project will be subject to a formal peer review process.

16 **Instrument, Equipment, and Supplies Testing and Maintenance Requirements** - For all field, laboratory, and data management equipment and supplies, describe the inspection and acceptance criteria for use. Indicate the requirements for calibration checks and maintenance, and the frequency for each.

17 **Assessments/Oversight** - Assessments include reviews and audits, designed to ensure that the QAPP is being followed throughout the project. Assessments will identify any shortcomings or deviations, and lead to the initiation of corrective actions.

List the inspections, audits, or reviews of management, field, laboratory, and data activities that will occur throughout the project. Identify who will perform these reviews, and the frequency of the proposed assessments. Discuss how the results of the assessments will be reported. Identify the procedures for responding to the assessments, implementing corrective actions, and documenting the results.

18 **Data Review, Validation, and Usability** - State the criteria which will be used to review, accept, reject, or qualify data. Specify what modeling or statistical evaluations will be performed and how they will be validated. Refer to laboratory SOPs, which discuss the steps required to obtain final results from raw data. Describe how errors, if detected, will be corrected. Describe how blanks, duplicates, spikes, etc. will be used in calculations and data review. Discuss how results obtained from the project will be reconciled with the user’s data quality objectives. Indicate how any limitation on the data will be reported to data users.

19 **Documentation and Records** - Discuss who will prepare the final project report and any interim reports that may be required. Summarize what will be included in the reports. Indicate where all raw data (i.e. field notes, laboratory data, forms, records) will be recorded and stored. Indicate how this information may be retrieved in the future, and how long the information must be retained.

5.11 Specific Sample Collection Quality Control Procedures

5.11.1 Introduction

This subsection provides guidelines for establishing quality control procedures for sampling activities. Strict adherence to all of the standard operating procedures outlined in this subsection form the basis for an acceptable sampling quality assurance program.

5.11.2 Experience Requirements

There is no substitute for field experience. Therefore, all professional and paraprofessional investigators shall have the Section Chiefs’ clearance before they are permitted to lead sampling surveys. Field experience shall be gained by on-the-job training using the "buddy" system. Each new investigator should accompany experienced employees on as many different types of field studies as possible. During this training period, the new employee will receive hands-on experience in all facets of field investigations, including sampling, under the direction and supervision of senior investigators.

5.11.3 Traceability Requirements

All sample collection activities shall be traceable through field records to the person(s) collecting the sample and to the sampling equipment (where appropriate) used to collect that sample. All calibration records for sampling equipment (where appropriate) shall be kept so that they are similarly traceable. See Sections 3.1 through 3.6 for specific procedures to be utilized that insure traceability.

5.11.4 Chain-of-Custody

Specific chain-of-custody procedures are included in Sections 3.1 through 3.6 of this SOP. These procedures will insure that data collected during an investigation will withstand scrutiny during litigation. To assure that procedures are being followed, it is recommended that field investigators or their designees self-audit chain-of-custody entries, field notes, and any other recorded information for accuracy.

5.11.5 Sampling Equipment Construction Material

Sampling equipment construction materials can affect sample analytical results. Materials used must not contaminate the sample being collected and must be used once and disposed, or easily decontaminated, so that samples are not cross contaminated.

5.11.6 Sample Preservation

Samples for some analyses must be preserved in order to maintain their integrity. It must be noted that the required preservative(s) will vary based upon the specific requirements of the regulated program that the sample are collected under. For example, preservatives required for routine analyses of samples collected under the NPDES program are given in 40 CFR Part 136 - Table II. All samples requiring preservation should be preserved immediately (i.e., within 15 minutes) of sample collection in the field. Samples that **should not** be preserved in the field are:

- Those collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials which may be highly reactive. Barrel, drum, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical. These samples may be preserved by placing the sample container on ice, if necessary.

- Those samples that have extremely low or high pH, or samples that may generate potentially dangerous gases if they were preserved using the procedures given in 40 CFR Part 136.

- Those samples for ultra low level metals analyses, which are best preserved in a laboratory clean room in order to minimize the possibility of contamination.

All samples preserved with chemicals shall be clearly identified by indication on the sample label that the sample is preserved. If samples normally requiring preservation were not preserved, field records should clearly specify the reason.

5.11.7 Special Precautions for Trace Pollutant Sampling

Some pollutants can be detected in the parts per billion and/or parts per trillion range. Extreme care must be taken to prevent cross-contamination of these samples. The following precautions shall be taken when trace pollutants are of concern:

- A clean pair of new, non-powdered, disposable latex gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come into contact with the media being sampled.

- Sample containers for source samples or samples suspected of containing high concentrations of pollutants shall be placed in separate plastic bags immediately after collecting, labeling, etc.

- If possible, ambient samples and source samples should be collected by different field teams. If different field teams cannot be used, all ambient samples shall be collected first and placed in separate ice chests or shipping containers. Samples of waste, or highly contaminated samples, shall never be placed in the same ice chest as environmental samples. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of pollutants shall be lined with new, clean, plastic bags.

- If possible, one member of the field sampling team should take all the notes, fill out labels, etc., while the other members collect the samples.

- When sampling surface waters, the water sample should always be collected before the sediment sample is collected. This is to ensure that the water sample is not biased by fine solids introduced into the water column by the sediment collection procedure.

- Sample collection activities should proceed progressively from the least suspected contaminated area to the most suspected contaminated area.

- Investigators should use equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned (Appendix B) for collection of samples for trace metals or organic compounds analyses. Teflon® or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC shall not be used to collect samples for trace organic compounds analyses.

5.11.8 Sample Handling and Mixing

After collection, all sample handling should be minimized. Investigators should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, investigators should ensure that melted ice cannot cause the sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as whirl pack bags or similar plastic bags sealed with tape, should be used when small sample containers (e.g., VOC vials) are placed in ice chests to prevent breakage and cross-contamination. Sample containers for trace pollutant analyses should be placed in zip lock bags in order to prevent cross-contamination.

Wherever possible, samples should be collected directly into their respective containers for analyses. In the case of samples collected by automatic composite sampler, the sampler collection jug should be capped and shaken to ensure that the sample is well mixed before pouring into individual sample containers. In some cases, the physical configuration of the sampling location may make it impossible to safely collect samples for volatile organic compound analysis directly in the 40 ml vials. In this situation, it is permissible to use pre cleaned amber glass jars with a rod and clamp as the initial sample collection device, and then immediately transfer the samples to the 40 ml vials. Grab samples for parameters which are compatible with plastic containers, may be collected with a plastic bucket and rope. The only exceptions to this technique are bacteria samples which must be collected with sterilized equipment.

It is extremely important that soil and sediment samples, **with the exception of VOC samples,** be mixed thoroughly to ensure that the sample is as representative as possible of the sample media. The common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:

1. The material in the sample pan should be divided into quarters and each quarter should be mixed individually.

2. Two quarters should then be mixed to form halves.

3. The two halves should be mixed to form a homogenous matrix .

This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

5.11.9 Special Handling of Samples for Volatile Organic Compounds (VOCs) Analysis

Water samples to be analyzed for volatile organic compounds should be stored in new 40-ml septum vials with screw cap and Teflon®-silicone disk in the cap to prevent contamination of the sample by the cap. Preservative should be in the vial prior to collection of the sample. The vials should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a convex meniscus. The cap is then applied and some overflow is lost, but the air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles. If any bubbles are present, turn the vial right side up and tap the side so that the bubble rise to the top. Then remove the cap, add a few more drops of sample, seal, and recheck. Since the VOC vials are pre-preserved, caution should be exercised when the vials are used as the collection device for surface water samples in order to prevent the loss of the preservative.

Soil and sediment samples for VOC analyses should be collected and handled as specified in section 14.4. Soil and sediment samples collected for VOC analyses should not be mixed.

5.11.10 Estimating Variability

Field Duplicates

For ambient surveys and other non routine sampling, five (5) percent of the samples should be field duplicates. Essentially, twice as much material is collected as normally would be required for a single sample. The material is taken into two sets of sample containers, and each of the two sets is given a unique sample identification. The project leader will record in the field records which pairs of samples are field duplicates. The data from field duplicates can be used to estimate the variability of the matrix being sampled. Some matrices, such as water can be expected to be relatively homogeneous at a specific time and sampling location. More variability is generally observed with soil and sediment matrices. Secondly, field duplicates will also reflect any variability introduced by small inconsistencies in sampling technique. Data from field duplicates should be discussed with the Quality Assurance Officer in order to estimate variability.

Blank Samples

Blanks are essentially analyte free water which is subjected to some of the same conditions as experienced by actual samples. Blanks may be used to demonstrate the thoroughness of cleaning techniques used for sampling equipment. Blanks are also used to determine whether samples have been subjected to additional contamination due to handling between the time of collection and the time of analysis. The following blank samples are commonly required:

- Water Sample VOC Blank - A water sample VOC blank sample is required for every study where water samples are collected for VOC analysis. Sealed and preserved 40-ml VOC vials shall be filled in the field with deionized organic free water. The field blank water can be carried into the field in a pre-cleaned amber glass jar, and it should not be more than one day before the scheduled inspection/investigation. These field blanks will be handled and treated in the same manner as the water samples collected for volatile organic compounds analysis on that particular study. These samples will be clearly identified on sample labels/tags and Chain-Of-Custody/Field Data Forms. In the event that laboratory organic free water is not reasonably available, commercially obtained bottled spring water may be substituted.

- Equipment Field Blanks - When cleaned reusable equipment is required during a sampling investigation, a set of cleaned equipment (i.e. all pieces used for a single sample) will be selected for collection of a rinsate blank. At least one rinsate blank will be collected during each sampling operation. After the piece of equipment has been field cleaned and prior to its being used for sample operations, it will be rinsed with organic/analyte free water. Some of the final rinse water will be collected and submitted for analyses of all constituents for which normal samples collected with that piece of equipment are being analyzed.

- Automatic Sampler Blanks - In general, cleaning procedures outlined in Appendix B of this SOP should be adequate to insure sample integrity. However, it is the standard practice of the Section to submit automatic sampler blanks for analyses when automatic samplers are used to collect samples for organic compounds and/or trace level metals analyses. Automatic sampler blanks for other standard analyses may be submitted in the event of special circumstances. The procedure will be to transport the sample collection jug to the field, filled with analyte free deionized water. When the automatic composite sampler is assembled with all tubing in place the intake line for the sampler will be placed in the sample collection jug. The analyte free water will be pumped through the tubing and the automatic composite sampler into appropriate sample containers. These samples will be labeled as equipment blanks. After purging the tubing of analyte free water and emptying the sample collection jug, the automatic composite sampler is set up to begin collecting actual samples.

Data from blank(s) analyses should be reported with all other data. In the event that an analyte is detected in a blank and also in a sample associated with that blank, the sample data may be reported if the concentration in the sample is more than five times the concentration detected in the blank. If the sample concentration is less than five times the concentration detected in the blank, the sample data must be rejected. In this case, consideration should be given to resampling, if practicable. It is regional policy that environmental data are never blank corrected. In other words, it is not proper to subtract blank values from sample values in an attempt to correct for blank contamination.

5.11.11 Sample Volumes for Laboratory Quality Control Procedures

The table of required sample volumes for analysis generally indicates that the first sample (QA/QC sample) for any study should have a larger volume than successive samples from the same study or site. The most recent table of required sample volumes was prepared by the Edison Laboratory Branch on March 2003, and is found in Appendix A. The initial volume is intended to allow the laboratory sufficient volume to run QA/QC procedures such as laboratory duplicates, matrix spikes, etc. The larger QA/QC volumes are required at least once per study, and should be repeated every 20 samples, for very large surveys. In selecting locations to collect QA/QC volumes, avoid locations which are expected to be relatively free of contamination, and those locations expected to be severely contaminated.

5.12 Investigation Derived Waste (IDW)

5.12.1 Types of IDW

Materials which may become IDW are:

- Personnel protective equipment (PPE) - This includes disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.

- Disposable equipment - This includes plastic ground and equipment covers, aluminum foil, conduit pipe, composite liquid waste samplers (COLIWASAs), Teflon® tubing, broken or unused sample containers, sample container boxes, tape, etc.

- Soil cuttings from drilling or hand auguring.

- Ground water obtained through well development or well purging.

- Cleaning fluids such as spent solvents and washwater.

- Packing and shipping materials.

5.12.2 Management of Non-Hazardous IDW

Disposal of non-hazardous IDW from survey sites should be addressed as part of the survey planning process. If the waste is from an active facility, permission should be sought from the operator of the facility to place the non-hazardous PPE, disposable equipment, and/or paper/cardboard wastes into the facility's dumpsters. Wastes may only be disposed on-site with the permission of the owner. In the absence of permission, wastes should be removed from the site and disposed of properly. Disposal of non-hazardous IDW such as purge water, decontamination wash water, should be specified in the approved study plan. It is recommended that these materials be placed into a unit with an environmental permit such as a wastewater treatment plant. These materials must not be placed into dumpsters. If the facility at which the study is being conducted is active, permission should be sought to place these types of IDW into the facility's treatment system. Monitoring well purge or development water from shallow wells may also be poured onto the ground down gradient of the monitoring well. Purge water from deep monitoring wells should be collected and discharged to a wastewater treatment system. Purge water from private potable wells which are in service may be discharged directly onto the ground surface.

5.12.3 Management of Hazardous IDW

Disposal of hazardous or suspected hazardous IDW must be specified in the approved study plan. Hazardous IDW must be disposed as specified in US-EPA regulations. If appropriate, these wastes may be placed back in an active facility waste treatment system. These wastes may also be disposed of in the source area from which they originated, if doing so does not endanger human health and the environment. If on-site disposal is not feasible, and if the wastes are suspected to be hazardous, appropriate tests must be conducted to make that determination. If they are determined to be hazardous wastes, they must be properly contained and labeled. They may be stored on the site for a maximum of 90 days before they must be manifested and shipped to a permitted treatment or disposal facility. Generation of hazardous IDW must be anticipated, if possible, to permit arrangements for proper containerization, labeling, transportation, and disposal/treatment in accordance with US-EPA regulations.

Spent solvents must be returned to the Edison Laboratory for proper disposal or recycling. All hazardous IDW must be containerized. Proper handling and disposal should be arranged prior to commencement of field activities.

5.13 References

1. US EPA Region 2 - Guidance for the Development of Quality Assurance Project Plans for Environmental Monitoring Projects, April 12, 2004. Available as a PDF file at: http://www.epa.gov/region02/qa/air_h20_qapp04.pdf

2. EPA Requirements for Quality Assurance Project Plans, EPA QA/R5,, March 2001. Publication number EPA/240/B-01/003. Available as a PDF file at: http://www.epa.gov/quality/qs-docs/r5-final.pdf

3. EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, EPA/240/R-02-009.

4. Guidance for Systematic PlanningUsing the Data Quality Objectives Process - EPA QA/G-4, February 2006. Publication number EPA/240/B-06/001. Available as a PDF file at:
http://www.epa.gov/quality/qs-docs/g4-final.pdf

5. Data Quality Objectives Process for Hazardous Waste Site Investigations- EPA QA/G-4HW, January 2000. Publication number EPA/600/R-00/007. Available as a PDF file at: http://www.epa.gov/quality/qs-docs/g4hw-final.pdf

SECTION 6
GROUND WATER SAMPLING

PERFORMANCE OBJECTIVES:

- To collect a sample representative of ground water residing in the formation of interest.
- To reduce the potential bias caused by the sampling equipment used to obtain the sample.

In the late 1990's, EPA Region 2 approved a ground water sampling procedure using low stress purging and sampling techniques. This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting groundwater samples from monitoring wells. This technique is used almost exclusively for Superfund work. Requests for the Monitoring and Assessment Branch to perform ground water sampling (under RCRA) has been a rare occurrence, and this is expected to continue. However, there may be some instances that MAB will be requested to sample ground water monitoring wells. In these instances, the low flow techniques specified in the Ground Water Sampling Procedure Using Low Stress Purging and Sampling Techniques (attached) will be followed. However, there will be some cases where low flow equipment and/or pumps cannot be used. In these cases the following procedures will be followed.

6.1 Introduction

Ground water sampling may be required for a variety of reasons, such as examining potable or industrial water supplies, checking for and/or tracking pollutant plume movement in the vicinity of a land disposal or spill site, Resource Conservation Recovery Act (RCRA) compliance monitoring, or examining a site where historical information is minimal or non-existent but where it is thought that ground water contamination may have occurred. Ground water samples are usually obtained from either temporarily, or permanently, installed ground water monitoring wells. They can also be obtained anywhere ground water is present, such as in a pit, or a dug hole, or drilled hole.

Occasionally, the ground water source may not be in the ideal location to meet a particular objective (e.g., to track a pollutant plume). In that case, either a temporary, or permanent, monitoring well should be installed. An experienced and knowledgeable person will need to locate the well and supervise its installation so that samples will be representative of the ground water. Additional guidance is given in RCRA Ground-Water Monitoring: Technical Guidance and Chapter 11 of SW-846. The ground water sampling procedures described in this SOP will meet or exceed the requirements of these documents.

Ground water sampling procedures can be sub-divided into two areas, purging and sampling, each of which has different goals and objectives. Within the topic of purging, it is necessary, because of the inherently different characteristics of the two types of wells, to address permanent and temporary wells separately. The procedures and techniques which follow in this section reflect these differences.

6.2 Purging

6.2.1 Purging and Purge Adequacy

Purging is the process of removing stagnant water from a monitoring well, immediately prior to sampling, causing its replacement by ground water from the adjacent formation, which is representative of actual aquifer conditions. In order to determine when a well has been adequately purged, field investigators should: 1) monitor the pH, specific conductance, temperature, and turbidity of the ground water removed during purging; and 2) observe and record the volume of water removed.

Prior to initiating the purge, the amount of water standing in the water column (water inside the well riser and screen) should be determined. To do this, the diameter of the well should be determined and the water level and total depth of the well are measured and recorded. Specific methodology for obtaining these measurements is found in Section 16.3 of this SOP. Once this information is obtained, the volume of water to be purged can be determined using one of several methods. One is the equation:

$$V = 0.041 \times (d \times d)\, h$$

Where:
h = depth of water in feet
d = diameter of well in inches
V = volume of water in gallons

Alternatively, the volume may be determined using a casing volume per foot factor for the appropriate diameter well, similar to that in Table 6.1. The water level is subtracted from the total depth, providing the length of the water column. This length is multiplied by the factor in the Table 6.1 which corresponds to the appropriate well diameter, providing the amount of water, in gallons, contained in the well. Other acceptable methods include the use of nomographs, or other equations or formulae.

With respect to volume, an adequate purge is normally achieved when three to five times the volume of standing water in the well has been removed. The field notes should reflect the single well volume calculations, or determinations, according to one of the above methods, and a reference to the appropriate multiplication of that volume, i.e., a minimum three well volumes, clearly identified as a purge volume goal.

With respect to the ground water chemistry, an adequate purge is achieved when the pH, specific conductance, and temperature of the ground water have stabilized and the turbidity has either stabilized, or is below 10 Nephelometric Turbidity Units (NTUs) (twice the Primary Drinking Water Standard of 5 NTUs). Although 10 NTUs is normally considered the minimum goal for most ground water sampling objectives, one (1) NTU has been shown to be easily achievable and reasonable attempts should be made to reach this level. Stabilization occurs when pH measurements remain constant within 0.1 Standard Unit (SU), specific conductance varies no more that 10 percent, and the temperature is constant for at least three consecutive readings. There are no criteria establishing how many sets of measurements are adequate for the determination of stability. If the calculated purge volume is small, the measurements should be taken frequently to provide a sufficient number of measurements to evaluate stability. If the purge volume is large, measurements taken every 15 minutes may be sufficient

If, after three well volumes have been removed, the chemical parameters have not stabilized according to the above criteria, additional well volumes (up to five well volumes), should be removed. If the parameters have not stabilized within five volumes, it is at the discretion of the project leader whether or not to collect a sample or to continue purging. If after five well volumes, pH and conductivity have been stabilized and the turbidity is still decreasing and approaching an acceptable level, additional purging should be considered to obtain the best sample possible. The conditions of sampling should be noted in the field log.

TABLE 6.1
WELL CASING DIAMETER vs. VOLUME

WELL CASING DIAMETER(INCHES) vs. VOLUME (GALS.)/FEET of WATER

CASING SIZE (in INCHES)	GALLONS/FT of WATER
1	0.041
2	0.163
3	0.367
4	0.653
5	1.020
6	1.469
7	1.999
8	2.611
9	3.305
10	4.080
11	4.934
12	5.875

In some situations, even with slow purge rates, a well may be pumped or bailed dry (evacuated). In these situations, this generally constitutes an adequate purge, and the well can be sampled following sufficient recovery (enough volume to allow filling of all sample containers). It is not necessary that the well be evacuated three times before it is sampled. The pH, specific conductance, temperature, and turbidity should be measured, during collection of the sample from the recovered volume, as the measurements of record for the sampling event.

Attempts should be made to avoid purging wells to dryness. This can be accomplished, for example, by slowing the purge rate. If a well is pumped dry, it may result in the sample being comprised partially of water contained in the sand pack, which may be reflective, at least in part, of initial stagnant conditions. In addition, as water re-enters a well that is in an evacuated condition, it may cascade down the sand pack or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the water column. It is particularly important that wells be sampled as soon as possible after purging. If adequate volume is available, the well must be sampled immediately. If not, sampling should occur as soon as adequate volume has recovered.

Equipment Available

Monitoring well purging is accomplished by using in-place plumbing and dedicated pumps or, by using portable pumps/equipment when dedicated systems are not present. The equipment may consist of a variety of pumps, including peristaltic, large and small diameter turbine (electric submersible), bladder, centrifugal, gear-driven positive displacement, or other appropriate pumps. The use of any of these pumps is usually a function of the depth of the well being sampled and the amount of water that is to be removed during purging. Whenever the head difference between the sampling location and the water level is less than the limit of suction and the volume to be removed is reasonably small, a peristaltic pump should be used for purging. Appendix E of this SOP contains the operating instructions for all pumps commonly used during Section conducted ground water investigations.

Bailers may also be used for purging in appropriate situations, however, their use is discouraged. Bailers tend to disturb any sediment that may be present in the well, creating or increasing sample turbidity. If a bailer is used, it should be a bottom loading Teflon® bailer.

6.2.2 Purging Techniques (Wells Without Plumbing or In-Place Pumps)

For permanently installed wells, the depth of water and depth of the well should be determined (if possible) before purging. Electrical water level indicators/well sounders can be used for this purpose. It is standard practice to mark the top of casing, providing a point of reference from which these measurements will be consistently made. Field investigators should look for these markings when taking these measurements. Extreme caution should be exercised during this procedure to prevent cross-contamination of the wells. This is a critical concern when samples for trace organic compounds or metals analyses are collected. At a minimum, the well sounding device should be cleaned by washing in a laboratory detergent solution, followed by rinses with tap water and analyte-free water. After cleaning, it should be placed in a clean plastic bag or wrapped in foil.

Purging with Pumps

When peristaltic pumps or centrifugal pumps are used, only the intake line is placed into the water column. The line placed into the water should be either standard-cleaned (see Appendix B) Teflon® tubing, for peristaltic pumps, or standard-cleaned stainless steel pipe attached to a hose for centrifugal pumps.

When submersible pumps (bladder, turbine, displacement, etc.) are used, the pump itself is lowered into the water column. The pump must be cleaned as specified in Appendix B.

Purging with Bailers

Standard-cleaned (Appendix B) bottom loading Teflon® bailers with Teflon® leaders and new nylon rope are lowered into top of the water column, allowed to fill, and removed. It is critical that bailers be slowly and gently immersed into the top of the water column, particularly during final stages of purging, to minimize turbidity and disturbance of volatile organic constituents. The use of bailers for purging and sampling is discouraged because the correct technique is highly operator dependent.

Field Care of Purging Equipment

Regardless of which method is used for purging, new plastic sheeting should be placed on the ground surface around the well casing to prevent contamination of the pumps, hoses, ropes, etc., in the event they need to be placed on the ground during the purging or they accidentally come into contact with the ground surface. It is preferable that hoses used in purging that come into contact with the ground water be kept on a spool or contained in a plastic-lined tub, both during transporting and during field use, to further minimize contamination from the transporting vehicle or ground surface.

Purging Entire Water Column

The pump/hose assembly, or bailer, used in purging should be lowered into the top of the standing water column and not deep into the column. This is done so that the purging will "pull" water from the formation into the screened area of the well and up through the casing so that the entire static volume can be removed. If the pump is placed deep into the water column, the water above the pump may not be removed, and the subsequent samples, particularly if collected with a bailer, may not be representative of the ground water.

It is recommended that no more than three to five feet of hose be lowered into the water column. If the recovery rate of the well is faster than the pump rate and no observable draw down occurs, the pump should be raised until the intake is within one foot of the top of the water column for the duration of purging. If the pump rate exceeds the recovery rate of the well, the hose or pump will have to be lowered, as needed, to accommodate the draw down. After the hose or pump is removed from the well, all wetted portions of the hose and the pump should be cleaned as outlined in Appendix B of this SOP.

Careful consideration shall be given to using pumps to purge wells which are excessively contaminated with oily compounds, because it may be difficult to adequately decontaminate severely contaminated pumps under field conditions. When wells of this type are encountered, alternative purging methods, such as bailers, should be considered.

General Low Flow/Low Stress Method Preference

The device with the lowest pump, or water removal rate, and the least tendency to stress the well during purging should be selected for use. For example, if a bailer and a peristaltic pump both work in a given situation, the pump should be selected because it will greatly minimize turbidity, providing a higher quality sample (Section 6.2.4 contains a description of low flow purging and sampling with a peristaltic pump used in a temporary well). If a Fultz® pump, or a Grundfos Redi-Flo2®, could both be used, the Redi-Flo2® may be given preference because the speed can be controlled to provide a lower pump rate, thereby minimizing turbidity.

Low Flow/Low Volume Purging Techniques/Procedures

Alternatives to the low flow purging procedures exist and may be acceptable. The low flow/low volume purging is a procedure used to minimize purge water volumes. The pump intake is placed within the screened interval at the zone of sampling, preferably, the zone with the highest flow rate. Low flow rate purging is conducted after hydraulic conditions within the well have re-stabilized, usually within 24 to 48 hours. Flow rates should not exceed the recharge rate of the aquifer. This is monitored by measuring the top of the water column with a water level recorder or similar device while pumping. These techniques, however, are only acceptable under certain hydraulic conditions and are not considered standard procedures.

6.2.3 Purging Techniques - Wells with In-Place Plumbing

Wells with in-place plumbing are commonly found at municipal water treatment plants, industrial water supplies, private residences, etc. Many permanent monitoring wells at active facilities are also equipped with dedicated, in-place pumps. The objective of purging wells with in-place pumps is the same as with monitoring wells without in-place pumps, i.e., to ultimately collect a sample representative of the ground water. Among the types of wells identified in this section, two different approaches are necessary. The permanent monitoring wells with in-place pumps should, in all respects, be treated like the monitoring well without pumps. They generally are sampled only occasionally and require purging as described for wells without in-place pumps, i.e., 3 to 5 well volumes and stable parameters.

In the case of the other types of wells, however, not enough is generally known about the construction aspects of the wells to apply the same criteria as used for monitoring wells, i.e., removing 3 to 5 well volumes. The volume to be purged in these situations, therefore, depends on several factors: whether the pumps are running continuously or intermittently, and whether or not any storage/pressure tanks are located between the sampling point and the pump. The following considerations and procedures should be followed when purging wells with in-place plumbing under the conditions described.

Continuously Running Pumps

If the pump runs more or less continuously, no purge (other than opening a valve and allowing it to flush for a few minutes) is necessary. If a storage tank is present, a spigot, valve or other sampling point should be located between the pump and the storage tank. If not, locate the valve closest to the tank. Measurements of pH, specific conductance, temperature, and turbidity are recorded at the time of sampling.

Intermittently Running Pumps

If the pump runs intermittently, it is necessary to determine, if possible, the volume to be purged, including storage/pressure tanks that are located prior to the sampling location. The pump should then be run continuously until the required volume has been purged. If construction characteristics are not known, best judgement should be used in establishing how long to run the pump prior to collecting the sample. Generally, under these conditions, 30 minutes will be adequate. Measurements of pH, specific conductance, temperature and turbidity should be made and recorded at intervals during the purge and the final measurements made at the time of sampling.

6.2.4 Purging Techniques - Temporary Monitoring Wells

Temporary ground water monitoring wells differ from permanent wells because temporary wells are installed in the ground water for immediate sample acquisition. Wells of this type may include standard well screen and riser placed in boreholes created by hand augering, power augering, or by drilling. They may also consist of a rigid rod and screen that is pushed, driven, or hammered into place to the desired sampling interval, such as the Direct Push Wellpoint®, the Geoprobe® and the Hydropunch®. As such, the efforts to remove several volumes of water to replace stagnant water do not necessarily apply in these situations, because generally, stagnant water is non-existent. It is important to note, however, that the longer a temporary well is in place and not sampled, the more appropriate it may be to apply, to the extent possible, standard permanent monitoring well purging criteria to it.

In cases where the temporary well is to be sampled immediately after installation, purging is conducted primarily to mitigate the impacts of installation. In most cases, temporary well installation procedures disturb the existing aquifer conditions, resulting primarily in increased turbidity. Therefore, the goal of purging is to reduce the turbidity and remove the volume of water in the area directly impacted by the installation procedure. Low turbidity samples in these types of wells are typically and routinely achieved by the use of low-flow purging and sampling techniques.

The following low-flow purging technique using peristaltic pumps has been used routinely to achieve acceptably low NTU values in a variety of temporary monitoring well applications.

In purging situations where the elevation of the top of the water column is no greater than approximately 25 feet below the pump head elevation, a peristaltic pump may be used to purge temporary wells. Enough tubing is deployed to reach the bottom of the temporary well screen. At the onset of purging, the tubing is slowly lowered to the bottom of the screen and is used to remove any formation material which may have entered the well screen during installation. This is critical to ensuring rapid achievement of low turbidity conditions. After the formation material is removed from the bottom of the screen, the tubing is slowly raised through the water column to near the top of the column. The tubing can be held at this level to determine if the pump is lowering the water level in the well. If not, secure the tubing at the surface to maintain this pumping level.

If the water column is lowered, and the pump is not variable speed, continue to lower the tubing as the water column is lowered. If a variable speed peristaltic pump is being used and draw down is observed on initiation of pumping, reduce the pump speed and attempt to match the draw down of the well. Sustained pumping at these slow rates will usually result in a relatively clear, low turbidity sample. If the draw down stabilizes, maintain that level, however, if it continues to lower, "chase" the water column until the well is evacuated. In this case, the recovered water column may be relatively free of turbidity and can be sampled. It may take several episodes of recovery to provide enough volume for a complete sample.

With many of the direct push sampling techniques, purging is not practical, or possible, therefore, no purging is conducted. The sampling device is simply pushed to the desired depth and opened and the sample is collected and retrieved.

6.2.5 Investigation Derived Waste

Purging generates quantities of purge water or investigation derived waste (IDW), the disposition of which must be considered. What is appropriate for the disposition of the water is, in part, dependent on the nature of the investigation. If the IDW is generated at a RCRA facility, it will generally be contained and disposed on site in an on-site treatment facility. IDW generated during Superfund or other investigations may, at the discretion of the field project leader or the program manager (remedial project manager), be discharged to the ground, away from the well, or be containerized for later disposal, or other appropriate action.

6.3 Sampling

Sampling is the process of obtaining, containerizing, and preserving the ground water sample after the purging process is complete. Non-dedicated pumps for sample collection generally should not be used. Many pumps are made of materials, such as brass, plastic, rubber, or other elastomer products which may cause chemical interferences with the sample. Their principle of operation may also render them unacceptable as a sample collection device. The pump may be turbine driven, which may release volatile organic constituents. It is recognized that there are situations, such as industrial or municipal supply wells or private residential wells, where a well may be equipped with a dedicated pump from which a sample would not normally be collected. Discretion should always be used in obtaining a sample.

6.3.1 Equipment Available

Because of the problems with most pumps described in the preceding paragraph, only three devices should be used to collect ground water samples from most wells. These are the peristaltic pump, a stainless steel and Teflon® bladder pump, and a bottom loading Teflon® bailer.

Other monitoring equipment used during sampling includes water level indicators, pH meters, thermometers, conductivity meters, and nephelometers (turbidity meters).

6.3.2 Sampling Techniques - Wells With In-Place Plumbing

Samples should be collected following purging from a valve or cold water tap as near to the well as possible, preferably prior to any storage/pressure tanks that might be present. Remove any hose that may be present before sample collection and reduce the flow to a low level to minimize sample disturbance, particularly with respect to volatile organic constituents. Samples should be collected directly into the appropriate containers (see Appendix A). It may be necessary to use a secondary container, such as a certified pre-cleaned 8 oz. sample jar, or a stainless steel scoop, to obtain and transfer samples from spigots with low ground clearance. Also, refer to the Potable Water Supply discussion in Section 2.2. All measurements for pH, specific conductance, temperature, and turbidity should be recorded at the time of measurement.

6.3.3 Sampling Techniques - Wells without Plumbing

Following purging, samples should be collected using a peristaltic pump, a Teflon®/stainless steel bladder pump, or a bottom loading Teflon® bailer. These techniques are described below.

Peristaltic pump

The peristaltic pump can be used for sample collection provided that a minimum length of pump tubing is used, and equipment blank samples are taken to verify if any contamination is caused by the sampling equipment. Use Teflon® tubing (¼-inch O.D.) to connect the pump tubing to the sample source, and an additional section of Teflon® tubing on the discharge side of the pump tubing. The pump creates a vacuum, and draws the sample into the sample container(s).

Samples for volatile organic compound analysis should be collected using a bailer, or by filling the Teflon® tube, by one of two methods, and allowing it to drain into the sample vials. The tubing can be momentarily attached to the pump to fill the tube with water. After the initial water is discharged through the pump head, the tubing is quickly removed from the pump and a gloved thumb placed on the tubing to stop the water from draining out. The tubing is then removed from the well and the water allowed to either gravity drain or be reversed, by the pump, into the sample vials. (Note: When reversing the pump, make sure the discharge tubing is not submerged in purge water. This will prevent introducing potentially cross contaminated purge water into the sample.) Alternatively, the tubing can be lowered into the well the desired depth and a gloved thumb placed over the end of the tubing. This method will capture the water contained in the tubing. It can then be removed from the well and the water collected by draining the contents of the tubing into the sample vials. Under no circumstances should the sample for volatile organic compound analysis be collected from the content of any other previously filled container. All equipment should be cleaned using the procedures described in Appendix B. Also, refer to the Potable Water Supply discussion, Section 2.2, for additional information. When sampling for metals only, it is also permissible to collect the sample directly from the pump discharge tubing after an adequate purge has been demonstrated. When collecting samples in this manner there are several considerations to be aware of. The pump head tubing (silastic, etc,) must be changed after each well and a rinsate blank must be collected of a representative piece of the pump head tubing (only one blank per investigation). Also, precautions must be taken to ensure that the end of the discharge tubing is not allowed to touch the ground or other surface to ensure the integrity of the sample collected in this manner.

Bladder Pumps

After purging has been accomplished with a bladder pump, the sample is obtained directly from the pump discharge. If the discharge rate of the pump, during purging, is too great, so as to make sample collection difficult, care should be taken to reduce the discharge rate at the onset of actual sample collection. This is necessary to minimize sample disturbance, particularly with respect to samples collected for the analysis of volatile organic compounds.

Bailers

When bailing, new plastic sheeting should be placed on the ground around each well to provide a clean working area. New nylon rope should be attached to the bailer via a Teflon® coated stainless steel wire. This coated wire is semi-permanently attached to the bailer and is decontaminated for reuse as the bailer is cleaned. The bailer should be gently immersed in the top of the water column until just filled. At this point, the bailer should be carefully removed and the contents emptied into the appropriate sample containers.

6.3.4 Sample Preservation

Immediately after collection, all samples requiring preservation must be preserved with the appropriate preservative. Consult Appendix A for the correct preservative for the particular analytes of interest. All samples preserved using a pH adjustment (except VOCs) must be checked, using pH strips, to ensure that they were adequately preserved. This is done by pouring a small volume of sample over the strip. Do not place the strip in the sample.

6.3.5 Special Sample Collection Procedures

Trace Organic Compounds and Metals

Special sample handling procedures should be instituted when trace pollutant samples are being collected. All sampling equipment, including pumps, bailers, water level measurement equipment, etc., which comes into contact with the water in the well must be cleaned in accordance with the cleaning procedures described in Appendix B. Pumps should not be used for sampling, unless the interior and exterior portions of the pump and the discharge hoses are thoroughly cleaned. Blank samples should be collected to determine the adequacy of cleaning prior to collection of any sample using a pump.

Order of Sampling with Respect to Analytes

In many situations when sampling permanent or temporary monitoring wells, an adequate purge, with respect to turbidity, is often difficult to achieve. Removal and insertion of equipment after the purge and prior to actual sampling may negate the low turbidities achieved during purging and elevate turbidity back to unacceptable levels. For this reason, it is important that special efforts be used to minimize any disturbance of the water column after purging and to collect the aliquot for metals first.

Filtering

As a standard practice, ground water samples will not be filtered for routine analysis. Filtering will usually only be performed to determine the fraction of major ions and trace metals passing the filter and used for flow system analysis and for the purpose of geochemical speciation modeling. Filtration is not allowed to correct for improperly designed or constructed monitoring wells, inappropriate sampling methods, or poor sampling technique.

When samples are collected for routine analyses and are filtered, such as under conditions of excessive turbidity, both filtered and non-filtered samples will be submitted for analyses. Samples for organic compounds analysis should not be filtered. Prior to filtration of the ground water sample for any reason other than geochemical speciation modeling, the following criteria must be demonstrated to justify the use of filtered samples for inorganic analysis:

1. The monitoring wells, whether temporary or permanent, have been properly constructed and developed.

2. The ground water samples were collected using sampling techniques in accordance with this section, and the samples were analyzed in accordance with EPA approved methods.

3. Efforts have been undertaken to minimize any persistent sample turbidity problems. These efforts may consist of the following:

    - Redevelopment or re-installation of permanent ground water monitoring wells.
    - Implementation of low flow/low stress purging and sampling techniques.

4. Turbidity measurements should be taken during purging and sampling to demonstrate stabilization, or the lack thereof. Measurements should be documented in the field notes.

If the ground water sample appears to have either a chemically-induced elevated turbidity, such as would occur with precipitate formation, or a naturally elevated colloid or fine, particulate related turbidity, filtration will not be allowed.

If filtration is necessary for purposes of geochemical modeling or other pre-approved cases, the following procedures are suggested:

1. Accomplish in-line filtration through the use of disposable, high capacity filter cartridges (barrel-type) or membrane filters in an in-line filter apparatus. The high capacity, barrel-type filter is preferred due to the higher surface area associated with this configuration. If a membrane filter is utilized, a minimum diameter of 142 mm is suggested.

2. Use a 5 µm pore-size filter for the purpose of determining the colloidal constituent concentrations. A 0.1 µm pore-size filter should be used to remove most non-dissolved particles.

3. Rinse the cartridge or barrel-type filter with 500 milliliters of the solute (ground water to be sampled) prior to collection of sample. If a membrane filter is used, rinse with 100 milliliters of solute prior to sample collection.

One blank sample should be taken per sampling event, prior to sample collection. Potential differences could result from variations in filtration procedures used to process water samples for the determination of trace element concentrations. A number of factors associated with filtration can substantially alter "dissolved" trace element concentrations; these include filter pore size, filter type, filter diameter, filtration method, volume of sample processed, suspended sediment concentration, suspended sediment grain-size distribution, concentration of colloids and colloidally associated trace elements, and concentration of organic matter. Therefore, consistency is critical in the comparison of short-term and long-term results. Further guidance on filtration may be obtained from the following: Metals in Ground Water: Sampling Artifacts and Reproducibility; Filtration of Ground Water Samples for Metals Analysis; and Ground Water Sampling - A Workshop Summary.

Bacterial Sampling

Whenever wells (normally potable wells) are sampled for bacteriological parameters, care must be taken to ensure the sterility of all sampling equipment and all other equipment entering the well. Further information regarding bacteriological sampling is available in the following: Sampling for Organic Chemicals and Microorganisms in the Subsurface; Handbook for Evaluating Water Bacteriological Laboratories; and Microbiological Methods for Monitoring the Environment, Water and Wastes.

6.3.6 Specific Sampling Equipment Quality Assurance Techniques

All equipment used to collect ground water samples shall be cleaned as outlined in Appendix B and repaired, if necessary, before being stored at the conclusion of field studies. Cleaning procedures utilized in the field (Appendix B), or field repairs shall be thoroughly documented in field records.

6.3.7 Auxiliary Data Collection

During ground water sample collection, it is important to record a variety of ground water related data. Included in the category of auxiliary data are water level measurements, well volume determinations, and pumping rates during purging. This information should be documented in the field records. Well volume determinations are described in Section 6.2.1.

6.4 Ground Water Level Measurements

6.4.1 Introduction

The measurement of the ground water level in a well is frequently conducted in conjunction with ground water sampling to determine the "free" water surface. This ground water level measurement can be used to establish ground water flow direction and gradients. Total well depth and ground water level measurements may be needed to determine the volume of water in the well casing prior to purging the well for sampling purposes.

All ground water level and total depth measurements should be made relative to an established reference point on the well casing and should be documented in the field records. To be useful for establishing ground water gradient, the reference point should be tied in with the NGVD (National Geodetic Vertical Datum) or a local datum. For an isolated group of wells, an arbitrary datum common to all wells in that group may be used, if necessary.

6.4.2 Specific Ground Water Level Measuring Techniques

Measuring the depth to the free ground water surface can be accomplished by the following methods:

1. Electronic Water Level Indicators - This instrument consists of a spool of dual conductor wire, a probe attached to the end, and an indicator. When the probe comes in contact with the water, the circuit is closed and a meter light and/or buzzer attached to the spool will signal the contact. Penlight or 9-volt batteries are normally used as a power source. Measurements should be made and recorded to the nearest 0.01 foot.

2. Interface Probe - This instrument is used if a light non-aqueous phase liquid (LNAPL) such as oil is floating on the surface of the ground water. When the probe comes in contact with the LNAPL, a continuous beeping sound is emitted. As the probe is lowered through the layer of LNAPL, it eventually comes in contact with the ground water surface and an intermittent beeping sound is emitted. By subtracting the depth to the LNAPL from the depth of the ground

water, the thickness of the LNAPL layer is calculated.

3. Weighted Tape - In this method a suitable weight, is used to suspend the tape. The weight should, ideally, be made of a relatively inert material and should be easily cleaned. Measurements should be made and recorded to the nearest 0.1 foot.

4. Chalked Tape - Chalk rubbed on a weighted steel tape will discolor or be removed when in contact with water. Distance to the water surface can be obtained by subtracting the wet chalked length from the total measured length. The tape should be withdrawn quickly from the well because water has a tendency to rise up the chalk due to capillary action. Measurements should be made and recorded to the nearest 0.01 foot. This method is not recommended if samples are to be collected for analyses of organic or inorganic pollutants.

5. Other Methods - There are other types of water level indicators and recorders available on the market such as the sliding float method, air line pressure method, and electrical and automatic recording methods. These methods are primarily used for closed systems or permanent monitoring wells. Acoustic water level indicators are also available which measure water levels based on the measured return of an emitted acoustical impulse. Accuracies for these methods vary and should be evaluated before selection. Any method not capable of providing measurements to within 0.1 foot should not be used.

6.4.3 Total Well Depth Measurement Techniques

The weighted tape, or electronic water level indicators can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weighted end is felt resting on the bottom of the well. Because of tape buoyancy and weight effects encountered in deep wells with long water columns, it may be difficult to determine when the tape end is touching the bottom of the well. Care must be taken in these situations to ensure accurate measurements. All total well depth measurements must be made and recorded to the nearest 0.1 foot.

6.4.4 Equipment Available

The following equipment is available for ground water level and total well depth measurements:

1. weighted steel measuring tapes

2. electronic water level indicators.

6.4.5 Specific Quality Control Procedures

Before each use, these devices should be prepared according to the manufacturer's instructions (if appropriate) and checked for obvious damage. These devices should be decontaminated according to the procedures specified in Appendix B prior to use at the next well. All maintenance data should be recorded in a logbook.

6.4.6 Well Pumping Rate - Bucket/Stop Watch Method

The pumping rate for a pump can be determined by collecting the discharge from the pump in a bucket of known volume and timing how long it takes to fill the bucket. The pumping rate should be in gallons per minute. This method shall be used primarily with pumps with a constant pump rate, such as gasoline-powered or electric submersible pumps. Care should be taken when using this method with some battery-powered pumps. As the batteries' charge decreases, the pump rate also decreases so that pumping rate calculations using initial pump rates may be erroneously high. If this method is used with battery powered pumps, the rate should be re-checked frequently to ensure accuracy of the pumping rate calculations.

6.4 References

1. US EPA., RCRA Ground-Water Monitoring: Draft Technical Guidance, November 1992, Office of Solid Waste, EPA/530-R-93-001. This document is available as a PDF file at: http://www.epa.gov/correctiveaction/resource/guidance/sitechar/gwmonitr/rcra_gw.pdf

2. US EPA., Test Methods for Evaluating Solid Waste, Volume II: Field Manual, Physical/Chemical Methods, November 1986, Office of Solid Waste and Emergency Response, SW-846.

3. Puls, Robert W., Don A. Clark, and Bert Bledsoe. Metals in Ground Water: Sampling Artifacts and Reproducibility. *Hazardous Waste and Hazardous Materials* 9(2): 149-162 (1992). This document is available on the internet as a PDF file at: http://www.epa.gov/tio/tsp/download/lwflw2a.pdf

4. Puls, Robert W., and Michael J. Barcelona. Filtration of Ground Water Samples for Metals Analysis. *Hazardous Waste and Hazardous Materials* 6(4): 385-393 (March1989). This document is available on the internet as a PDF file at: http://www.epa.gov/tio/tsp/download/gwsamp2.pdf

5. Ground Water Sampling - A Workshop Summary. Proceedings from the Dallas, Texas November 30 - December 2, 1993 Workshop. US EPA Office of Research and Development Robert S. Kerr Environmental Research Laboratory. EPA/600/R-94/205, January 1995. This document is available on the internet as a PDF file at: http://www.epa.gov/OUST/cat/gwwkshop.pdf

6. Sampling for Organic Chemicals and Microorganisms in the Subsurface, US EPA, EPA-600/2-77/176 (1977).

7. Handbook for Evaluating Water Bacteriological Laboratories, US EPA, ORD, Municipal Environmental Research Laboratory, Cincinnati, Ohio, 1975.

8. Microbiological Methods for Monitoring the Environment, Water and Wastes, US EPA, ORD, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, 1978.

Attachment

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUNDWATER SAMPLING PROCEDURE
LOW STRESS PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting groundwater samples from monitoring wells. Low Stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of groundwater conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater. The procedure is appropriate for collection of groundwater samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of non-aqueous phase liquid (NAPL) samples and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: <u>DNAPL Site Evaluation</u> (Cohen & Mercer, 1993) and the <u>RCRA Ground-Water Monitoring: Draft Technical Guidance</u> (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the Low Stress Purging and Sampling procedure is to collect ground water samples from monitoring wells that are representative of groundwater conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the groundwater during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of groundwater purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump's intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of three options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; or c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book. The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough "daily" decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

IV. EQUIPMENT

- Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist.
- Well construction data, location map, field data from last sampling event.
- Polyethylene sheeting.
- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).
- Adjustable rate, positive displacement groundwater sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.
- Interface probe or equivalent device for determining the presence or absence of NAPL.
- Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.
- Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).
- Power source (generator, nitrogen tank, etc.).
- Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.
- Decontamination supplies (see Section VII, below).

- Logbook (see Section VIII, below).
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID or FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID or FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any DNAPLs or LNAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the groundwater.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrdogeologist or project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    ±0.1 for pH
    ±3% for specific conductance (conductivity)
    ±10 mv for redox potential
    ±10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 50 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal

turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.

Some groundwater samples require pH adjustment. The appropriate EPA Program Guidance (e.g., Region II CERCLA QA Manual) should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, groundwater samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see #18 below).

17. Daily Decon

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. <u>Between-Well Decon</u>

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.

- QA/QC data for field instruments.

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, EPA/540/S-95/504.

U.S. EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

SECTION 7
SAMPLING OF POTABLE WATER SUPPLIES

PERFORMANCE OBJECTIVES:

- To collect a sample representative of the drinking water supply.
- To reduce the bias of system related variables (pumps, piping, holding tanks, etc.).

7.1 Introduction

The same sampling techniques used for wastewater, ground water, surface water, etc., (including thorough documentation of location, date, time, etc.) are to be used during potable water supply sampling. There are certain additional procedures which apply.

7.2 Sampling Site Selection

The following should be considered when choosing the location to collect a potable water sample:

- Taps selected for sample collection should be supplied with water from a service pipe connected directly to a water main in the segment of interest.
- Whenever possible, choose the tap closest to the water source, and prior to the water lines entering the residence, office, building, etc., and also prior to any holding or pressurization tanks.
- The sampling tap must be protected from exterior contamination associated with being too close to a sink bottom, or to the ground. Contaminated water or soil from the faucet exterior may enter the bottle during the collection procedure, since it is difficult to place a bottle under a low tap without grazing the neck interior against the outside faucet surface. If the tap is too close to the ground for direct collection into the appropriate container, it is acceptable to use a smaller (clean) container to transfer sample to a larger container. The smaller container should be made of certified pre-cleaned plastic, glass or stainless steel.
- Leaking taps that allow water to discharge from around the valve stem handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations.
- Disconnect any hoses, filters, or aerators attached to the tap before sampling. These devices can harbor a bacterial population if they are not routinely cleaned or replaced when worn or cracked.
- Taps where the water flow is not constant should be avoided because temporary fluctuation in line pressure may cause clumps of microbial growth that are lodged in a pipe section or faucet connection to break loose. A smooth flowing water stream at moderate pressure without splashing should be used. The sample

should be collected without changing the water flow. It may be appropriate to reduce the flow for the volatile organic compounds aliquot to minimize sample agitation.

Occasionally, samples are collected to determine the contribution of system related variables (e.g., transmission pipes, water coolers, water heaters, holding tanks, pressurization tanks, etc.) to the quality of potable water supplies. In these cases, it may be necessary to insure that the water source has not been used for a specific time interval (e.g., over a weekend, or a three or four day, holiday period). Sample collection may consist of collecting a sample of the initial flush, collecting a sample after several minutes, and collecting another sample after the system being investigated has been completely purged. When sampling for bacterial content, the sample container should not be rinsed before use due to possible contamination of the sample container or removal of the sodium thiosulfate dechlorinating agent (if used). When filling any sample container, care should be taken that splashing drops of water from the ground or sink do not enter into either the bottle or cap. When sampling at a water treatment plant, samples are often collected from the raw water supply and the treated water after chlorination. Obtain the name(s) of the resident or water supply owner/operator, the resident's exact mailing address, and the resident's work and home telephone numbers. The information is required so that the residents or water supply owner/operators can be informed of the results of the sampling program.

Sampling Technique

The following procedures should be followed when collecting samples from potable water supplies:

1 Ideally, the sample should be collected from a tap or spigot located at or near the well head or pump house and before the water supply is introduced into any storage tanks or treatment units. If the sample must be collected at a point in the water line beyond a pressurization or holding tank, a sufficient volume of water should be purged to provide a complete exchange of fresh water into the tank and at the location where the sample is collected. If the sample is collected from a tap or spigot located just before a storage tank, spigots located inside the building or structure should be turned on to prevent any backflow from the storage tank to the sample tap or spigot. It is generally advisable to open several taps during the purge to ensure a rapid and complete exchange of water in the tanks.

2 Purge the system for at least 15 minutes, when possible. After purging for several minutes, measure the turbidity, pH, specific conductivity, and temperature of the water. Continue to monitor these parameters until three consistent readings are obtained. If possible, obtain three consistent readings after the 15 minute purge.

3 After three consistent readings have been obtained, samples may be collected.

7.3 References

1. Sampling for Organic Chemicals and Microorganisms in the Subsurface, United States Environmental Protection Agency, EPA-600/2-77-176, 1977.

SECTION 8
SAMPLING FOR LEAD IN WATER IN SCHOOLS

SECTION OBJECTIVE:

- To provide guidance for the proper collection of drinking water samples at schools to protect children from drinking lead contaminated water.

8.1 Background/Introduction

Lead is a toxic metal that can be harmful when ingested (or inhaled), and young children are particularly sensitive to the effects of lead. Lead can get into drinking water by being present in the source water, or by interaction of the water with plumbing materials containing lead (through corrosion). Common sources of lead in drinking water include: solder, fluxes, pipes and pipe fittings, fixtures, and sediments. Thus, it is possible that different water outlets in a given building could have dissimilar concentrations of lead.

Lead in drinking water is regulated under the Safe Drinking Water Act (1974) as amended. The Lead Contamination Control Act (LCCA) amended the Safe Drinking Water Act and is aimed at identifying and reducing lead in drinking water in schools (and day care facilities). In April 1994, EPA prepared two guidance documents to assist municipalities in meeting the requirements of the LCCA.

8.2 Sampling Procedure

The sampling procedure is a two-step process, a first draw and a follow-up draw sample from the cold water outlet. Both samples will be collected from the tap directly into the actual container. The EPA (Lead in Drinking Water in Schools and Non-Residential Building Manual) has established an action level of greater than 20 ug/L of lead in the first draw sample that would trigger follow-up testing.

The sampler will place sample labels on each sample bottle that contains the project/school name, field sample number, parameter to be analyzed, date of collection and any preservation technique used. The sampler will then put on a new pair of non-colored latex gloves and wear those gloves until that outlet has been sampled for both the first draw and follow-up draw samples. Care should be taken not to touch other surfaces with the gloves until sampling is complete. This is to avoid the potential for cross contamination of sample outlets by sampling personnel. The sampler will also follow the protocols provided below for the various types of cold water distribution points or outlets.

8.2.1 For water coolers (1C/2C)

These water coolers have a reservoir greater than 500 milliliters (mL). Water in these coolers are stored in a pipe coil or reservoir.

- for the first-draw, cold water is collected into a 250 mL HDPE certified clean or LDPE acid washed container. This sample will be collected before any water is used, to assure that no water is withdrawn from the outlets from which the samples are to be collected. This sample will indicate whether the outlet, and/or the tank is the source of any lead.

- for the follow-up sample, cold water will be collected into another 250 mL container after allowing the water to flow for 15 minutes. This sample will be used to indicate whether the piping that supplies that outlet with water is a source of lead.

8.2.2 For bubblers (1A/2A), bubblers with individual chillers (1B/2B) and faucets (1F/2F)

Most faucets and bubblers have a single spigot. If there are multiple spigots, then the spigot furthest from the source of the water, or if indeterminate, the one on the left side for consistency should be sampled.

- for the first-draw, cold water is collected into a 250 milliliters (mL) HDPE certified clean or LDPE acid washed container. This sample will be collected before any water is used, to assure that no water is withdrawn from the outlets from which the samples are to be collected. This sample will indicate whether the outlet and/or piping and the outlet, is the source of any lead.

- for the follow-up sample, cold water will be collected into another 250mL container after allowing the water to flow for 30 seconds. The sample will be used to indicate whether the piping that supplies that outlet with water is a source of lead.

8.3 Equipment

Equipment and supplies that will be needed to perform the sampling survey are latex non-colored gloves, certified pre-cleaned 250 mL plastic bottles, weatherproof labels, Chain of Custody forms, bound field logbook, indelible ink pen, camera, cooler.

8.4 Documentation

All observations, diagrams, sample id’s, sample dates, sampler names, etc., will be entered in the bound field logbooks.

8.5 Sample Preservation

Samples are to be preserved with Laboratory grade nitric acid to a pH<2 within 48 hours of sample receipt in the laboratory.

8.6 References

1. Lead in Drinking Water in Schools and Non-Residential Buildings
EPA 812-B-94-002, April 1994. Available to be downloaded at:
http://www.epa.gov/dclead/leadinschools.pdf

2. Sampling for Lead in Drinking Water in Nursery Schools and Day Care Facilities. EPA 812-B-94-003, April 1994. Available to be downloaded at:
http://www.smallbiz-enviroweb.org/pub_video/epadocs/hdocs/h09.pdf

SECTION 9
WASTEWATER SAMPLING

SECTION OBJECTIVE:

- To provide guidance for the proper collection of wastewater samples.

9.1 Introduction

The variety of conditions at different sampling locations require that considerable judgment be exercised regarding the methodologies and procedures for the collection of representative samples of wastewater. Each sampling location warrants attention commensurate with its complexity. There are, however, basic rules and precautions generally applicable to sample collection. Acceptable procedures are generally those outlined in the NPDES Compliance Inspection Manual. Some important considerations for obtaining a representative wastewater sample include:

- Collecting the sample where the wastewater is well mixed. Therefore, the sample should be collected near the center of the flow channel, at approximately 40 to 60 percent of the water depth, where the turbulence is at a maximum and the possibility of solids settling is minimized. However, allowances should be made for fluctuations in water depth due to flow variations. Skimming the water surface or dragging the channel bottom should be avoided. However, when sampling wastewater for oil and grease (petroleum hydrocarbons), and the material is floating on the surface, it would be considered acceptable to bias the sample by collecting the sample by skimming the surface.

- If manual compositing is employed, the individual sample portions must be thoroughly mixed before pouring the individual aliquots into the composite container. For manual composite sampling, the individual sample aliquots should be preserved at the time each aliquot is collected.

- When collecting samples or installing sampling equipment, field investigators should always wear a new pair of the appropriate protective disposable gloves to prevent contamination of the sample and reduce exposure to hazardous substances.

9.2 Site Selection

Where applicable, wastewater samples should be collected at the location specified in the NPDES permit (if the source has a permit). In some instances the sampling location specified in the permit, or the location chosen by the permittee, may not be acceptable for the collection of a representative wastewater sample. In such instances, the investigator is not limited by permit specifications and may collect a sample at a more representative location. When a conflict exists between the permittee and the regulatory agency regarding the most representative sampling location, both sites should be sampled, and the reason for the conflict should be noted in the field notes and the inspection report. Recommendations and reasons for a change in sampling locations should be given to the appropriate permitting authority.

9.2.1 Influent

Influent wastewaters are preferably sampled at locations of highly turbulent flow in order to ensure good mixing. Influent samples should be collected upstream from any sidestream return flows, whenever possible. However, in some instances the most desirable location is not accessible. Preferable influent wastewater sampling locations include: 1) the upflow distribution box following pumping from main plant wet well; 2) aerated grit chamber; 3) the throat section of a flume; 4) pump wet well when the pump is operating; or 5) downstream of preliminary screening.

9.2.2 Effluent

Effluent samples should be collected at the site specified in the permit, or if no site is specified in the permit, select a location that is the most representative site furthest downstream from all entering wastewater streams prior to discharge into the receiving waters. If a conflict exists between the permittee and inspector regarding the location being sampled, or the location of the most representative site, follow the procedures previously described under “Site Selection”.

9.2.3 Pond and Lagoon Sampling

Generally, composite samples should be collected of effluent wastewater from ponds and lagoons. Even if the ponds or lagoons have long retention times, composite sampling is necessary because of the tendency of ponds and lagoons to have flow paths that short-circuit the treatment unit, which modifies the design detention time.

9.3 Sample Types

For NPDES sampling, two types of sampling techniques are used: grab and composite. For these procedures, the NPDES permit specifies the appropriate sample type. A complete description of all NPDES sampling procedures and techniques is presented in the NPDES Compliance Inspection Manual.

9.3.1 Grab Samples

Grab samples consist of either a single discreet sample, or individual samples, collected over a period of time not to exceed 15 minutes. The grab sample should be representative of the wastewater conditions at the time of sample collection. The volume of sample collected depends on the type and number of analyses to be performed. The most recent list of sample volumes and containers (provided by the Laboratory Branch), should be used (see Appendix A).

9.3.2 Composite Samples

A composite sample represents the average wastewater characteristics during the compositing period. Various methods for compositing are available and are based on either time or flow proportioning. The choice of a flow proportional or time composite sampling scheme depends on the permit requirements, variability of the wastewater flow rate, and sampling location. The investigator must know *each* of these criteria before a sampling program can be initiated.

Generally, a time composite is acceptable. Flow proportional samples are preferable, however, in enforcement cases where strict adherence to permit requirements are necessary, or if an investigator knows or suspects that there is significant variability in the homogeneity of the wastewater flow. A time composite sample can be collected either manually or with an automatic sampler. A time composite sample consists of equal volume discrete sample aliquots collected at constant time intervals into one container. Composite samples are collected over time, either by continual sampling or by mixing discrete samples.

A flow proportional composite sample can be collected using one of two methods. One method consists of collecting a constant sample volume at varying time intervals proportional to the wastewater flow. For the other method, the sample is collected by varying the volume of each individual aliquot proportional to the flow, while maintaining a constant time interval between the aliquots. Prior to collecting flow proportional samples, the facility's flow measuring system should be examined for proper installation and accuracy (see Section 19). If the facility's primary flow measuring device does not meet standard conditions (see Section 19), or is in an unsafe or inaccessible location, then the investigator should collect time composite samples. If the flow measurement system is acceptable, samples should be collected using the appropriate flow proportioning methods. Flow proportional samples can be collected with an automatic sampler and a compatible flow measuring device, with a flow chart and an automatic sampler capable of collecting discrete samples, or manually by compositing individual grab samples by volume versus flow chart readings.

9.4 Use of Automatic Samplers

9.4.1 Introduction

Automatic samplers may be used to collect composite or grab samples when several aliquots are to be collected at frequent intervals, or when a continuous sample is required. For composite sampling applications, the automatic samplers may be used to collect time composite or flow proportional samples. In the flow proportional mode, the samplers are activated and paced by a compatible flow meter. Flow proportional samples can also be collected using an automatic sampler equipped with multiple containers and manually compositing the individual sample portions proportional to the flow. Automatic samplers must meet the following requirements:

- Sampling equipment must be properly cleaned to avoid cross-contamination which could result from prior use (see Appendix B for cleaning procedures). New tubing is used for each sampling location, unless cleaning procedures which serve to prevent or minimize cross-contamination are prescribed in a QAPP.

- Sampling materials and containers shall be compatible with the analytes of concern.

- The automatic sampler must be capable of providing adequate refrigeration during the sampling period, when required. This can be accomplished in the field by using sufficient quantities of wet ice.

- The automatic sampler should be capable of providing a lift of at least 20 feet, and the sample volume should be adjustable, since the volume is a function of the pumping head.

- The pumping velocity must not allow solids to settle.

- The intake line leading to the pump must be purged before and after each sample is collected.

- The minimum inside diameter of the intake line should be 1/4 inch.

- An adequate power source should be available to operate the sampler for the time required to complete the project. The use of rechargeable batteries is preferred, because it will provide an independent source of reliable power. Facility electrical outlets may be used if available, but are not recommended. Operating temperature (e.g., extreme cold), and long sampling depths (20 feet or more), must be taken into consideration when using batteries, because these conditions may cause the batteries to deplete their charge faster than expected. Bringing extra batteries, and changing them during the survey, would help to provide a stable source of power if these conditions are encountered.

- Facility automatic samplers should only be used if 1) field conditions do not allow for the installation of EPA sampling equipment, and 2) the facility sampling equipment meets all of the requirements of this SOP. Specific operating instructions, capabilities, capacities, and other pertinent information for automatic samplers are included in the respective operating manuals (ISCO® and American Sigma®). When using the facilities sampling equipment, a clean container should be used to collect composite samples.

9.4.2 Conventional Sampling (Inorganic Parameters)

Conventional sampling includes all inorganic parameters (e.g., 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), chemical oxygen demand (COD) and nutrients) that can be collected using an automatic sampler. New tubing (Silastic®, or equal, in the pump housing, and either Teflon® or Tygon® tubing (depending on the parameter that will be sampled), or equal, for the rest of the sample tubing) will be used for each sampler installation. Installation procedures include cutting the proper length of tubing, positioning it in the wastewater stream, attaching a strainer (if needed), followed by sampler calibration and programming. Protective gloves must be worn to reduce exposure to pollutants, and to maintain the integrity of the sample.

For a time composite sample, the automatic sampler should be programmed to collect aliquots at a frequency which provides a representative sample, and also provides enough sample volume to conduct all required analyses, including split samples, if requested. For a flow proportional sample, the sampler should be programmed to collect aliquots with the interval predetermined based on the flow of the wastewater to be monitored. At the end of the compositing period, the sample collected should be homogenized and transferred into the appropriate sample containers, followed by immediate preservation, if required.

9.4.3 Metals

When an automatic sampler is used for collecting samples for metals analyses, the composite jug should be washed and rinsed with organic/analyte-free water. Then, a weak solution (5%) of nitric acid should be used to rinse the container, and deionized water (DI) should be used to triple rinse it. Finally, the composite container should be allowed to dry by turning it upside down (in a laboratory fume hood), while keeping contaminants from the rim and lid of the container. If the sampler tubing is attached to a metal conduit, the sampler intake tubing should be carefully installed *upstream* and away from the conduit to prevent metals contamination.

9.4.4 Extractable Organic Compounds, Pesticides, Phenols and PCBs

When an automatic sampler is used for collecting samples for the analyses of extractable organic compounds, pesticides, phenols and/or PCBs, the installation procedures include cutting the proper length of new clean Teflon® tubing, attaching a stainless steel strainer (if used), flushing the entire sampler collection system with organic/analyte-free water, and then collecting appropriate blanks for the analysis organic compounds. For the organic/analyte-free water rinse, approximately one gallon in a pre-cleaned* glass container is initially pumped into the pre-cleaned* composite sample container and discarded. An additional volume of DI water is then pumped through the composite sampler and into the appropriate sample containers for the blank sample. Finally, the collection tubing should be positioned in the wastewater stream and the sampler programmed and initiated. (*pre-cleaned in this sense is prepared by rinsing with methanol and air drying, or DI water rinse, acetone rinse, hexane rinse and air dry.)

9.4.5 Automatic Sampler Security

Field investigators should take whatever steps are necessary to prevent tampering with EPA equipment. A lock must be placed on the sampler to deter and detect tampering. However, this does not prevent tampering with the sample collection tubing. If necessary, custody seals may be placed on the sampling tubing to further reduce tampering possibilities.

9.4.6 Automatic Sampler Maintenance, Calibration, and Quality Control

To ensure proper operation of automatic samplers, and thus the collection of representative samples, the following maintenance and calibration procedures should be used, and any deviations should be documented in the field logbook. Prior to being used, the sampler operation should be checked to ensure that it is operating properly. This includes:

- changing the peristaltic pump tubing;
- checking that the pump operates in forward, reverse, automatic modes, and performing at least one purge-pump-purge cycle;
- checking desiccant and replacing it if necessary; and
- checking the 12-volt NiCad batteries to be used with the sampler.
- During each field trip, prior to initiating the automatic sampler, the purge-pump-purge cycle shall be checked at least once.

- The pumping volume should be checked using a graduated cylinder or other calibrated container prior to initiating the sampler.

For flow proportional sampling, the flow meter that activates the sampler should be checked several times to ensure that it is operating properly.

Upon returning from a field trip, the automatic sampler should be cleaned, dried and replaced in the sampler inventory. The structural integrity of the sampler should be made, and the equipment should be repaired or replaced, if necessary. If repairs are not made immediately, the sampler should be clearly marked that it is malfunctioning, so that others do not use the unit. The desiccant should be checked, and regenerated and/or replaced, as needed. If repairs were made the operation of the pump in forward, reverse, automatic, modes should be checked. The automatic sampler should be checked against the manufacturer's specifications and documented whenever one or more of the sampler functions appears to be operating improperly.

9.5 Manual Sampling

Manual sampling is typically used for collecting grab samples and/or for immediate in-situ field analyses. However, it can also be used in lieu of automatic equipment over extended periods of time for composite sampling, especially when it is necessary to evaluate unusual waste stream conditions. Manual sampling must be conducted in a manner to collect a water or wastewater sample that is both homogenous and representative of the sampling location.

In general, samples are manually collected by first selecting a location in the waste stream that is well mixed (Section 9.1) then dipping the container in the water or wastewater stream, aligning the mouth of the container upstream. The container should not be overfilled if preservatives are present in the container. The best method to manually collect a sample is to use the actual sample container which will be used to transport the sample to the laboratory. This eliminates the possibility of contaminating the sample through intermediate collection containers.

Equipment that contacts the water or wastewater sample must not alter the integrity of the sample. Equipment made of plastic or Tygon® is generally used to collect samples for conventional and inorganic parameters, but not for any organic parameters. Under appropriate circumstances a clean plastic bucket, rinsed with the waste stream can be used. Stainless steel, Teflon®, or glass, is required when collecting and analyzing samples for organic compounds, pesticides, and PCBs.

If the water or wastewater stream cannot be physically reached by the sampling personnel, or it is unsafe to reach, an intermediate collection container may be used, from which the sample can be redistributed to other containers. If this is done, the intermediate container must be made of compatible materials and properly cleaned (Appendix B).

Samples for oil and grease, bacteria, volatile organic compounds, and sulfides analyses must be collected directly into the sample container. In some cases it may be best to use a pump to withdraw a sample from the water or wastewater stream. If a pump is used, it is imperative that all components of the pump that come in contact with the sample are properly cleaned (see Appendix B).

9.6 Special Sample Collection Procedures

9.6.1 Organic Compounds and Metals

Trace organic compounds and trace metals detection limits are usually in the parts per billion or parts per trillion range, so extreme care must be exercised to ensure sample integrity. All containers, composite bottles, tubing, etc. used for sample collection for trace organic compounds and trace metals analyses should be prepared as described in Appendix B.

When possible, the sample should be collected directly into the appropriate sample container. If the material to be sampled cannot be physically reached, an intermediate collection device may be used. This should be made of Teflon®, glass, or stainless steel or using Teflon® tubing in conjunction with a peristaltic-type pump. The device which is used should be cleaned as described in Appendix B.

9.6.2 Bacteriological

Samples for bacteriological analyses must always be collected directly into the prepared glass or plastic sample container. The sterile sample container should be kept unopened until it is to be filled. When the cap is removed, care should be taken not to contaminate the cap or the inside of the bottle. The bottle should be held near the base and filled to within about one inch of the top without rinsing and recapped immediately. During sample collection, the sample container should be plunged with the neck partially below the surface and slightly upward. The mouth should be directed against the current. When the sample container must be lowered into the waste stream, either because of safety or impracticality (manhole, slippery effluent area, etc.), care must be taken to avoid contamination. Appendix A lists the approved preservation techniques and holding times.

9.6.3 Immiscible Liquids/Oil and Grease

Oil and grease may be present in wastewater as a surface film, an emulsion, a solution, or as a combination of these forms. Samples for the analysis of oil and grease must always be collected directly into the 32-ounce (or 1-liter) glass sample container. Since it is very difficult to collect a representative sample for oil and grease analysis, the inspector must carefully evaluate the sampling location. The most desirable sampling location is the area of greatest mixing. Quiescent areas should be avoided. The sample container should be plunged into the wastewater using a swooping motion with the mouth facing upstream. Care should be taken to ensure that the bottle does not overfill during sample collection. Because losses of oil and grease will occur on sampling equipment, an automatic sampler should never be used to collect samples for oil and grease analysis.

9.6.4 Volatile Organic Compounds

Samples to be analyzed for volatile organic compounds (VOCs) should be collected in 40-ml septum vials with screw caps with a Teflon® lined silicone disk in the cap. The disks should be in the caps with the Teflon® side placed so that it will be in contact with the sample, prior to initiating the sampling.

When sampling for VOCs, triplicate samples should always be collected from each location. In addition, a set of trip blanks and equipment blanks are required for VOC analyses. The investigator should determine if the water to be sampled contains chlorine. The EPA - Edison laboratory prefers that 1+1 hydrochloric acid (HCl) is **NOT added** to the three 40-ml vials - See notes below. It is imperative that there are absolutely no visible air bubbles in the filled sample bottle. Since acid is not added to the sample vials the samples may be only be held for up to seven (7) days before analysis. Samples containing chlorine must be dechlorinated with sodium thiosulfate. The sodium thiosulfate must be added into the bottle before the sample is collected. These samples can be held up to 7 days before analysis, if they are maintained at 4^{o} Celsius. The 40-ml vials should be completely filled to prevent volatilization, and extreme caution should be exercised when filling each vial to prevent any turbulence which could produce volatilization. The sample should be carefully poured down the side of the vial. As a general rule, it is best to gently fill the cap with sample and pour those last few drops into the vial so that surface tension holds the water in a "convex meniscus." The cap is then applied and some overflow is lost, but air space in the bottle is eliminated. After capping, turn the vial over and tap it to check for bubbles. If any are present, add a few drops of sample to top off the vial and repeat the procedure. Alternatively, use a new 40-ml vial and repeat the procedure.

In a July 28, 2004, memorandum from the EPA Region 2 laboratory, John Bourbon (Chief of the Organic and Inorganic Chemistry Section), states:

> “*Under 40 CFR Part 136.3 Table II - Required Sample Containers, Preservation and Holding Times, the required preservation and holding time for NPDES samples collected for VOA analysis depends upon the type of VOAs sought. The preservation and holding time for the three cases is as follows:*
>
> *Case #1 - Method 624 VOAs **including** the aromatic hydrocarbons Benzene, Ethylbenzene and Toluene w/Acid*
>
> *Preservation: Cool to 4 °C; Sodium Thiosulfate; HCl to pH 2*
> *Holding Time: 14 days*
>
> *Case #2 - Method 624 VOAs **including** the aromatic hydrocarbons Benzene, Ethylbenzene and Toluene w/o Acid*
>
> *Preservation: Cool to 4 °C; Sodium Thiosulfate*
> *Holding Time: 7 days*
>
> *Case #3 - Method 624 VOAs **excluding** the aromatic hydrocarbons Benzene, Ethylbenzene and Toluene , e.g., pharmaceutical Industry*
>
> *Preservation: Cool to 4 °C; Sodium Thiosulfate*
> *Holding Time: 14 days*”
>
> *Note: The EPAOur Laboratory prefers no acid preservation since the combination of acid plus sodium thiosulfate can lead to the formation of compounds that interfere with some of the VOA target analytes; however, that is based on the specific method conditions that we employ and may not applicable in other environmental laboratories. The use of sodium thiosulfate plus acid is acceptable (see Case#1).*

9.7 Supplementary Data Collection

While conducting wastewater sampling, the following information will also be obtained (if applicable):

- Field measurements -- pH, dissolved oxygen, conductivity, and temperature (see Section 16 for standard field analytical techniques).
- Flows associated with the samples collected - totalizer flows for continuous composite samples and instantaneous flows for grab samples (Section 18).
- Diagrams and/or written descriptions of the wastewater treatment systems (if available).
- Photographs of pertinent wastewater associated equipment, such as flow measuring devices, treatment units, sampling locations, etc. (keep a photo log as specified in section 3.3.2).
- Process control information on the wastewater treatment process (if applicable).
- Completion of applicable forms required during specific investigations.

All observations, measurements, diagrams, etc., will be entered in bound field logbooks or attached thereto (where applicable, as specified in Section 3.6).

9.8 Sample Preservation

All sample collection and preservation procedures should comply with the requirements outlined in 40 CFR, Part 136.3 (e), Table II for samples collected under the NPDES program. For other programs, use the relevant regulations that pertain to sample preservation under those programs.

9.9 References

1. NPDES Compliance Inspection Manual, United States Environmental Protection Agency, July 2004. Available as a PDF file at: http://www.epa.gov/compliance/resources/publications/monitoring/cwa/inspections/npdesinspect/npdesmanual.html

2. Code of Federal Regulations, 40 CFR, Part 136.3, Table II, (latest issue).

3. US-EPA, "Process Control Manual: Aerobic Biological Treatment Facilities MD-14", EPA 430/09-77-006, Office of Water, Washington, D.C., 1977.

SECTION 10
WASTEWATER FLOW MEASUREMENT

10.1 Introduction

The measurement of flow with surface water and wastewater sampling is essential to almost all water pollution control activities. Activities such as water quality enforcement studies, NPDES permit compliance monitoring, water quality monitoring, and municipal operation and maintenance investigations, rely on accurate flow measurements. The importance of obtaining accurate flow data cannot be overemphasized, particularly with respect to enforcement investigations since these data will be used as evidence in enforcement cases. NPDES permits often limit the quantity (mass loading) of a particular pollutant that may be discharged, and calculations of mass loadings are also frequently necessary for water quality studies and other purposes. As much attention and care should be given to flow measurement in the design of a sampling program as to the collection of samples and their subsequent laboratory analysis. The basic objectives of this section are to:

- outline standard practices with respect to wastewater flow measurements during water enforcement and NPDES compliance monitoring activities, and other studies where wastewater flow measurements are required;
- outline standard practices for obtaining surface water flow measurements during water quality surveys;
- present acceptable, commonly used flow measurement techniques; and
- present general and specific quality assurance procedures for flow measurement equipment and techniques.

A complete discussion of all available flow measurement techniques, and the theory behind them, is beyond the scope of this section. However, most of the commonly used techniques are covered in general terms. A comprehensive list of references is included at the end of this section, and a detailed discussion of flow measurement techniques may be found in those references.

10.2 Wastewater Flow Measurement

10.2.1 Introduction

The USDI Water Measurement Manual is a standard reference for details on checking the installation of primary open channel flow devices. Basic guidance for making wastewater flow measurements and a basic description of all acceptable wastewater flow measurement systems are given in the NPDES Compliance Inspection Manual, United States Environmental Protection Agency, July 2004. This manual shall be used as Section guidance for taking flow monitoring measurements.

10.2.2 Site Selection

It is the field investigator's responsibility to ensure that the wastewater flow measurement system, or technique used measure the total wastewater discharged (which may be described by the NPDES permit, if applicable) is adequate for monitoring purposes. All recycled wastewater must be accounted for, so that reported flows accurately reflect the volume of wastewater discharged. The location of the wastewater flow measurement equipment should satisfy these criteria, be consistent with NPDES permit requirements, and accurately measure the actual flow.

10.2.3 Flow Measurement Systems

Flow may be measured on an instantaneous, or a continuous basis. A typical continuous system consists of a primary flow measuring device, a flow sensor, transmitting equipment, a recorder, and a totalizer. Instantaneous flow measurements can be obtained without using such a system.

The heart of a typical continuous flow measurement system is the primary flow device. This device is constructed to produce predictable hydraulic responses which are related to the flow rate of water or wastewater through it. Examples of such devices include weirs and flumes, which relate water depth (also referred to as “head”) to flow, Venturi and orifice type meters relate the changes in differential pressure to flow, and magnetic flow meters relate an induced electric voltage to flow. Standard primary flow devices have undergone detailed testing and experimentation, and their accuracy has been verified.

A flow sensor is required to measure the particular hydraulic responses of the primary flow measurement device, and transmit them to the recording system. Typically, sensors include ultrasonic transmitters, floats, pressure transducers, capacitance probes, differential pressure cells, electromagnetic cells, etc. Generally, the sensor signal is converted using mechanical, electro mechanical, or electronic systems into units of flow, which are recorded directly on a chart, or transmitted to a data system. Systems which utilize a recorder are generally equipped with a flow totalizer, which displays the total flow on a real time basis. Studies that need continuous flow measurements require a complete system. Instantaneous flow measurements do not necessarily dictate the use of any portion of a complete flow monitoring system. Techniques which are described later in this Section are available for measuring instantaneous flows with portable equipment. An important consideration during wastewater studies is that the investigator may want to obtain continuous flow data at a facility where only instantaneous flow data are being measured. If an open channel primary flow device is utilized for making instantaneous measurements, only the installation of a portable field sensor and recorder is necessary. If, on the other hand, the facility being investigated does not utilize a primary flow device, and a continuous flow record is desired, a portable primary flow device may have to be installed. Field investigators do not have open channel primary flow monitoring equipment available for field use. These devices should be installed according to the manufacturer’s specifications, and require considerable time and effort to set up properly. Many commonly used wastewater flow measurement systems are generally very accurate. However, any system that cannot measure the wastewater flow within ± 10 percent of the actual flow is considered unacceptable for use in measuring wastewater flow.

10.2.4 Use of Existing Flow Measurement Systems

The installation of systems to measure wastewater flows can be time consuming, particularly if a primary device is not available. Therefore, field personnel can use existing facility primary flow devices and flow measurement systems, when the accuracy of these devices, and the system, can be verified. The objective of this section is to outline the responsibilities of field personnel in verifying the accuracy of existing primary flow devices and systems.

The field investigator must verify that an existing facility flow measurement system (including the primary flow device) utilized to measure wastewater flows, conforms with recognized design and installation standards. Any deviations from standard conditions shall be documented, and may warrant correction. The accuracy of the primary flow device should be checked by making sure that it has been properly calibrated (within the last year), it is installed properly, the secondary monitoring device is at the correct location, and the flow is appropriate for the particular flow measurement device. If there is no usable or existing primary flow measuring device, or if the device has not been properly located, the investigator will not be able to verify the accuracy of the flow monitoring system.

If the discharger's flow measurement system is accurate within ±10 percent of the actual flow, the investigator can use the installed system. The accuracy of flow sensors and recorders for open channel flow devices can be checked by making an instantaneous measurement utilizing the primary flow device, and comparing this against the recorder reading. In addition, EPA flow equipment can be installed to check facility totalizer readings. The chart recorder should be checked to verify that the time and scale are correct. If non-standard primary flow devices are being used, data supporting the accuracy and precision of the methods being employed should be provided by the discharger. Deficiencies should be recorded by the investigator, and the discharger should be informed that the equipment needs to be repaired, replaced or properly calibrated, as soon as possible.

10.2.5 Specific Techniques

This section outlines and familiarizes the field investigator with the most commonly used methods for wastewater flow measurements and the primary devices that will be encountered during field studies. Volumetric and dilution techniques are presented at the beginning of this section since they are applicable to both open channel, and closed conduit flow situations. The remaining methods are grouped under categories dealing with open channels and closed conduits. The general method of checking individual primary flow devices is given, where applicable. Several estimation techniques are presented. However, it should be recognized that flow estimates do not satisfy NPDES permit monitoring requirements, unless the permit specifically states that this is permissible. The following methods are included only to enable the field investigator to make accurate flow estimates when necessary.

Volumetric Techniques

Volumetric flow measurement techniques are among the simplest and most accurate methods for measuring flow. These techniques basically involve the measurement of volume and/or the measurement of time required to fill a container of known size.

Vessel Volumes

The measurement of vessel volumes to obtain flow data is particularly applicable to batch wastewater discharges. Accurate measurements of the vessel volumes and the frequency that they are dumped are all that is required. An accurate tape to verify vessel dimensions and a stop watch are the only required field equipment. The NPDES Compliance Inspection Manual, United States Environmental Protection Agency, July 2004 is a useful reference on the equations for calculating volumes of various containers.

Sump Pumps

This measurement is made by observing the water levels in the sump when the pump(s) turn on and off, and then calculating the volume contained between these levels. This volume, along with the number of pump cycles, will give a relatively good estimate of the daily wastewater flow. The inspector must also account for the quantity of wastewater that flows into the sump during the pumping cycle, which may be accomplished using the Bucket and Stop Watch technique.

Bucket and Stop Watch

The bucket and stop watch technique is particularly useful for the measurement of small wastewater flows. It is accurate, and easy to use. The only equipment required to make this measurement is a calibrated container (bucket, drum, tank, etc.) and a stop watch. A minimum of 10 seconds is recommended to fill the container. If it takes less than 10 seconds to fill the container, this would tend to reduce the accuracy of this method. Three consecutive measurements should be made, and the results should be averaged.

Dilution Methods

Dilution methods for water and wastewater flow measurements are based on the color, conductivity, fluorescence, or other quantifiable property of an injected tracer. The dilution methods require specialized equipment, special attention to detail by the investigator, and are time consuming. Dilution methods are not described in this document.

10.2.6 Open Channel Flow Measurements

Measurement of wastewater flow in open channels is the most frequently encountered situation during field investigations. An open channel is defined as any open conduit, such as a channel or flume, or any closed conduit, such as a pipe, which is not flowing full. The most commonly encountered methods in measuring open channel wastewater flows are described in this section. Several flow estimation techniques are also presented. Measurement accuracies quoted in this section apply only to the specific method, or to the primary flow device being discussed. The total error involved in a continuous flow measurement system, which is the sum of the errors of each component, is beyond the scope of this discussion. The reader is referred to the list of references at the end of this chapter for such a discussion.

Weirs

A weir is basically defined as an overflow structure built according to specific design standards across an open channel to measure the flow of water. Equations can be derived for weirs of specific geometry which relate static head to water flow (discharge). Weirs are generally classified into two general categories; broad crested and sharp crested.

Broad crested weirs use the following formula to determine flow (Q): $Q=CLH^{3/2}$. Where:

Q = discharge
C = discharge coefficient
L = length
H = head over the weir

The values for the coefficient C are given in hydraulic handbooks. Broad crested weirs can only be used to calculate instantaneous flows.

Sharp crested weirs are constructed in a wide variety of shapes, and the most commonly encountered are V-notch, rectangular, and Cipolletti weirs. If such weirs are constructed as outlined in the USDI Water Measurement Manual, they are considered standard primary flow devices. A flow measurement checklist for weirs, which includes a diagram of a sharp crested weir, is attached at the end of this section.

All weirs should be inspected to determine if the weir installation and construction conform to the conditions given in the USDI Water Measurement Manual, provide a uniform influent flow distribution, and that the weir is placed squarely across the channel perpendicular to the direction of flow. Useful tools for checking weir construction and installation include a carpenter's level, a framing square, a measuring tape, a staff gage, or surveyors level and rod. Problems observed during the inspection or study should be noted in the field records or logbook. A set of weir tables is necessary for calculating flows. The USDI Water Measurement Manual, the Stevens Water Resource Data Book, and the ISCO Open Channel Flow Measurement Handbook contain a complete set of tables.

A flow measurement checklist for weirs, which includes a diagram of a sharp crested weir, is attached at the end of this section. The checklist should be used to evaluate weirs when conducting an inspection.

Flumes

Conditions that must be met in a flume are similar to those that occur at a weir or spillway crest, since water passing through the throat section should not be impeded by downstream conditions (e.g., constrictions, bends in channel, obstructions). A flow measurement checklist for flumes, which includes a diagram of a Parshall flume, is attached at the end of this section. There are several types of flumes (e.g., Palmer-Bowlus, Cutthroat, H, and Trapezoidal) but the most widely used is the Parshall flume. The Parshall flume is considered a standard primary flow device when constructed and installed as outlined in the USDI Water Measurement Manual. A complete discussion of other types of flumes is given in the other references listed at the end of this Section. All flumes should be inspected to determine if entrance conditions provide a uniform influent flow distribution, the flume dimensions conform to those given in the USDI Water Measurement Manual, the floor of the flume at the throat section is level, and the throat section walls are vertical. Useful tools for checking the construction and installation of Parshall (and other) flumes include a carpenter's level, a framing square, and a measuring tape. The flume should be closely examined to determine if it is discharging freely. If there is any question about free discharge, the downstream head (Hb) should be measured and compared to the head at the proper location (Ha) in the converging section. A staff gage is useful for making head measurements. Any problems observed during the inspection or study should be noted in the field logbook. A set of flume tables is necessary for calculating flows. The USDI Water Measurement Manual, the Stevens Water Resources Data Book, and the ISCO Open Channel

Flow Measurement Handbook contain a complete set of tables. The explanatory material accompanying these tables should be read and understood before they are used. In many cases, tabulated flow values are given for measured heads that are not within the usable measurement range.

A flow measurement checklist for flumes, which includes a diagram of a Parshall flume, is attached at the end of this section. The checklist should be used to evaluate flumes when conducting an inspection.

A table representing appropriate dimensions for various sizes of Parshall flumes, their monitoring locations, and flow ranges is provided in a table on the next page.

Parshall flume Table
Dimensions, Monitoring location and Flow Range

W - throat width	**A** - converging section length	**2/3 A** - Monitoring location	Min Flow (MGD)	Max Flow (MGD)
1-inch	**14-9/32**	**9-17/32"**	**0.006**	**0.13**
2-inch	**16-5/16**	**10-7/8"**	**0.012**	**0.26**
3-inch	**18-3/8**	**12-1/4"**	**0.02**	**0.71**
6-inch	**24-7/16**	**16-5/16"**	**0.03**	**2.52**
9-inch	**34-5/8**	**23-1/8"**	**0.06**	**5.75**
12" (1-foot)	**54**	**36" (3'-ft)**	**0.07**	**10.41**
18"-inch	**57**	**38" (3'+2")**	**0.1**	**15.9**
24" (2-feet)	**60**	**40" (3'+4")**	**0.27**	**21.39**
36" (3-feet)	**66**	**44" (3'+8")**	**0.69**	**32.57**
48" (4-feet)	**75**	**48" (4-ft)**	**0.84**	**43.88**
60" (5-feet)	**78**	**52" (4'+4")**	**1.03**	**55.32**
72" (6-feet)	**84**	**54" (4'+8")**	**1.68**	**66.89**
84" (7-feet)		**60" (5-ft)**		
92" (8-feet)		**64" (5'+4")**	**2.30**	**90.17**
120" (10-feet)		**72" (6-ft)**	**3.71**	**128.4**
144" (12-feet)		**80" (6'+8")**	**5.13**	**224.2**
180" (15-feet)		**92" (7'+8")**		
240" (20-feet)		**112" (9'+4")**		
300" (25-feet)		**132' (11-ft)**		
360" (30-feet		**152" (12'+8")**		
480" (40-feet)		**192" (16-ft)**		
600" (50 feet)		**232" (19'+4")**		

Open Flow Nozzles

Open flow nozzles such as parabolic or Kennison nozzles are factory calibrated and are ordinarily supplied as part of a flow measurement system. Calibration and installation information for each nozzle should be supplied by, or obtained from the manufacturer. The accuracy of these devices is reported to be often better than ± 5 percent of the indicated flow. A volumetric flow measurement may be used to check accuracy of this device if flow volumes are not excessive.

Velocity-Area Method

The basic principal of this method is that the flow in a channel (cubic feet/second) is equal to the average velocity (in feet per second) times the cross sectional area (in square feet) of the channel. The velocity of the water, or wastewater, is determined with a current meter. The area of the channel is either measured, or calculated, using an approximation technique. Refer to Section 10.3 for Surface Water Flow Measurements.

10.2.7 Closed Conduit Flow Measurements

The accuracy of closed conduit flow measuring devices can be difficult to verify. Occasionally, it may be necessary to verify accuracy by making an independent flow measurement, using a dilution technique. Below are some of the more commonly used closed conduit devices.

Venturi Meter

The Venturi meter employs a conversion of static head to velocity head, whereby a differential is created that is proportional to flow. The typical accuracy of a Venturi meter is at 1 to 2 percent.

Orifice Meter

The orifice meter is a pressure differential device that measures flow by the difference in static head. Orifice meters require from 40 to 60 pipe diameters of straight pipe upstream of the installation. They can be accurate, e.g., within 0.5 percent, although their usable range is limited.

Flow Nozzle

The basic principle of operation is the same as that of the Venturi meter. The flow nozzle has an entrance section and a throat, but lacks the diverging section of the Venturi meter. Flow nozzle accuracies can approach those of Venturi meters.

Electromagnetic Flow Meter

The electromagnetic flow meter operates according to Faraday's Law of Induction where the conductor is the liquid stream, and the field is produced by a set of electromagnetic coils. The accuracy of the device is within ±1 percent of full scale.

Other Closed Conduit Devices

References for other closed conduit flow measurement methods such as acoustic flow meters, trajectory methods, pump curves, and water meters can be found in the NPDES Compliance Inspection Manual, United States Environmental Protection Agency, July 2004.

10.3 Surface Water Flow Measurements

10.3.1 Introduction

Surface waters are considered to be open channels for flow measurement purposes. Where installation of a primary flow device is practical, open channel flow measurement shall adhere to Section 10.2.6. Where installation of a primary flow device is not practical, flow measurements shall be made using stream gaging techniques.

Where practical, flow data and/or rating curves shall be obtained from existing permanent stream gaging stations maintained by the United States Geological Survey (USGS), the Army Corps of Engineers, or other federal or state agency. Where permanent stations do not exist, flow may be measured using stream gaging techniques. In making stream gaging measurements, Section personnel shall utilize the procedures outlined in the USGS publication Discharge Measurements at Gaging Stations:

- select the flow measurement site,
- perform stream gaging, and
- calculate flow.

If a station is to be used more than one time during a water quality survey, a rating curve may be developed for that station. A rating curve is constructed by making a series of independent flow measurements and simultaneous tape down or staff gage measurements for the same section of a particular station at different water levels and plotting the resulting data pairs on a semi-log graph. At least two (preferably three) flow measurement-tape downs shall be made to develop a rating curve.

Current meters can be used for conducting stream gaging. For wadeable streams, these meters may be deployed using a top-setting wading rod. Depth may be determined using Raytheon or Lowrance fathometers, taken from a standard top setting wading rod, or by taking the difference of tape down measurements of the river bottom and surface. Width measurements may be made using steel tapes, or cloth tapes.

10.4 Quality Assurance Procedures

Techniques and procedures for making wastewater and surface water flow measurements are outlined in this section. The USDI Water Measurement Manual, the USGS publication Discharge Measurements at Gaging Stations, and the NPDES Compliance Inspection Manual, United States Environmental Protection Agency, July 2004. A set of weir and flume tables are available to all field investigators. However, the measurements of wastewater and water flows require considerable experience. Therefore, no field investigator shall make flow measurements until they have had at least six months of actual field experience, and has performed these measurements under the supervision of a senior field investigator.

Wastewater flow shall be expressed in million gallons per day (mgd), or the metric equivalent (cubic meters per day (m^3/day)). Stream flow shall be expressed in cubic feet per second or the metric equivalent (cubic meters per second (m^3/sec)). Time records associated with flow measurements shall be kept in local time, and shall be made in the 2400 hour military time format.

All flow measurements conducted shall be documented in field records. All measurements shall be traceable both to the individual making the measurements and the equipment utilized. All field equipment shall be operated, calibrated, and maintained according to manufacturer's specifications. All equipment shall be visually inspected and tested prior to deployment to ensure proper operation.

10.5 Equipment

Equipment available for the measurement of surface water or wastewater flows are direct flow measurement equipment and instrumentation. The hardware available to determine flows include continuous recording ultrasonic flow meters from ISCO© (model 3210) and American Sigma (model 950).

10.5.1 ISCO© Model 3210 Flow Meter Configuration

The ultrasonic flow level sensor/transducer is suspended over the liquid and measures its level without contacting the flow stream. The time it takes the electronic pulse to return to the sensor is converted to a level, or height, of stream flow. The following is a list of the input and output ports on the model 3210 flow meter:

- 12 VDC port - this connects the 12 Volt DC power to flow meter (it is a 2 pin male connector).
- Sampler port - this connects the flow meter to sampler (it is 6 pin male connector).
- Interrogator port - this provides serial data in/out and power (it is 6 pin female connector).
- Ultrasonic port - this connects the ultrasonic level sensor/transducer to the flow meter (it is a 4 pin male connector).
- Remote port - this provides serial data to plotter (Model 2312) capability, (it is a 4 pin female connector).
- Printer port - this is a port used for printing program information in the field. It also is the input port for the tipping bucket rain gauge.
- Modem port - it connects the flow meter to telephone line (5 pin male connector).

10.5.2 ISCO© Model 3210 Flow Meter Setup and Operation

- In order for the Ultrasonic Level Sensor to make accurate measurements, the probe must be at least 1½ feet above the MAXIMUM EXPECTED height of the flow, and no more than 11 feet above the LOWEST expected height of flow. The cable is 25 feet long, and the sensor has a straightener attachment.

- When measuring flow rate the Ultrasonic flow meter is normally used with a primary measuring device, such as a weir or flume, or other open channel flow arrangement where a known relationship exists between level and flow rate. It can also be used to measure flow using the Manning equation for monitoring flow in pipes. The flow meter provides a means to set off flow-proportioned sampling and for recording flow rate information on a plotter.

- How does it work? - The Ultrasonic level sensor mounts over the stream and measures liquid level by emitting an ultrasonic pulse and measuring the time it takes for the echo to return from the surface of the liquid. The speed of the pulse through the air varies with temperature (± 1% for 10 °F variation), but compensation for this error is built in to the unit.

10.5.3 ISCO© Model 3210 Flow Meter - Known problems

- Noise in the 40 khz frequency range can render the system unuseable.

- Surface objects, such as foam floating on the surface can absorb or weaken pulses.
- Temperature: ± 1% for 10°F variation.

- Waves can deflect sound energy so that it does not return to the transducer directly.

- Beam Angle (10 degrees), if the beam angle is too wide it may detect unwanted surfaces.

- Wind can blow the sound away, or reduce the intensity of the returned echo.

10.5.4 ISCO© Model 3210 Flow Meter - Keypad Layout and Functions:

- Arrow Left (←) - used to select a menu option. Also, used in LEVEL ADJUST program step.

- Arrow Right (➔) - used to select a menu option. Also, used in LEVEL ADJUST program step.

- ± (Plus or Minus) - used when entering equation.

- PRINT PROGRAM - When in normal operating state pressing this key will produce a hard copy of the program selections by the printers internal printer. After setting up the flow meter it is a good idea to print this data out.

- CHART ADVANCE - This key causes the chart to advance as long as the key is pressed.

- . (Decimal) - used to enter numeric values into the program.
- Number Keys - used to enter numeric values into the program.
- ENTER PROGRAM STEP - When the power switch is turned on, pressing this key will allow the user to enter the program to make changes. THERE IS ALWAYS A PROGRAM IN MEMORY. You can also view the program in memory by pressing this key. As each entry is displayed the SELECTED entry will flash. Press the ENTER PROGRAM STEP key to enter the value selected into memory, and advance to the next step in the program.
- CLEAR ENTRY - provides the user with a way to return to a previous entry of a program step.
- GO TO PROGRAM STEP - Pressing this key followed by the keys corresponding to a particular program step number takes you to that program step (1-11).
- EXIT PROGRAM - This key is used to put the flow meter back into the "running" state after changes have been made to the program.
- PRINT REPORT - This key is used to print a flow or level data report IF the report generation feature was enabled.

10.5.5 ISCO© Model 3210 - Programming the Flow Meter

Use the ENTER PROGRAM STEP key to program the flow meter. There are 11 steps to go through, but all of the programming can be done back in the office, except for the "LEVEL ADJUST", if you know exactly what will be on site.

In order to minimize flow level measurement errors:

- Avoid temperature differences between the level sensor and the flow stream, since the flow meters compensation will be based on the level sensor. For example, at 35 °F difference, the level error = 0.001 X 35 x 2 feet = 0.070 foot (or about 1 inch), and at 10 °F difference, the level error = 0.001 X 10 x 2 feet = 0.020 foot (or about ¼ inch).
- Calibrate at the expected temperature, and check if the temperature changes.
- Avoid foam, oil and areas where the water flow is turbulent.
- Place the sensor/transducer to avoid windy areas.
- Mount the sensor/transducer at least 18 inches above the maximum expected water level, if possible.

FLOW Measurement Checklist for WEIRS

WEIRS - a dam or obstruction across an open channel over which liquid flows. Common weirs include rectangular (with and without end contractions), V-notch and Cipolletti.

1. Is the top of the weir thin or beveled (with a sharp upstream corner)? Y____ N____
2. Is the weir plate thin (1/8 - 1/4-inch thick) with a straight edge? Y____ N____
   or, if there is a thicker weir plate does it have a chamfered edge? Y____ N____
3. Is the upstream edge of the weir sharp with right angled corners? Y____ N____
4. Is the upstream face of the weir smooth and perpendicular? Y____ N____
5. Is the crest of the weir EXACTLY level? Y____ N____
6. Is the connection of the weir to the channel waterproof? Y____ N____
7. Is the length of the weir crest (or notch angle) accurately measured? Y____ N____
8. Does the nappe spring free of the weir plate? Y____ N____
9. Is the height (H) of the crest of the weir at least two times the Maximum expected head of the liquid above the crest? Y____ N____
10. Is the approach section straight for a distance of 20 times the Maximum head, and have little or no slope? Y____ N____
11. Is the weir submerged? Y____ N____
12. Is the flow sensor for the flow meter located at least three times back from the distance of the Maximum head?, or, 4 times from the head plate? Y____ N____
13. Is the flow sensor for the flow meter in a quiet section (or in a stilling well)?Y____ N____
14. Is the zero point of the head (flow) measuring device set EXACTLY level with the weir crest? How it this determined? Y____ N____
15. Is the weir crest kept clean? Y____ N____
16. Is the upstream side of the weir kept free of silt and solids? Y____ N____
17. Is the velocity of the flow uniformly distributed over the channel? Y____ N____
18. If measuring with an ultrasonic sensor, is there foam present? Y____ N____
19. Can the flow monitoring system measure normal and maximum flows? Y____ N____
20. How often is the flow monitoring system calibrated? 1x per year? Y____ N____
21. Is the total flow being monitored? Any flow after the weir? Y____ N____

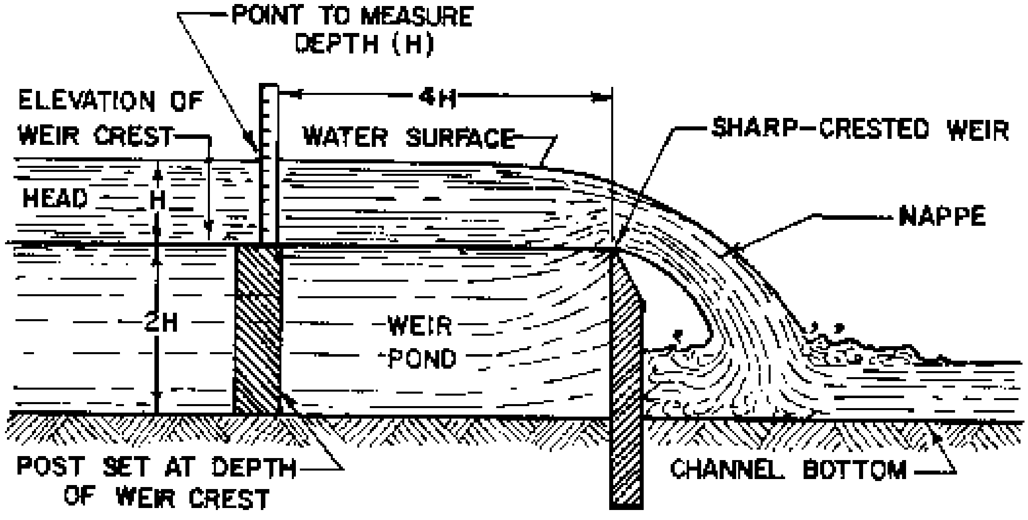


FIGURE I.—PROFILE OF A SHARP-CRESTED WEIR

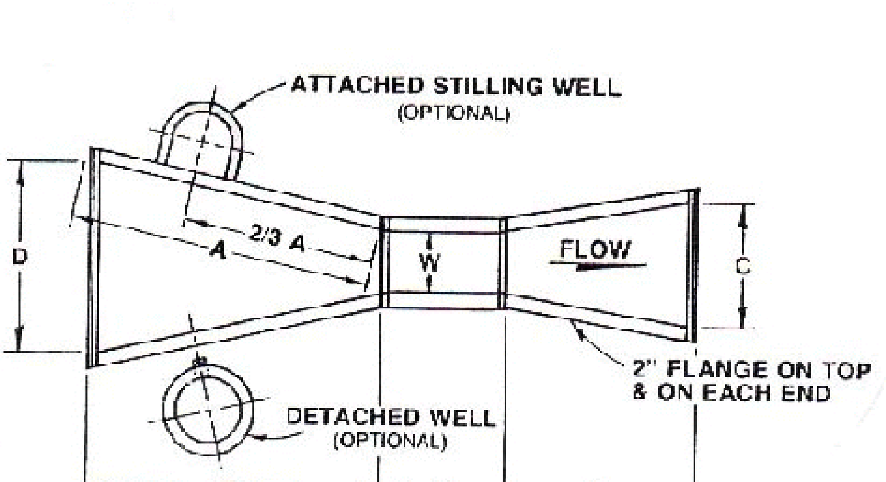
FLOW Measurement Checklist for FLUMES

Flumes - Specially shaped open channel device with a restriction and/or a change in channel slope that results in an increased velocity. Flumes measure Higher flows than comparably sized weirs. Flumes are better suited to measure flows containing sediment or solids, since they are designed to be self cleaning. They are more expensive than weirs. Common flumes include Parshall, Palmer-Bowlus, and “H” flumes.

1. Is the flume in a straight section of the channel without bends immediately upstream that would affect the laminar flow in the channel? Y____ N____
2. Is the approaching flow free of turbulence and waves, and evenly distributed across the channel? Y____ N____
3. Is the flume submerged? Y____ N____
4. Is the flow measured at exactly 2/3 the distance upstream of the converging section of the flume? Y____ N____
5. Is the staff gauge located at the proper location? Y____ N____
6. Is the staff gauge zero aligned with the zero of the primary device? Y____ N____
7. Is the flume level? Y____ N____
8. Is the floor of the flume calibrated to zero flow? Y____ N____

If a stilling well is used:

9. Is the inlet to the stilling well located properly? Y____ N____
10. Can the inlet be easily cleaned out (especially if there are significant amounts of solids in the liquid? Y____ N____



PLAN VIEW

10.6 References

1 Water Measurement Manual, Second Edition, Revised, United States Department of Interior, Bureau of Reclamation, 1981. Available from the United States Government Printing Office, D.C. 20402.

2 Handbook of Hydraulics, Seventh Edition, Ernest F. Brater, Horace Williams King, James E. Lindell, C. Y. Wei; McGraw-Hill; New York, March 1996.

3 NPDES Compliance Inspection Manual, United States Environmental Protection Agency, July 2004. Available as a PDF file at: http://www.epa.gov/compliance/resources/publications/monitoring/cwa/inspections/npdesinspect/npdesmanual.html

4 US EPA, Region 4, Ecological Assessment Branch Standard Operating Procedures (EABSOP), 2001.

5 Stevens Water Resource Data Book, Third Edition, Leopold Stevens, Inc.: Beaverton, Oregon, 1978.

6 ISCO Open Channel Flow Measurement Handbook, Fifth Edition, First Printing, Instrumentation Specialists Company: Lincoln, Nebraska, 1997.

7 Discharge Measurements at Gaging Stations, Hydraulic Measurement and Computation, Book I, Chapter 11, United States Department of Interior, Geological Survey, 1965.

8 Sewer Flow Measurement: A State-of-the-Art Assessment, Municipal Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency: Cincinnati, Ohio, 600-2-75-027, November 1975.

9 A Guide to Methods and Standards for the Measurement of Water Flow, United States Department of Commerce, National Bureau of Standards, NBS Special Publication 421, 1975.

SECTION 11
SURFACE WATER SAMPLING

PERFORMANCE OBJECTIVE:

- To collect a representative sample of the surface water of interest.

11.1 Introduction

Surface water sampling techniques and equipment are designed to minimize effects on the chemical and physical integrity of the sample. If the guidance provided in this section is followed, a representative sample of the surface water should be obtained. The physical location of the investigator, when collecting a sample may dictate the equipment to be used. If surface water samples are required, direct dipping of the sample container into the stream is desirable. This is possible, however, only from a small boat, a pier or bridge, etc., or by wading in the stream. Wading, however, may cause the re-suspension of bottom deposits and bias the sample. Wading is acceptable if the stream has a noticeable current (is not impounded), and the samples are collected while facing upstream. If the stream is too deep to wade, or if the sample must be collected from more than one water depth, or the sample must be collected from a bridge, etc., supplemental sampling equipment must be used.

Once samples have been collected, and placed into a properly labeled sample container, the sample should be preserved, if necessary. If a pre-preserved sample bottle is used, take care not to overfill it. Depending on the parameter to be analyzed, cool the sample to 4 degrees Centigrade and place out of direct sunlight. Record all pertinent data in the site logbook and/or on field data sheets, and complete the Chain of Custody record, if needed. If shipping, attach custody seals to the cooler prior to shipment.

11.2 Surface Water Sampling Equipment

11.2.1 Direct Method: Dipping Using Sample Container

A sample may be collected directly into the sample container when the surface water source is accessible by wading, or other means. This method is not to be used for sampling areas where contact with pollutants is a concern.

Using adequate protective clothing, access the sampling station by appropriate means. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and the boat wake. When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation. The surface water sample should always be collected prior to the collection of a sediment sample at the same location.

11.2.2 Discrete Depth Samplers

When discrete samples are desired from a specific depth, and where site access is from a boat, helicopter or structure such as a bridge or pier, a standard Kemmerer or Van Dorn sampler may be used. The Kemmerer sampler is a stainless steel, brass, or teflon cylinder with rubber stoppers that leave the ends of the sampler open while being lowered in a vertical position, thus allowing free passage of water through the cylinder. The Van Dorn sampler is plastic and is lowered in a horizontal position.

Set the sampling device so that the sampling end pieces are pulled away from the sampling tube (body) and place in a cocked opened position allowing the substance to be sampled to pass through this tube. Lower the preset sampling device to the predetermined depth, and avoid disturbing the bottom sediments. Once at the required depth, a “messenger” is sent down a rope to cause the stoppers to close the cylinder. Retrieve the sampler and discharge the sample from the bottom drain. Discard the first 10-20 mls of samplle to clear any potential contamination of the valve. Transfer the sample to the appropriate sample container.

With a plastic or rubber tube attached to the valve, dissolved oxygen sample bottles (BOD bottles) can be properly filled by allowing an overflow of the water being collected. Insert the plastic or rubber tube to the bottom of the bottle. Fill the bottle to overflowing for approximately 10 seconds, while trying to minimize turbulence and the formation of bubbles while filling. When filling other bottles, care should be taken not to make contact between the sampling device and the bottle.

11.2.3 Peristaltic Pumps

Another device that can be effectively used to sample a water column, such as a shallow pond, is the peristaltic pump. The use of a metal conduit to which the tubing is attached, allows for the collection of a vertical sample (to about a 25-foot depth) which is representative of the water column. Or a weight attached to the tubing can be used to collect a discrete sample. At each sampling point the tubing should be new or properly cleaned and flushed with sample.

11.2.4 Buckets

A plastic bucket can be used to collect samples for in-situ analyses, e.g., pH, temperature and conductivity. However, the bucket should be rinsed twice with the sample water prior to collection of the sample.

11.2.5 Water Column Profiler/Recorder

When an *in situ* water column profile of depth, temperature, conductivity, and/or dissolved oxygen is needed, a water column recorder can be operated from a vessel of any size, although having a mechanism to raise and lower the profiler is helpful. The SEABIRD Sealogger model 25 profiler consists of a set of sensors and electronics enclosed in a steel protective cage to allow collection of water column data in marine or fresh-water environments to depths of 6800 m. Data can be transmitted in real-time if the communication/power cable is connected or the data can be downloaded when the instrument is on-board. Software is available from SEABIRD for system configuration, communication, and data processing. Readings can be taken automatically at a frequency of 1, 2, 4, or 8 times a second. Sensors for pH, chlorophyll, photosynthetically active radiation (PAR) can added. A carousel can also be added to obtain water samples.

The SEABIRD manual can be found at:
http://www.seabird.com/pdf_documents/manuals/25_013.pdf

SECTION 12
HELICOPTER SAMPLING PROGRAM

12.1 Helicopter Operations

EPA helicopters and rented or leased helicopters are to be boarded only by authorized personnel. Authorization to board helicopters will be determined by the senior EPA official present.

Training of new employees who will be working in helicopters during the regular monitoring season will occur at the beginning of each season. This safety training is mandatory for all DESA employees who will work in the helicopter as part of their regular duties, as well as those employees who will serve as alternates for regular helicopter personnel. This training is also recommended for other employees who expect to fly in helicopters for purposes other than water sampling, such as hazardous waste site reconnaissance and oil spill sighting.

Helicopter Safety Training will be given to regular crews by the Office of Aircraft Services on a regular basis and will include the following:

1 Film and/or videotape on helicopter safety and ditching survival

2 A lecture by a trained individual on helicopter safety and personal protective equipment, and a general orientation on helicopter capabilities and limitations.

3 A helicopter ditching exercise or video thereof will take place once each season and will be led by the Office of Aircraft Services.

Two mobile dry chemical fire extinguishers are to be located at the helicopter pad for possible use. If for some reason those extinguishers become inoperable, handheld units shall be used, but efforts should be made to restore the main units to available status.

Boarding - Helicopters should never be entered or exited while rotor blades are in motion, except in an emergency situation, or when directed by the pilot. If you must board while the rotors are moving, the following rules should be observed:

1. Stay away from the rear of the helicopter
2. Crouch low before getting under the main rotor.
3. Approach from the side or front, making sure to establish eye contact with the pilot before approaching the helicopter.
4. Hold firmly to hats and loose articles.
5. Never reach up or dart after a hat or other object that might be blown off or away.
6. Protect eyes by shielding with a hand or by squinting.
7. If suddenly blinded by dust or a blowing object, STOP, CROUCH LOWER OR BETTER YET, SIT DOWN AND WAIT FOR HELP.

8. NEVER GROPE OR FEEL YOUR WAY TOWARD OR AWAY FROM THE HELICOPTER.

12.2 Pre-take off Briefing

Since few helicopters carry cabin attendants, this briefing must be made by the pilot, or other qualified personnel, as directed by the pilot. The type of operation will dictate what sort of briefing is necessary. Passengers should always be briefed on:

1. Basic safety procedures as described above.
2. Over water flights: The location and use of floatation gear and other survival equipment that might be on board. How and when to abandon ship should a ditching be necessary.
3. Flights over rough or isolated terrain: All occupants should be told where maps and survival gear are located.
4. Emergency instructions: In the event of an emergency, passengers should follow the pilot's specific instructions.
5. Pre-landing Briefing - The nature of the landing area will determine what the passengers need to be told.
6. Protective Apparel - All personnel when flying in the EPA helicopter over water at such a distance to preclude safe autorotation onto land shall wear a survival suit under any of the following conditions:
   - The water temperature is less than 60 °F.
   - The combined water and air temperature is less than120 °F.

Each employee flying in the helicopter as part of his/her regular duties will be supplied with a flight helmet. Wearing this equipment will provide protection from blows to the head and will also provide hearing protection. Foam earplugs are available for use to provide additional hearing protection. The earplugs are not required since the flight helmet sufficiently reduces the outside noise.

Night Operations

No landings except in an emergency are to be made at the EPA helicopter pad after dark. Landings of contract helicopters after dark will be made at their private helicopter pad if approved for nighttime landings or at a commercial airport. The EPA helicopter will land at a commercial airport with a helicopter pad approved for night landings.

Toxic Plumes

Under no circumstances is the EPA helicopter to be flown intentionally into or through the plume of a fire, explosion, factory exhaust, or other source of potentially hazardous fumes. Airborne surveillance of such plumes or events is extremely hazardous. Since the use of respiratory protection is not recommended for the helicopter pilot or passengers, the helicopter is not to be used for any sampling or surveillance mission for which respiratory protection would be needed.

Communications Procedures

Flight Plan: A flight plan should be filed with a certified FAA Flight Service Station, prior to all flights. The pilot will take responsibility in filing and canceling the flight plan.

1. Landing: The Branch Chief is responsible for ensuring that the communications console is to remain on during business hours and is to be monitored throughout the day while helicopter operations are under way. When necessary, the Branch Chief will ensure that at least one console is monitoring an airborne unit.

2. Prior to flying offshore, the pilot shall contact the appropriate U.S. Coast Guard Air Station to arrange the radio guard procedures. The Air Station will be notified every fifteen minutes, with reports that include the helicopter’s current position, the number of people on board, and the amount of fuel. When your call is fifteen minutes overdue, and the Coast Guard is unable to reach the helicopter by radio, a U.S. Coast Guard helicopter will take off for search and rescue.

3. As part of the helicopter safety equipment, helicopters have emergency location transmitters (ELT) which are automatically activated in the event of a crash. The ELT operates on frequency VHF 121.5 Mhz and UHF 243.0 Mhz and has a normal line of sight range of 150 miles.

SECTION 13
SEDIMENT SAMPLING

PERFORMANCE OBJECTIVE:

- To collect a representative sample of sediment from a surface water body.

13.1 Introduction

Sampling techniques and equipment are designed to minimize effects on the chemical and physical integrity of the sample. If the guidance in this section is followed, a representative sample of the sediment should be obtained. The physical location of the investigator when collecting a sample may dictate the equipment to be used. Wading is the preferred method for reaching the sampling location, particularly if the stream has a noticeable current (is not impounded). However, wading may disrupt bottom sediments causing biased results. If the stream is too deep to wade, the sediment sample may be collected from a boat. The equipment that can be used to collect sediment samples will vary based on the physical location of the sediment, its particle size distribution and compaction, and the final use of the data. The sediment collection information presented is mainly taken from Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses (USEPA, 2001), Assessing Aquatic Ecosystems Using Pore Waters and Sediment Chemistry (Burton, 1998), and an EPA Technology website on Sampling for Contaminants in Sediments and Sediment Pore Water (which can be found on the internet at: http://clu-in.org/programs/21m2/sediment/. The technology website provides a survey of the equipment that can be used to collect sediment and pore water samples. The website also provides useful diagrams of most of the sampling equipment that is used to collect sediment samples.

13.2 Sampling considerations

The physical location considerations include the depth of the water body overlying the sediment and the strength of the current present. Unless the sampling event is to occur in a very shallow environment, a bathymetric survey, conducted prior to choosing the sampling equipment is recommended, and a general understanding of the current to be encountered needs be obtained. Particle size distribution and compaction generally dictate whether a given sampling device is capable of obtaining a sample of the target sediment. Coring devices are usually not effective in gravelly bottoms, and grab samplers may have problems in areas where there is extensive vegetative debris or compacted sediment.

The data quality objectives established for the project determines the depth horizon needed for the sediment sample, the volume required, and the acceptable degree of disturbance. For investigations concerned with recent contamination events or the affects of contaminated sediments on the benthic community, the sampling horizon is generally in the 10 to 15 cm range (EPA, 2001). On the other hand, if historical deposition patterns are the focus, or the actual thickness of contaminated sediment is needed for remedial evaluations, then the required depth may extend to several meters or more.

The type of chemical or toxicological testing that needs to be performed influences both the required volume of sediments and the amount of disturbance that can be tolerated. A full chemical suite of analytical testing for the presence of contamination requires a large volume of sediments which will result in some degree of disturbance. When the concern is bioavailability, a large quantity of sediments may be required for testing while preserving the in situ redox conditions to the extent possible (EPA, 2001). Preserving redox conditions requires maintaining the sample's integrity by minimizing disturbances in the sediment's structure and exposures to conditions (atmospheric oxygen) that might change the chemical balance (EPA, 2001). Also the materials the sampler is constructed of needs to be evaluated to determine if they will have any impact on the chemical integrity of the sample.

Typical volume requirements for various analyses for the EPA Region 2 laboratory are found in Appendix A of this SOP. The EPA Technology website on Sampling for Contaminants and Sediments and Sediment Pore Water (which can be found on the internet at: http://clu-in.org/programs/21m2/sediment/, provides information on the advantages and disadvantages of the more commonly used core samplers and grab samplers (see Tables 2 and 3, respectively). In addition, Tables 2 and 3 of the EPA Technology website, also provides information pertaining to the depth of sample that can be taken, and the volume of material, that can be collected by each sampling device.

The bioavailability of chemicals in sediments is often estimated using sediment pore water (Burton, 1998). Pore water can be obtained by ex-situ (centrifuge, suction, or pressure) methods or in situ (probe pumping or diffusion) methods. While in situ methods generally are better than ex situ at preserving the samples integrity, logistical constraints such as the depth of the water, or the volume of sample required, sometimes leave ex situ methods as the only viable choice. If ex situ methods are needed, centrifugation is the preferred method (EPA, 2001).

13.3 Sampling Equipment

In addition to the physical conditions at a site (water depth, sediment type, current strength), the choice of sampler from among the wide variety available depends on what the data objectives are (e.g., undisturbed core to determine sedimentation history, maintenance of sample redox conditions, sample analysis volume requirements). Sampler descriptions may be divided into two large groups: those capable of providing sediment solids and pore water and those capable of collecting pore water alone.

Regardless of the method used, precautions should be taken to insure that the sample collected is representative of the water body. These methods are discussed in the following paragraphs.

13.3.1 Scoops and Spoons

If the surface water body is wadeable, the easiest way to collect a sediment sample is by using a plastic or stainless steel scoop or spoon. Sampling is accomplished by wading into the surface water body and while facing upstream (into the current), scooping the sample along the bottom of the surface water body in the upstream direction. Excess water may be removed from the scoop or spoon. However, this may result in the loss of some fine particle size material associated with the bottom of the surface water body. Care should be taken to minimize the loss of the fine particle sizes. Aliquots of the sample are then placed in a stainless steel or glass pan, and homogenized according to the quartering method described in Section 5.11.8 of this SOP.

13.3.2 Dredge and Grab samplers

Although similar in mechanical design to grab samplers, dredges are generally designed to efficiently remove bottom sediments with little regard for maintaining the integrity of the sediment. The bucket and dipper designs are examples of these. In the bucket design (e.g. clamshell and orange peel), the device is dropped into the sediment with its jaws open. After penetrating the sediment, the jaws are closed and the bucket of sediment is raised to the surface. Newer designs make the closed bucket water proof so potentially contaminated water does not drain out the bottom. However, these designs can cause considerable disturbance of the sediment stratigraphy, and washout of surficial materials is common. The dipper design resembles the surface operating steam shovel where a rigid bucket is driven into the sediment in a scooping motion before bringing the sediment to the surface. This design also is subject to severe washout problems. Dredge samplers are generally not recommended for environmental sampling, but may be useful in benthic collection (EPA, 2001).

Grab samplers are designed to minimize the bow wave caused by the sampler's descent. They typically do this by incorporating flaps on the top of the sampler that open as the sampler moves down to allow water to pass through rather than being pushed ahead. Also, unlike the dredging equipment, grab samplers are designed to minimize disturbance of the sediment when the sample is taken and brought to the surface. The flaps mentioned above are closed during ascent to protect the surface of the sample and prevent washout.

- **Birge-Ekman** style grab samplers vary in size, with larger models requiring a winch for operation. The spring-tensioned jaws are mounted on pivot points and are set with a trigger assembly that is activated from the surface by weighted messenger. Flaps on the top of the sampler open during descent to allow water to flow freely through, and close during ascent to reduce the loss of sample. The sediment can be subsampled through the flaps. Birge-Ekman samplers are suitable for collecting, soft, fine-grained sediments. Larger matrices (gravel, shells) and vegetative matter tend to prevent the jaws from fully closing, which results in sample loss and the need to resample (Resources Inventory Committee, 1998). Birge-Ekman samplers may be restricted to low current situations, and have been known to lose fine surface sediments during retrieval. The Birge-Eckman dredge has only limited usefulness. It performs well where the bottom material is unusually soft, as when covered with organic sludge, or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms, and is too light for use in streams with high velocities. It should not be used from a bridge that is more than a few feet above the water, because the spring mechanism which activates the sampler can be damaged by the messenger if dropped from too great a height.

- **Petersen** grab samplers consist of a pair of weighted, semi-cylindrical jaws that are held open by a catch bar. The impact with the sediment loosens the tension on the catch bar allowing the jaws to close. Additional weights can be added to the jaws to provide better penetration into harder compacted sediment. As there is no access through the top of the sampler, only bulk samples can be taken. Petersen samplers are suitable for collection of hard bottom material such as sand, marl, gravel, and firm clay (Resources Inventory Committee, 1998). These samplers are restricted to low current conditions and may produce a bow/shock wave that disturbs fine grained sediments. For routine analyses, the Peterson dredge can be used when the bottom is rocky, in very deep water, or when the stream velocity is high. The dredge should be lowered very slowly as it approaches bottom, since it can displace and miss fine particle size sediment if allowed to drop freely. In the presence of cobbles or vegetative debris the jaws may not completely close.

- **Ponar** grab samplers come in two sizes (standard and petite) and have a pair of weighted, tapered jaws that are held open by a catch bar. The sampler is triggered by impact with the sediment bottom. The upper portion of the sediment jaws is covered with a mesh screen that allows water to freely flow during descent, thereby reducing the bow wave that precedes the sampler and reduces disturbance of the sediment surface. Upon recovery, the wire mesh can be removed to allow subsampling. Ponar grabs can sample fine-grained to coarse materials (Resources Inventory Committee 1998). The standard sampler is heavy and requires a winch for deployment. However, the 1-liter petite may not penetrate the sediment to the desired depth and may require multiple deployments to obtain sufficient sediment sample. Both samplers are subject to incomplete closure and loss of sample in large grained sediments, or those with vegetative matter. The Ponar dredge is a modification of the Peterson dredge and is similar in size and weight. It has been modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing turbulence around the dredge. The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The petite Ponar dredge is a smaller, much lighter version of the Ponar dredge. It is used to collect smaller sample volumes when working in industrial tanks, lagoons, ponds, and shallow water bodies. It is a good device use when collecting sludge and sediment containing hazardous constituents, because the size of the dredge makes it more amenable to field cleaning.

- **Shipek** grab samplers have a top cast half cylinder barrel attached to a lowering wire with stabilizing bars to keep the sampler vertical. Within this barrel is a second sampling cylinder that is activated by a high torque spring. When activated, the second cylinder rotates 180 degrees through the sediment and forms a seal with the upper cylinder. The sample is removed from the sampler by disconnecting it from the upper assembly. The sampler is designed for unconsolidated sediments in deep lakes and near offshore locations to a depth of approximately 10 cm. Hard, compacted sediments can present sampling problems and washout of fines can occur during the ascent of the sampler from the bottom have been reported with some designs. Large objects such as pieces of wood or shells can be trapped as the sampler closes, causing washout when it is drawn to the surface.

- **Smith-McIntyre** grab samplers are mounted on steel frames that can be weighted and ensure the sampler remains vertical. The two spring-loaded jaws are released when the frame comes to rest on the bottom. The jaw tops are covered with brass screens and rubber flaps to minimize the bow wave on the descent and prevent sample washout on the ascent. The sediment sample can be subsampled from the top of the sampler. The typical sampled area is about 31 cm by 31 cm square. Smith-McIntyre samplers can sample soft, fine-grained to sandy sediments and are designed primarily for deployment in marine environments. The sampler requires a power winch to deploy.

- **Van Veen** grab samplers are manufactured in several sizes. A stainless steel screen with rubber flaps covers the top of the jaws. This design allows the sampler to be lowered to the bottom with a minimum bow wave, thus preserving the integrity of the sediment surface. Upon reaching the bottom the tension in the lowering wire slackens, releasing the small chains holding the jaws open. Pulling up on the lowering chain engages the chains attached to the jaw arms, causing them to bite into the sediments and close. Latches on the jaws ensure they stay closed. The sediment sample may be subsampled through the removal of the screens on the jaws. Lead weights are available to improve the sampler's penetration into the sediment. This sampler is effective in fine-grained to sandy sediments that are in deep water and strong currents. The sampler may not close completely resulting in loss of sediments and requires a winch to deploy.

13.3.3 Core Sampling Devices

Core samplers are used to sample vertical columns of sediment. They are particularly useful when a historical picture of sediment deposition is desired since they preserve the sequential layering of the deposit, and when it is desirable to minimize the loss of material at the sediment-water interface. Many types of coring devices have been developed depending on the depth of water from which the sample is to be obtained, the nature of the bottom material, and the length of core to be collected. They vary from hand push tubes to electronic vibrational core tube drivers.

Coring devices are particularly useful in pollutant monitoring because turbulence created by descent through the water is minimal, thus the fines of the sediment-water interface are only minimally disturbed; the sample is withdrawn intact permitting the removal of only those layers of interest; core liners manufactured of glass or Teflon® can be purchased, thus reducing possible sample contamination; and the samples are easily delivered to the lab for analysis in the tube in which they were collected. The disadvantage of coring devices is that a relatively small surface area and sample size is obtained often necessitating repetitive sampling in order to obtain the required amount of material for analysis. Because it is believed that this disadvantage is offset by the advantages, coring devices are recommended in sampling sediments for trace organic compounds, or metals analyses.

In shallow, wadeable waters, the direct use of a core liner, or tube, manufactured of Teflon®, plastic, or glass is recommended for the collection of sediment samples. (Plastic tubes are principally used for collection of samples for physical parameters such as particle size analysis). Their use can also be extended to deep waters when SCUBA diving equipment is utilized. Teflon® or plastic are preferred to glass since they are unbreakable which reduces the possibility of sample loss. Stainless steel push tubes are also acceptable and provide a better cutting edge and higher strength than Teflon®. The use of glass or Teflon® tubes eliminates any possible metals contamination from core barrels, cutting heads, and retainers. The tube should be approximately 12 inches in length if only recently deposited sediments (8 inches or less) are to be sampled. Longer tubes should be used when the depth of the substrate exceeds 8 inches. Soft or semi-consolidated sediments such as mud and clays have a greater adherence to the inside of the tube, and can be sampled with larger diameter tubes. Because coarse or unconsolidated sediments such as sands and gravel tend to fall out of the tube, a small diameter is required for them. A tube about two inches in diameter is usually the best size. The wall thickness of the tube should be about 1/3 inch for Teflon®, plastic, or glass. The inside wall may be filed down at the bottom of the tube to provide a cutting edge to facilitate entry of the liner into the substrate. Caution should be exercised not to disturb the bottom sediments when the sample is obtained by wading in shallow water. The core tube is pushed into the substrate until four inches or less of the tube is above the sediment-water interface. When sampling hard or coarse substrates, a gentle rotation of the tube while it is being pushed will facilitate greater penetration and decrease core compaction. The top of the tube is then capped to provide a suction and reduce the chance of losing the sample. A Teflon® plug or a sheet of Teflon® held in place by a rubber stopper or cork may be used. After capping, the tube is slowly extracted with the suction and adherence of the sediment keeping the sample in the tube. Before pulling the bottom part of the core above the water surface, it too should be capped.

In deeper, non-wadeable water bodies, sediment cores may be collected from a bridge or a boat using different coring devices such as Ogeechee Sand Pounders®, gravity corers and vibrating coring devices. All three devices utilize a core barrel with a core liner tube system. The core liners can be removed from the core barrel and replaced with a clean core liners, as needed, after each sample. Liners are made of either stainless steel, Teflon or plastic. The type of core liner, and its composition, should be based on the compounds that will be analyzed.

Ogeechee Sand Pounders® and gravity corers are hand held devices that use a standard size 2" core barrel. The core tube and liner are interchangeable between the two units. The Ogeechee® uses a slide hammer mechanism attached to the core head that allows the sampler to pound the core tube into the sediment. The Ogeechee® is good for sandy, more consolidated sediments. The gravity corer uses a guiding fin mechanism with a built in gravity type check valve. The gravity corer is placed in the water and released at the surface to free fall to the bottom. The fin mechanism keeps the core tube upright and free from spinning in the water column as it descends. The core tube stabs the bottom forcing the sediment into the tube. Both coring devices are equipped with removable nose pieces on the core barrel and disposable core catchers for the liner tubes. The core catchers are designed to cap the liner tube to avoid loss of the core when retrieved from the bottom. The gravity corer can be modified to attach a slide hammer mechanism, similar to the Ogeechee®, to further pound the corer into the sediment further if deemed necessary.

Sediment cores collected from most hand operated coring devices can suffer from either spreading or compaction when driven into the sediment, depending on the softness of the sediment. Spreading occurs when the sediment is pushed, or moved to the side, during the advancement of the core tube. Compaction is when the sediment is being pushed downward as the core tube is advanced. Both phenomena can affect the physical integrity of core sample. For instance, the core tube may be advanced through the sediment to a depth of 36 inches, but upon examination of the recovered core there are only 24 inches of sediment in the core tube.

- **Hand Corers** are generally suitable for collecting sediment samples in marshes, streams, and shallow rivers, or at some depth by a diver. Depending upon the sediment composition, the samples typically are less than 1 meter in depth. Samplers need to be equipped with a top valve that allows water to pass through when set in the sediment and closes during withdrawal to prevent washout. An alternative design is a piston type device that forms a seal with the corer walls and is drawn or pushed up as the sample is collected. The piston maintains a vacuum against the top of the sediment which aids in its retention and prevents water from entering the sampler during withdrawal.

- **Russian Peat Borers** are another form of hand corer that are side filling and are designed to collect relatively uncompressed sediment samples. The components of the borer include a stainless steel, chambered core tube; extension rods, a stainless steel turning handle; and a core head and bottom point that support a stainless steel cover plate. The cover plate is curved and sharpened to minimize disturbance when the sampler is driven into the sediment. Once driven to the target depth, the core tube is rotated clockwise to fill the tube by cutting out a segment of sediment. The borer is capable of obtaining samples at depths of 10 feet or more, with little sample loss (USEPA, 1999).

- **Ogeechee™ Sand Corers** are another form of hand corer that have been designed to specifically sample sandy sediments. The corer consists of a core head that contains a check valve that can be manually closed by the operator, a stainless steel core body with plastic liner and core catcher, and driving tip. The sampler can be twisted or hammered into the sediment. Extension handles allow for sampling in deeper water (15 feet) and it can be used in fast moving water that can adversely affect the performance of gravity type corers.

- **Alpine gravity corers** are finless with a heavy (45 kg, 100 lb) lead weight attached at the top. The core tube ID is 4.1 cm and can be up to 1.8 m (6 ft) long. A valve at the top of the sampling tube is maintained by a light spring that allows the valve to open during descent and close after the sampler penetrates the sediment. The closed valve protects the sample from washout during ascent. It has been reported that this sampler may have problems entering the sediments vertically. Also, examination of the cores showed sheared laminae and disturbed surfaces of the sediment samples.

- **Benthos gravity corers** weigh approximately 25 kg (55 lbs), and with extra lead weights, require a winch or crane to deploy. The core tube ID is 6.6 cm, and the upper section has been equipped with fins to aid in vertical descent. The core tube can recover up to 3 m of sediment. A removable valve system, located at the top of the core liner, allows water to pass through during descent. The valve closes against a machined seat when the retrieval process is begun to prevent wash out. Benthos gravity corers may compact the sediment sample.

- **Boomerang corers** are free falling samplers that weigh approximately 85 kg (187 lbs) and are deployed directly from the side of a boat. They utilize a disposable ballast section (nose cone, pilot weight, core barrel, weights, float release mechanism), and a retrievable float section (two glass spheres tethered to a core assembly). The core assembly consists of a 1.2 m by 6.7 cm ID clear plastic liner with a stainless steel catcher and top cover valve. After the corer strikes the sediment surface, the glass spheres are released, and they pull the liner from the core tube and float to the surface. Sampling depths of up to 9,000 m are possible.

- **Box corers** are rectangular gravity corers that come in a variety of sizes. They can take large relatively undisturbed samples in soft sediment and are excellent for sediment water interface studies. There are two basic designs: an Ekman type where two bottom flaps can be triggered, and the jaws close much like the Ekman grab sampler; and the Reinecke design where a shovel like device slides across the base of the corer. In general, these corers are large and can only be operated from a boat with a large lifting capacity [2,000 - 3,000 kg (4,400 - 6,600 lbs)] and sufficient deck space to accommodate it.

- **Piston corers** are capable of taking cores up to 20 m long. They generally consist of stabilizer fins, weighted head, core barrel, piston, core retainer, cutting head, and trigger mechanism, and they are deployed by a boat equipped with a crane. The corer is not allowed to free fall from the surface. A pilot weight or corer is attached to the release mechanism by wire. The length of the wire determines when the corer is released and the distance it falls. Piston corers are generally employed for sediment studies in oceans and large lakes. Problems have been reported regarding shortened samples and disturbed/missing surficial (up to 1 m) sediments when using piston corers.

- **Phleger corers** weigh about 8 kg (17 lbs) without additional lead weights and have a core tube ID of 3.5 cm (1.2 inches). The top part of the corer has fins for stabilization and an area for adding weights to increase penetration. A valve assembly at the top of the coring tube consists of a tapered bung that can slide in two directions - up during descent to allow water to flow through thereby decreasing the bow wave, and down during ascent to form a seal on the tapered tube seating, and thus prevent washout and aid in sample retention. This sampler is generally deployed from a boat to sample soft to sandy sediments and semi-compacted material in shallow lakes or marshes. The small sample size can be an issue when chemical or biological analyses require larger volumes.

- Standard **Kajak-Brinkhurst corers** weigh about 9 kg (19.8 lb) without additional lead weights and have a core tube ID of 5 cm (2 in). Unrestricted water flow through the sampler during descent minimizes bow wave affects. A valve located at the top of the sampling tube closes during ascent to prevent washout. The sampler is suitable for taking soft, fine-grained sediment samples to a maximum depth of about 70 cm. While the standard Kajak-Brinkhurst corer is hand deployable from a boat, heavier versions may require a winch.

13.3.4 Electronic Vibratory Core Tube Drivers (Vibracore®)

The Rossfelder P-1 Vibrocorer can be used to collect sediment core samples in unconsolidated sediments that require minimal disturbance and compaction of the sample core. The Vibrocorer is assembled on the deck of the sampling vessel. A polyethylene liner is placed inside the core tube using a retractable tape measure. The liner should extend six inches beyond each end of the core tube and is then cut at each end with an exacto knife. At the bottom of the core tube, the liner is pulled back over the outside of the core tube. A stainless steel nose cone and core catcher is placed in the bottom of the core tube and attached with pop rivets using a hand riveter. The top of the core tube is attached to the vibration head unit using an adjustable wrench. The assembled unit is then raised using a power winch and A-frame. The Vibrocorer is lowered over the back side of the sampling vessel until it makes contact with the sediment at the desired sampling location. A 10-foot section of the lift cable is marked with a grease pen to measure the distance the unit has advanced through the sediment. The vibration head is turned on while holding the unit steady. After the Vibrocorer has advanced to the desired depth, the vibration head is turned off and the assembled unit is retrieved using the power winch and A-frame. The unit is placed on the deck and the penetration depth is recorded by visually inspecting the outside of the core tube. The unit is then hosed down with site water. The top of the core tube is disassembled from the vibration head using an adjustable wrench. The nose cone and core catcher are removed from the core tube by removing the rivets with a chisel. The polyethylene liner is pulled out of the core tube with the undisturbed sediment core inside. The length of the sediment core is measured and recorded in the field notebook. The polyethylene liner is cut with an exacto knife and the sediment core description is logged in the field notebook. Depending on the objective of the sampling survey, the sediment core is either sampled at discreet intervals or placed in a 5-gallon pail. Also, the entire sediment core can be archived by sealing the ends of the polyethylene liner with twist ties. Each end should be marked “top” or “bottom”. At the completion of the core sampling, the work area is hosed down with site water and the core tube is decontaminated using standard procedures. The sampling vessel is moved to the next location and the procedure is repeated.

13.4 Special Considerations for Collection of Samples for Volatile Organic Compounds

Samples collected for volatile organic compound analyses must be collected prior to any sample homogenization, as described in Section 5.11.8. Regardless of the method used for collection, the aliquot for volatile organic compound analyses must be collected directly from the sampling device, to the extent practical, using equipment and methods described in Section 14.4. The aliquot should be collected directly from the device, such as a hand auger bucket or scoop, if possible. If a device such as a dredge is used, the aliquot should be collected after the sample is placed in the mixing container prior to mixing.

In some cases, the sediment may be soft and not lend itself to collection by plunging an EnCore™, or syringe, samplers into the sample matrix. In these cases, it is appropriate to open the sample device, i.e., the EnCore™ barrel, or syringe, prior to sample collection, and to carefully place the sediment in the device, filling it fully with the required volume of sample. Additional information is on the EnCore™ sampler is provided in section 14.

13.5 References and Additional Information

1. Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses, Technical Manual, October 2001. EPA-823-B-01-002. This document is available on the internet as a PDF file at: http://www.epa.gov/waterscience/cs/collectionmanual.pdf

2. Assessing Aquatic Ecosystems Using Pore Waters and Sediment Chemistry (Burton, 1998), Natural Resources Canada.

3. An EPA Technology website on Sampling for Contaminants in Sediments and Sediment Pore Water, found on the internet at: http://clu-in.org/programs/21m2/sediment/

4. Handbook of Techniques for Aquatic Sediment Sampling, Second Edition,1994. ISBN: 1566700272. By Alena Mudrock, and Scott D. MacKnight.

5. Guidance for Sediment Quality Evaluations, November 1998. New Jersey Department of Environmental Protection. This reference may be found on the internet at: http://www.state.nj.us/dep/srp/regs/sediment/

6. For Quality Assurance/Quality Control information, consult Section 5.

7. For information about recommended containers, holding times and sample preservation is listed in Appendix A-1.

8. Consult Appendices B and C for cleaning procedures.

9. See Appendix D for sample shipping procedures.

10. If required, consult Appendix F for information related to criminal investigations.

SECTION 14
SOIL SAMPLING

PERFORMANCE OBJECTIVES:

To collect a soil sample that is representative of conditions as they exist at the site:

- By selecting the appropriate sampling device(s);
- By taking measures to avoid introducing contamination as a result of poor sampling and/or handling technique;
- By reducing the potential of cross contamination between samples.

14.1 Introduction

Prior to conducting a soil sampling investigation, a sampling strategy should be developed based on the objectives of the investigation (Section 5.5 of this SOP contains a discussion of soil sampling strategies). After developing a soil sampling strategy, the appropriate equipment and techniques must be used to conduct the investigation. This section discusses the various soil sample collection methods, sample handling, and available sampling equipment which has been shown to be technically appropriate.

14.2 Equipment

Selection of equipment is usually based on the depth of the samples to be collected, but it is also controlled to a certain extent by the characteristics of the soil. Manual techniques and equipment such as hand augers are usually used for collecting surface or shallow, subsurface soil samples. Power operated equipment is usually associated with deep sampling, but can also be used for shallow sampling when the bore hole begins to collapse, or when the soil is so tight that manual sampling is not practical.

14.2.1 Precautions for Trace Pollutant Soil Sampling

All soil sampling equipment used for sampling trace pollutants should be constructed of inert materials, such as stainless steel, where possible. Pans used for mixing should be made of Pyrex® (or equivalent) glass. In no case will chromium, cadmium, galvanized, or plated equipment be used for soil sampling when trace levels of inorganic pollutants are of concern. Similarly, no painted or plastic equipment may be used where trace levels of organic pollutants are of concern. Paint, scaly or heavy rust and grease must be removed before use, most often by sandblasting the equipment. Ancillary equipment such as auger flights may be constructed of other materials since this equipment does not come in direct contact with the samples. The procedures outlined in Section 5.11.7 should be followed.

14.3 Sampling Methodology

This discussion of soil sampling methods reflects both the equipment used to collect the sample as well as how the sample is handled and processed after retrieval. Selection of equipment is usually based on the depth of sampling, but it is also controlled, to a certain extent, by the characteristics of the material. Simple, manual techniques and equipment, such as hand augers, are usually selected for surface, or shallow, subsurface soil sampling. As the depth of the sampling interval increases, some type of powered sampling equipment is usually needed to overcome the friction induced by soil resistance and depth. The following is an overview of the various sample collection methods employed over three general depth classifications: surface, shallow subsurface, and deep subsurface. Any of the deep collection methods described may be used to collect samples from the shallower intervals.

14.3.1 Manual Collection Techniques and Equipment

These methods are used primarily to collect surface and shallow subsurface soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface. The shallow subsurface interval may be considered to extend from approximately 12 inches below ground surface to a site-specific depth at which sample collection using manual methods becomes impractical.

Surface Soils

Surface soils may be collected with a wide variety of equipment, if constructed of appropriate materials. Spoons or hand-augers are typically used to collect surface soil samples. If a thick, matted root zone is encountered at or near the surface, it should be removed before the sample is collected. The collected soil is placed in a pan, thoroughly mixed, (Section 5.11.8), and placed in the appropriate sample container(s). Section 13.4 contains specific procedures for collecting and handling soil samples for volatile organic compounds analysis.

Shallow Subsurface Soils

Hand augers are the most common equipment used to collect shallow subsurface samples. Typically, 4-inch auger-buckets with cutting heads are pushed and twisted into the ground, then removed as the buckets are filled. The auger holes are advanced one bucket at a time. The practical depth of investigation using a hand-auger depends upon the soil properties. In sand, auguring is usually easily performed, but the depth of collection is limited to the depth at which the sand begins to flow back into the hole. At this depth, the bore hole will usually collapse and cannot be advanced. Deeper sampling must be accomplished using power equipment. Hand auguring may also be of limited use in tight clays or cemented sands. Regardless of the soil type, at depths approaching 20 feet sidewall friction may become so severe that power equipment must be used.

Power augers such as the Little Beaver® may be used to advance the borehole where hand augers are impractical. Power augers are a sampling aid, not a sampling device, and can be used to advance a borehole to approximately 20 feet, depending upon soil conditions. If power augers are used to advance the borehole, care must be taken that exhaust fumes, gasoline, and\or oil do not contaminate the borehole. The soil sample may then be collected using a hand auger. After the sample has been collected, the borehole may again be advanced (if necessary), and additional samples collected. The auger bucket must be replaced between samples with a properly decontaminated auger bucket. When a new borehole is advanced, the entire hand auger assembly must be replaced with a properly decontaminated hand auger assembly. If the borehole is advanced using a hand auger, upon reaching the desired sampling depth replace the bucket with a properly decontaminated bucket. The sample may then be collected. After the sample has been collected, the borehole may be advanced (if necessary) with the bucket that was used to collect the sample. Each sample must be collected using a properly decontaminated bucket.

Before the soil is placed in a pan, it is necessary to remove the top several inches of soil to minimize the possibility of cross-contamination of the sample from fall-in of material from the upper portions of the hole. Once the soil is placed in a pan, it is thoroughly mixed, (Section 5.11.8), and placed in the appropriate sample container(s). Section 13.4 contains specific procedures for collecting and handling soil samples for volatile organic compounds analysis.

14.3.2 Powered Equipment

Powered equipment may be used to acquire soil samples from any depth (surface, shallow subsurface, and deep subsurface). When power equipment is used to advance the borehole and collect the sample, care must be taken that exhaust fumes, gasoline, and\or oil do not contaminate the borehole and the sample. Among the common types of powered equipment used to collect subsurface soil samples are splitspoon samplers driven with a drill rig drive-weight assembly or pushed using drill rig hydraulics; continuous split-spoon samplers; direct-push rigs; and back-hoes. The Region 2 office does not own this type of equipment, however, contractors may be hired to perform work involving this equipment. Therefore, a brief description of this equipment is provided below.

Drill Rigs

Drill rigs offer the capability of collecting soil samples from greater depths. For all practical purposes, the depth of investigation achievable by this method is controlled only by the depth of soil overlying bedrock, which may be in excess of 100 feet.

Split-spoon samplers are usually driven either inside a hollow-stem auger or an open borehole after the auger(s) have been temporarily removed. The spoon is driven with a 140-pound hammer through a distance of up to 24 inches and removed.

Continuous split-spoon samplers may be used to obtain five-foot long, continuous samples approximately 3 to 5 inches in diameter. These devices are placed inside a five-foot section of hollow-stem auger and advanced with the auger during drilling. As the auger advances, the central core of soil moves into the sampler and is retained. Before the soil is placed in a pan, it is necessary to remove the top several inches of soil to minimize the possibility of cross-contamination of the sample from fall-in of material from the upper portions of the hole. Once the soil is placed in a pan, it is thoroughly mixed, (Section 5.11.8), and placed in the appropriate sample container(s). Section 13.4 contains specific procedures for collecting and handling soil samples for volatile organic compounds analysis.

Direct Push Rigs

This method uses a standard split-spoon modified with a locking tip, which keeps the spoon closed during the sampling push. Upon arrival at the desired depth, the tip is remotely released and the push continued. During the push, the released tip moves freely inside of the spoon as the soil core displaces it. This technique is particularly beneficial at highly contaminated sites, because no cuttings are produced. The push rods are generally retrieved with very little residue resulting in minimal exposure to sampling personnel and reduced IDW. Before the soil is placed in a pan, it is necessary to remove the top several inches of soil to minimize the possibility of cross-contamination of the sample from fall-in of material from the upper portions of the hole. Once the soil is placed in a pan, it is thoroughly mixed (see Section 5.11.8), and placed in the appropriate sample container(s). Section 13.4 contains specific procedures for collecting and handling soil samples for volatile organic compounds analysis.

Geoprobe® Large Bore Soil Sampler

Geoprobe® offers several tools for soil sample collection. Among these are the Macro-Core® Soil Sampler and the large bore and dual tube soil sampling systems. The Branch does not have this equipment on hand, and therefore would need to hire a contractor to perform this work.

Back-Hoes

Back-hoes may be utilized in the collection of shallow subsurface soil samples. Samples may be collected directly from the bucket, or the trench wall (subject to applicable safety procedures). The bucket must be free of rust, grease, and paint. Only soil which has not been in contact with the bucket may be sampled, unless the bucket is cleaned according to the procedures described in Appendix B of this SOP.

Trenches offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. The sample should be collected without entering the trench itself, if possible. To collect the sample without entering the trench, use a stainless steel scoop attached to rigid conduit with a scoop bracket to “dress” the wall of the trench (by removing the surface layer of soil smeared on the trench wall as the bucket passed). Replace the scoop with a clean or decontaminated scoop, and then collect the soil sample. The collected soil is placed in a pan, thoroughly mixed, (see Section 5.11.8), and placed in the appropriate sample container(s). Section 13.4 contains specific procedures for collecting and handling soil samples for volatile organic compounds analysis.

14.4 Soil/Sediment Sampling (Method 5035)

The following sampling protocol is recommended for site investigators assessing the extent of volatile organic compounds (VOCs) in soils and sediments at a project site. Because of the large number of options available, careful coordination between field and laboratory personnel is needed. The specific sampling containers and sampling tools required will depend upon the detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method best applicable to the investigation can be made.

14.4.1 Equipment

Soil\sediment for VOC analyses may be retrieved using the equipment specified in Section 13 of this SOP. Soil\sediment cab be collected in either the EnCore™ VOC sampler, or using a stainless steel spatula and standard 4-oz. soil VOC container. The specific sample containers and the sampling tools required will depend upon the data quality objectives established for the site or sampling investigation. The various methods are described below.

14.4.2 Sampling Methodology - Low Concentrations

When total VOC concentrations in the soil/sediment are expected to be less than 200 ug/kg, the samples may be collected directly with the EnCore™ sampler. When sampling directly with the EnCore™ sampler, the vial must be immediately capped. A soil/sediment sample for VOC analysis may also be collected with conventional sampling equipment (as described in Section 13 of this SOP). A sample collected in this fashion must either be placed in the final sample container (EnCore™) immediately, or the sample may be immediately placed into an intermediate sample container with no head space. If an intermediate container (usually 4-oz. soil jar) is used, the sample must be transferred to the final sample container (EnCore™) as soon as possible, and should not to exceed 30 minutes.

NOTE: After collection of the sample into either the EnCore™ sampler or other container, the sample must immediately be stored in an ice chest and cooled. EnCore™ sampler soil\sediment samples may be prepared for shipping by capping, locking and securing the sampler in a plastic bag.

14.4.3 Sampling Methodology - High Concentrations

Based upon the data quality objectives and the detection level requirements, this high level method may also be used. Specifically, the sample may be packed into a single 4-oz. glass container with a screw cap and septum seal. The sample container must be filled quickly and completely to eliminate head space. Soils\sediments containing high total VOC concentrations may also be collected as described in Section 14.4.2, and preserved using 10 mL methanol.

14.4.4 Waste Samples

Collect an un-preserved sample into a single 4–oz. glass container. Handle waste samples in accordance with Section 15 of this SOP.

14.4.5 Special Techniques and Considerations

Sample Size

While this method is an improvement over earlier ones, field investigators must be aware of an inherent limitation. Because of the extremely small sample size, sample representativeness for VOC's may be reduced compared to samples with larger volumes collected for other constituents. The sampling design and objectives of the investigation should take this into consideration.

Holding Times

Sample holding times are specified in Appendix A. Field investigators should note that the holding time for an un-preserved VOC soil/sediment sample is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and\or analyze the sample within 48 hours of collection.

Percent Moisture

Samplers must ensure that the laboratory has sufficient material to determine percent moisture in the VOC soil/sediment sample to correct the analytical results to dry weight. If other analyses requiring percent moisture determination are being performed upon the sample, these results may be used. If not, a separate sample (minimum of 4-oz.) for percent moisture determination will be required.

Safety

Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all required safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should be stored in a cooler with ice at all times.

Shipping

Methanol and sodium bisulfate are considered dangerous goods, therefore shipment of samples preserved with these materials by common carrier is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulations must be followed when shipping methanol and sodium bisulfate. Consult the above documents or the carrier for additional information. **The shipment of the quantities of methanol and sodium bisulfate used for sample preservation falls under the exemption for small quantities.** A summary of the requirements for shipping samples follows. Refer to the CFR for a complete review of the requirements.

1. The maximum volume of methanol or sodium bisulfate in a sample container is limited to thirty (30) mls.

2. The sample container must not be full of methanol.

3. The sample container must be stored upright and have the lid held securely in place. Note that the mechanism used to hold the cap in place must be able to be completely removed so weight is not added to the sample container, as specified in Method 5035.

4. Sample containers must be packed in a sorbent material capable of absorbing spills from leaks or breakage of the sample containers.

5. The maximum sample shuttle weight must not exceed 64 pounds.

6. The maximum volume of methanol or sodium bisulfate per shipping container is 500

milliliters.

7. The shipper must mark the sample shuttle in accordance with shipping dangerous goods in acceptable quantities.

8. The package must not be opened or altered until no longer in commerce.

SECTION 15
WASTE SAMPLING

SECTION OBJECTIVE:

- To describe equipment and procedures that can safely be used to collect waste samples.

15.1 Introduction

Hazardous wastes are regulated by the US EPA under 40 CFR Parts 260-265. As a consequence, many of the methods that are used to manage, store, treat, and dispose hazardous wastes and potential hazardous wastes are of concern to both the regulators and the regulated community. Samples are often required of regulated or potentially regulated materials. While it is understood that each facility and waste stream may present its own unique sampling and analytical challenges, this section will list equipment and procedures that have been used to safely and successfully sample specific waste units.

15.1.1 Safety

Sampling of waste units should, be assessed for potential hazards by both the project leader and the site safety officer (SSO). It is the project leader and the SSOs responsibility to enforce the site safety plan, and to ensure that procedures used during waste sampling are in accordance with Section safety procedures and protocols.

Sampling equipment contaminated during waste sampling investigations should be cleaned with laboratory detergent and rinsed with tap water prior to returning the equipment from the field. Contaminated sampling equipment that is to be discarded must be properly disposed according to Section 5.12 and should be specified in the site-specific study plan.

15.1.2 Quality Control Procedures

In some instances, special decontamination procedures will be necessary and should be developed on a case-by-case basis according to the specific material encountered. Any cleaning procedures and equipment repairs conducted in the field which deviate from those specified in Appendix B or the study plan, should be thoroughly documented in the logbooks. All air monitoring and field analytical/screening equipment should be checked and/or calibrated before being used for field studies (see Section 18).

15.1.3 Collection of Auxiliary Information and Data

The collection of auxiliary information and data is particularly important when collecting waste samples. Any field analyses or field screening results should be recorded in a logbook as outlined in Section 3.6. Sketches of waste units, sampling locations, containers, tanks and ancillary equipment, markings/labels, etc., should be fully documented in logbooks. Photographs are extremely useful for recording this information and may be used during waste sampling operations. A field log of the photographs taken should be maintained.

15.2 Waste Unit Types

Waste management units can be generally categorized into two types: open and closed. In practice, open units are larger than closed units. Open units include waste piles and surface impoundments, whereas closed units include containers and tanks as well as ancillary tank equipment. Besides containers and tanks, sumps may also be considered closed units because they are designed to collect the spillage of liquid wastes, and are sometimes configured as a confined space. Although both may pose hazards, units that are open to the environment are generally less hazardous than closed units. Sampling of closed units is considered a higher hazard risk because of the potential of exposure to toxic gases and flammable/explosive atmospheres. Because closed units prevent the dilution of the wastes by environmental influences, they are more likely to contain materials that have concentrated levels of hazardous constituents. While opening closed units for sampling purposes, investigators shall use Level B personnel protective equipment (PPE), and air monitoring instruments to ensure that the working environment does not contain hazardous levels of flammable/explosive gases or toxic vapors, and follow the appropriate safety requirements stipulated in the site specific safety plan. Buried waste materials should be located and excavated with extreme caution. Once the buried waste is uncovered, the appropriate safety and sampling procedures utilized will depend on the type of waste material.

15.2.1 Open Units

While open units may contain many types of wastes and come in a variety of shapes and sizes, they can be generally regarded as either waste piles or surface impoundments. Definitions of these two types of open units from 40 CFR Part 260.10 are:

- Waste pile - any non-containerized accumulation of solid, non-flowing hazardous waste that is used for treatment or storage and that is not a containment building.

- Surface impoundment - a facility or part of a facility which is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials (although it may be lined with man-made materials), which is designed to hold the accumulation of liquid wastes or wastes containing free liquids, and which is not an injection well. Examples of surface impoundments are holding, storage, settling and aeration pits, ponds, and lagoons. One of the distinguishing features between waste piles and surface impoundments is the state of the waste. Waste piles typically contain solid or non-flowing materials whereas liquid wastes are usually contained in surface impoundments. The nature of the waste will also determine the mode of delivering the waste to the unit. Wastes are commonly pumped or gravity fed into impoundments while heavy equipment or trucks may be used to dump wastes in piles. Once the waste has been placed in an open unit, the state of the waste may be altered by environmental factors (e.g., temperature, precipitation, etc.). Surface impoundments may contain several phases such as floating solids, liquid phase(s), and sludges. Waste piles are usually restricted to solids and semi-solids. All of the potential phases contained in a waste unit should be considered in developing the sample design to meet the study's objective.

15.2.2 Closed Units

There are a variety of designs, shapes, sizes, and functions of closed units. In addition to the challenges of the various designs and the safety requirements for sampling them, closed units are difficult to sample because they may contain liquid, solid, semi-solid/sludge, or any combination of phases. Based on the study's design, it may be necessary to obtain a cross sectional profile of the closed unit in an attempt to characterize the unit. The following are definitions of some types of closed waste units described in 40 CFR Part 260.10:

- Container - any portable device in which a material is stored, transported, treated, disposed, or otherwise handled. [Examples of containers are drums, overpacks, pails, totes, and roll-offs.]

- Tank - a stationary device, designed to contain an accumulation of hazardous waste which is constructed primarily of non-earthen materials (e.g., wood, concrete, steel, plastic), which provide structural support. [Portable tanks, tank trucks, and tank cars vary in size and may range from simple to extremely complex designs. Depending on the unit's design, it may be convenient to consider some of these storage units as tanks for sampling purposes even though they meet the definition of a container.]

- Ancillary equipment - any device including, but not limited to, such devices as piping, fittings, flanges, valves, and pumps that is used to distribute, meter, or control the flow of hazardous waste from its point of generation to a storage or treatment tank(s), between hazardous waste storage and treatment tanks to a point of disposal on-site, or to a point of shipment for disposal off-site.

- Sump - any pit or reservoir that meets the definition of a tank and those troughs/trenches connected to it that serve to collect hazardous wastes. [Note: some outdoor sumps may be considered open units/surface impoundments. Although any of the closed units may not be completely sealed and may be partially open to the environment, the unit needs to be treated as a closed unit for sampling purposes until a determination can be made. Once a closed unit is opened, a review of the proposed sampling procedures and level of protection can be performed to determined if the PPE is suitable for the site conditions.]

Samples collected from different waste units should not be composited into one sample container without additional analytical and/or field screening data to determine if the materials are compatible and will not cause an inadvertent chemical reaction.

15.3 Equipment

Selecting appropriate equipment to sample wastes is a challenging task due to the uncertainty of the physical characteristics and nature of the wastes. It may be difficult to separate, homogenize and/or containerize a waste due to its physical characteristics (viscosity, particle size, etc.). In addition, the physical characteristics of a waste may change with temperature, humidity, or pressure. Waste streams may vary depending on how and when a waste was generated, how and where it was stored/disposed, and the conditions under which it was stored/disposed. Also, the physical location of the wastes or the unit configuration may prevent the use of conventional sampling equipment. Given the uncertainties that a waste may present, it is desirable to select sampling equipment that will facilitate the collection of samples that will meet the study's objective, and that will not unintentionally bias the sample by excluding some of the sample population that is under consideration. However, due to the nature of some waste matrices or the physical constraints of some waste units, it may be necessary to collect samples knowing that a portion of the desired population was omitted due to limitations of the equipment. Any deviations from the study plan or difficulties encountered in the field concerning sample collection that may have an effect on the study's objective should be documented in a logbook, reviewed with the analytical data, and presented in the report.

15.3.1 Waste Sampling Equipment

Waste sampling equipment should be made of non-reactive materials that will neither add to nor alter the chemical or physical properties of the material that is being sampled. Table 15.3.1 lists some conventional equipment for sampling waste units/phases and some potential limitations of the equipment. Another reference for selecting sampling equipment is the ASTM, Standard Guide for Selection of Sampling Equipment for Wastes and Contaminated Media Data Collection Activities, D 6232-00.

15.3.2 Ancillary Equipment for Waste Sampling

In addition to the equipment listed in Table 15.3.1 which provides the primary device used to collect various waste samples, ancillary equipment may be required during the sampling for safety and/or analytical reasons. Some examples of these types of equipment are glass mixing pans, particle size reducers, remote drum opening devices, and spark resistant tools. See Section 15.7 for particle size reduction procedures. Any influences that these types of ancillary equipment may have on the data should be evaluated and reported as necessary.

TABLE 15.3.1
SAMPLING EQUIPMENT for VARIOUS WASTE UNITS

Equipment	Waste Units/Phases	Limitations
scoop with bracket/conduit	impoundments, piles, containers, tanks/liquids, solids, sludges	Can be difficult to collect deeper phases in multiphase wastes. Depth constraints.
spoon	impoundments, piles, containers/solids, sludges	Similar limitations as the scoop. Generally not effective in sampling liquids.
push tube	piles, containers/cohesive solids, sludges	Should not be used to sample solids with dimensions less than one-half the diameter of the tube. Depth constraints.
auger	impoundments, piles, containers/solids	Can be difficult to use in an impoundment or a container, or for solidified wastes.
sediment sampler	impoundments, piles/solids, sludges	Should not be used to sample solids with dimensions less than one-half the diameter of the tube.
ponar dredge	impoundments/solids, sludges	Must have means to position equipment to desired sampling location. Difficult to decon.
COLIWASA or drum thief	impoundments, containers, tanks/liquids	Not good with viscous wastes. Devices greater than 7- feet require 2 samplers to use effectively.
Dipstick™ / Mucksucker™	impoundments, containers, tanks/liquids, sludges	Not recommended for tanks greater than 11 feet deep. Devices greater than 7- feet require 2 samplers to use effectively.
bacon bomb	impoundments, tanks/liquids	Not good with viscous wastes.
bailer	impoundments, tanks/liquids	Only if waste is homogeneous. Not good with viscous wastes.
peristaltic pump	impoundments, tanks/liquids	Cannot be used in flammable atmospheres. Not good with viscous wastes.
back-hoe bucket	piles/solids, sludges	May be difficult to access desired sampling location. Difficult to decon. Can lose volatiles.
split-spoon	piles/solids	Requires drill rig or direct push equipment.
roto-hammer	piles, containers/solids	Physically breaks up sample. May release volatiles. Not good for flammable atmospheres.

15.4 Waste Sampling Procedures

15.4.1 Waste Piles

Waste piles vary in size, shape, composition, and compactness, and may vary in distribution of hazardous constituents and characteristics (strata). These variables will affect safety and access considerations. The number of samples, the type of sample(s), and the sample location(s) should be based on the study's objectives. Commonly used equipment to collect samples from waste piles are listed in Table 15.3.1. All equipment should be compatible with the waste and should have been cleaned to prevent any cross contamination of the sample.

15.4.2 Surface Impoundments

Surface impoundments vary in size, shape, and waste content, and may vary in distribution of hazardous constituents and characteristics (strata). The number of samples, the type of sample(s), and the sample location(s) should be based on the study's objectives. Commonly used equipment to collect samples from surface impoundments are listed in Table 15.3.1. All equipment should be compatible with the waste and should have been cleaned to prevent any cross contamination of the sample. Because of the potential danger of sampling waste units suspected of containing elevated levels of hazardous constituents, personnel should never attempt to sample surface impoundments used to manage potentially hazardous wastes from a boat. All sampling should be conducted from the banks or piers of surface impoundments. Any exception must be approved by the appropriate project leader and/or the site safety officer.

15.4.3 Drums

Drums are the most frequent type of containers sampled by field investigators for chemical analyses and/or physical testing. Caution should be exercised by the field investigators when sampling drums because of the potential presence of explosive/flammable gases and/or toxic vapors. Therefore, the following procedures should be used when collecting samples from drums of unknown material:

- Visually inspect all drums that are being considered for sampling for the following:

    - ✓ pressurization (bulging/dimples);
    - ✓ crystals formed around the drum opening;
    - ✓ leaks, holes, stains;
    - ✓ labels, markings;
    - ✓ composition and type (steel/poly and open/bung);
    - ✓ condition, age, rust; and
    - ✓ sampling accessibility.

Drums showing evidence of pressurization and crystals should be furthered assessed to determine if remote drum opening is needed. If drums cannot be accessed for sampling, heavy equipment is usually necessary to stage drums for the sampling activities. Adequate time should be allowed for the drum contents to stabilize after a drum is handled.

- Identify each drum that will be opened (e.g., paint sticks, spray paint, cones, etc).

LEVEL "B" PROTECTION IS REQUIRED FOR THE FOLLOWING PROCEDURES.

- Before opening, ground each metal drum that is not in direct contact with the earth using grounding wires, alligator clips, and a grounding rod or metal structure. If a metal drum is in an overpack drum, the metal drum should be grounded.

- Touch the drum opening equipment to the bung or lid and allow an electrical conductive path to form. Slowly remove the bung or drum ring and/or lid with spark resistant tools (brass/beryllium).

- Screen drums for explosive gases and toxic vapors with air monitoring instruments as bung or drum lid is removed. Depending on site conditions screen for one or more of the following:

    - ✓ radioactivity;
    - ✓ cyanide fumes;
    - ✓ halogen vapors;
    - ✓ pH; and/or
    - ✓ flash point (requires small volume of sample for testing).

Note the state, quantity, phases, and color of the drum contents. Record all relevant results, observations, and information in a logbook. Review the screening results with any pre-existing data to determine which drums will be sampled.

- Select the appropriate sampling equipment based on the state of the material and the type of container. Sampling equipment should be made of non-reactive materials that will meet the study's objective(s).

- Place oil wipe pads (as necessary), sampling equipment, and sample containers near drum(s) to be sampled.

AIR MONITORING FOR TOXIC VAPORS AND EXPLOSIVE GASES AND OXYGEN DEFICIENT ATMOSPHERES SHOULD BE CONDUCTED DURING DRUM SAMPLING.

<u>Liquids</u> - With the inner sealing rod end about 1-inch above the bottom of the COLIWASA, slowly lower the COLIWASA (or drum thief) to the bottom of the container. Close the COLIWASA with the inner rod or create a vacuum with the sampler's gloved thumb on the end of the thief and slowly remove the sampling device from the drum. Release the sample from the device into the sample container. Repeat the procedure until a sufficient sample volume is obtained.

Solids/Semi-Solids - Use a push tube, bucket auger, or screw auger, or if conditions permit, a pneumatic hammer/drill to obtain the sample. Carefully use a clean stainless steel spoon to place the sample into container(s) for analyses.

- Close the drums when sampling is complete. Segregate contaminated sampling equipment and investigative derived wastes (IDW) containing incompatible materials as determined by the drum screening procedure (see above). At a minimum, contaminated equipment should be cleaned with laboratory detergent and rinsed with tap water prior to returning it from the field. IDW should be managed according to Section 5.12.

15.4.4 Tanks

Sampling tanks is considered hazardous due to the potential for them to contain large volumes of hazardous materials and therefore, appropriate safety protocols must be followed. Unlike drums, tanks may be compartmentalized or have complex designs. Preliminary information about the tank's contents and configuration should be reviewed prior to the sampling operation to ensure the safety of sampling personnel and that the study's objectives can be achieved.

In addition to having discharge valves near the bottom of tanks and bulk storage units, most tanks
have hatches at the top. It is desirable to collect samples from the top hatch because of the potential for the tank's contents to be stratified. Additionally, when sampling from the discharge valve, there is a possibility of a stuck or broken valve which could cause an uncontrolled release. Investigators should not utilize valves on tanks, or bulk storage devices, unless they are operated by the owner or operator of the facility, or a containment plan is in place, in case the valve sticks open or breaks. If the investigator must sample from a tank discharge valve, the valving arrangement of the particular tank must be clearly understood to insure that the compartment(s) of interest is sampled.

Because of the many different types of designs and materials that may be encountered, only general sampling procedures that outline sampling a tank from the top hatch are listed below:

- All relevant information concerning the tank such as the type of tank, the tank capacity, markings, condition, and suspected contents should be documented in a logbook.

- The samplers should inspect the ladder, stairs, and catwalk that will be used to access the top hatch to ensure that they will support the samplers and their equipment.

LEVEL "B" PROTECTION IS REQUIRED FOR THE FOLLOWING PROCEDURES.

- Before opening, ground each metal tank using grounding wires, alligator clips, and a grounding rod or metal structure.

- Any vents or pressure release valves should be slowly opened to allow the unit to vent to atmospheric pressure. Air monitoring for explosive/flammable gases and toxic vapors should be conducted during the venting with the results recorded in a logbook. If dangerous concentrations of gases come from the vent, or the pressure is too great, leave the area immediately.

- Touch tank opening equipment to the bolts in the hatch lid and allow electrical conductive path to form. Slowly remove bolts and/or hatch with spark resistant tools (brass/beryllium). If a pressure build up is encountered or detected, cease opening activities and leave the area.

- Screen tanks for explosive/flammable gases and toxic vapors with air monitoring instruments. Depending on the study objectives and site conditions, conduct characteristic screening (e.g., pH, halogen, etc.) as necessary. Collect a small volume of sample for flash point testing, if warranted. Note the state, quantity, number of phases, and color of the tank contents. Record all relevant results, observations, and information in a logbook. Compare the screening results with any pre-existing data to determine if the tank should be sampled.

- Select the appropriate sampling equipment based on the state of the material and the type of tank. Sampling equipment should be constructed of non-reactive materials that will meet the study's objective(s).

- Place oil wipe pads (as necessary), sampling equipment, and sample containers near tank(s) opening to be sampled.

AIR MONITORING FOR TOXIC VAPORS, EXPLOSIVE GASES AND OXYGEN DEFICIENT ATMOSPHERES SHOULD BE CONTINUOUS DURING TANK SAMPLING.

<u>Liquids</u> - Slowly lower the bailer, bacon bomb, Dipstick™, COLIWASA, or Teflon® tubing to the desired sampling depth. <u>(NOTE: In work areas where explosive/flammable atmospheres could occur, peristaltic pumps powered by 12 volt batteries should not be used.)</u> Close the sampling device or create a vacuum and slowly remove the sampling device from the tank. Release the sample from the device into the sample container. Repeat the procedure until a sufficient sample volume is obtained.

<u>Solids/Semi-Solids</u> - Use a push tube, bucket auger, screw auger, Mucksucker™, or if conditions permit a pneumatic hammer/drill to obtain the sample. Carefully extrude the sample from the sampling device or use a clean stainless steel spoon to place the sample into containers for analyses.

- Close the tank when sampling is complete. Segregate contaminated sampling equipment and investigative derived wastes (IDW) containing incompatible materials as determined by the screening procedure (see above). At a minimum, contaminated equipment should be cleaned with laboratory detergent and rinsed with tap water prior to returning it from the field. IDW should be managed according to Section 5.12.

15.5 Miscellaneous Contaminated Materials

Sampling may be required of materials or equipment (e.g., documents, building materials, equipment, etc.) to determine whether or not various surfaces are contaminated by hazardous constituents, or to evaluate the effectiveness of decontamination procedures.

Wipe or swab samples may be taken on non-absorbent, smooth surfaces such as metal, glass, plastic, etc. The wipe materials must be compatible with the solvent used and the analyses to be performed, and should not come apart during use. The wipes are saturated with a solvent; methylene chloride, hexane, isopropanol or analyte free water depending on the parameters to be analyzed. The laboratory performing the analyses can provide the appropriate solvent. Wipe samples should not be collected for volatile organic compounds analysis. Sampling personnel should be aware of hazards associated with the selected solvent and should take appropriate precautions to prevent any skin contact or inhalation of these solvents. All surfaces and areas selected for sampling should be based on the study's objectives. Typically, 10 cm by 10 cm templates are prepared from aluminum foil which are secured to the surface of interest. The prepared (saturated with solvent) wipe(s) is removed from its container with tongs or gloves, and used to wipe the entire area with firm strokes using only one side of the wipe. The goal is to systematically wipe the whole area. The wipe is then folded with the sample side inward and placed into the sample container. This procedure is repeated until the area is free of visible contamination or no more wipes remain. Care should be taken to keep the sample container tightly sealed to prevent evaporation of the solvent. Samplers must also take care to not touch the used side of the wipe. All requests for support from the Region 2 laboratory for wipe preparations and wipe analyses should be made well in advance of the scheduled sampling event. (Note: if gloves are used to collect the wipe samples, control samples should be collected to determine if the gloves could potentially contribute constituents to the parameters of interest.)

For items with porous surfaces such as documents (usually business records), insulation, wood, etc., actual samples of the materials are required. It is therefore important, that during the collection and/or analyses of the sample that evidentiary material is not destroyed. Use scissors or other particle reduction device that have been cleaned as specified in Appendix B to cut/shred the sample. Mix in a glass pan as specified in Section 5.11.8. The shredded, homogenized material is then placed in sample containers.

15.6 Waste Sample Handling Procedures

When collecting samples of concentrated wastes for laboratory analyses, field personnel are required to screen the waste materials to ensure safe handling and transportation of the samples. Safety procedures, sampling and screening methods used to collect the samples must comply with those procedures/methods described in this manual. It should be noted that waste samples should not be preserved, because of the potential for an inadvertent chemical reaction with the preservative. Additionally, concentrated waste samples are not required to be cooled to 4 °C. After samples have been collected and containerized, the outside of the sample containers should be cleaned with water, paper towels and/or oil wipes to remove any spilled material from the exterior of the container. It should be noted that each sample container should be labeled and sealed, placed in a plastic bag, and the bag securely closed. Samples collected from materials that did not demonstrate any hazardous characteristics during the screening process may be placed in coolers and handled as non-hazardous samples in accordance with Appendix A.

Field investigators will use knowledge gained from site practices and processes, labels and marking on waste containers, field screening results, and personal observations made during their investigation to determine the hazard potential of a sample. Samples considered to be hazardous by the field investigators will be placed in secondary containment for transport to the Edison laboratory and for subsequent handling upon arrival.

15.7 References

1. Title 40 Code of Federal Regulations, Parts 260-265, US-EPA, July 1, 2000.

2. ASTM, D 62332-03, 2003. Standard Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities.

3. ASTM, D5956-96, 2001. Standard Guide for Sampling Strategies for Heterogeneous Wastes.

4. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846), Third Edition, Draft Update IVB, US-EPA, Office of Solid Waste and Emergency Response, Washington, D.C., November, 2000. Available on the internet as a PDF file at: http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm

5. Compendium of ERT Waste Sampling Procedures, US EPA, EPA/540/P-91/008 (OSWER Directive 9360.4-07), January 1991. Available on the internet as a PDF file at: http://www.epa.gov/region09/qa/pdfs/fieldsamp-ertsops.pdf

6. Characterization of Hazardous Waste Sites - A Methods Manual: Volume I - A Methods Manual, US-EPA, EMSL, Las Vegas, EPA 600/4-84-075, April 1985. Available on the internet as a PDF file at: http://www.hanford.gov/dqo/project/level5/Charhws1.pdf

7. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II -Available Sampling Methods, 2nd Edition, US-EPA, EMSL, Las Vegas, EPA-600/4-84-076, December 1984. Available on the internet as a PDF file at: http://www.hanford.gov/dqo/project/level5/Charhws2.pdf

SECTION 16
OBTAINING FIELD LOCATIONAL DATA MEASUREMENTS USING GLOBAL POSITIONING SYSTEM (GPS) EQUIPMENT

SECTION OBJECTIVE:

- To present the existing procedures and practices for obtaining locational data in the field using GPS equipment.

16.1 Introduction

The Global Positioning System is a satellite based radio navigation system, which provides position, velocity and time information continuously around the world. The GPS system includes at least 24 operational satellites and five ground stations, that monitor the GPS satellites, and check both their operational health and their exact position in space. Currently there are 28 operational GPS satellites, which provide coverage on a continuous basis.

The basis of GPS is a procedure known as "trilateration". To trilaterate, a GPS receiver measures distance using the travel time of radio signals. The length of time it takes for the radio wave to reach the GPS receiver on the ground can be used to determine the distance that it traveled. In order to measure travel time, GPS needs very accurate timing, which it achieves with some technology (very accurate atomic clocks on board the satellites), and some tricks. Accurately measuring the travel time of the radio signal is vital to obtaining accurate locational data. If the accuracy of the time of travel is off by **only one thousandth of a second**, at the speed of light (which is how fast radio signals travel), **the distance measurement is off by almost 200 miles**. The GPS receiver determines the travel time of a signal from a satellite by comparing something known at the "pseudo random code" it's generating, with an identical code in the signal that are sent from the satellite. Along with distance, the GPS receiver needs to know exactly where the satellites are in space. Even though the orbits of the satellites are extremely precise, the Air Force monitors the locations of the satellites with the ground control stations. These monitoring stations use very precise radar to check each satellites exact altitude, position and speed. If there are errors, they are very slight, but they are taken into account. Once the satellite's exact position has been measured, that information is transmitted back up to the satellite. Now the new corrected position information is included in the timing signals the satellite is broadcasting, and that information is also broadcast from the satellite to the GPS receiver in an “almanac”.

Finally, since the time of travel of the radio signal (at the speed of light) is only constant in a vacuum, any delays the signal experiences as it travels through the atmosphere must also be corrected. And, there are other errors that must be accounted for from the signal bouncing off local obstructions (this is known as multipath), slight errors in the position of the satellites (since they are not monitored every minute), and the geometry of where the satellites are in the sky (known as geometric dilution of position). It is beyond the scope of this document, but most of the errors can be removed by using “differential correction”. Differential correction uses two GPS receivers that are relatively close to each other (within 150 miles). One receiver is at a known position, and the other is “in the field”. It can be assumed that the signals that reach both receivers have traveled the same path through the atmosphere, and so will have virtually the same errors. With differential GPS the receiver at the known location can determine the errors in the signal (using mathematical calculations). That information can be used to correct the locational data information received on the GPS receiver in the field.

16.2 Using GPS Equipment to Obtain Locational Data

16.2.1 Introduction

Global Positioning System (GPS) techniques specified in the Region 2 Global Positioning System Standard Operating Procedures should be used to horizontally locate sample points or various site features during site investigations. The Region 2 SOP for using GPS can be found at http://intranet.r02.epa.gov/intranet/gis/gps/index.html. In Region 2 our goal is to strive to get locational data that is better than five meters in accuracy. Typically the GPS equipment is able to provide locational data that is accurate to 10 - 15 meters (uncorrected), 1 - 2 meters (real time differentially corrected), and about 1 meter (post processed and differentially corrected). Additional information on the fundamental principles on GPS technology may be found in the reference to this section.

Prior to using GPS equipment in the field, the operator must be trained. The course provides the operator with sufficient knowledge and directions to enable the collection of highly accurate locational data.

16.2.2 Equipment Available

The following equipment is available for field use in conducting horizontal surveys in support of site investigations:

- 10 Trimble Pathfinder Pro XR 8-channel and 12 channel receivers
- One Trimble GEO-XR 12 channel receiver
- tripod(s)
- steel tapes
- compasses

16.2.3 Specific Equipment Quality Control Procedures

Each piece of field equipment (as appropriate) shall be named with a letter of the alphabet, and the first digit of the default file name will be the same as the one matching the GPS field unit.

The GPS equipment will need to:

- be tested to ensure it is properly working prior to use in the field, refresher training is available from the Region 2 GPS Coordinator (Mike Glogower). If the GPS equipment is damaged or suspected to be in error, the equipment shall be serviced and calibrated.
- be checked out using procedures outlined in the Region 2 GPS SOP before use.
- be checked and cleaned upon return. And, the compasses will be checked for proper movement of the compass needle.

16.2.4 Procedures for Differential GPS

Differential GPS involves the use of two or more multichannel receivers. One or more are used as the rover receiver(s) and usually only one is used as the base station. The base station and the rover(s) should be within 150 miles of each other in order to increase the accuracy of the measurements (accuracy increases as separation between base and rover decreases) and have a clear view of the sky. The base is set up on a control point of known horizontal location (usually expressed in terms of latitude, longitude and elevation). Trilaterated coordinate positions from the satellites are recorded at the base, which will be compared to the actual horizontal control point coordinates for the development of a correction factor to be applied to other roving GPS units. Since the base station receiver and the rover receiver(s) synchronize with the satellite's clocks, data must be recorded or logged by both receivers at the exact same time in order for the correction factor to be applicable. Often times, base station data will be obtained from the internet, after the field data has been collected by the field units. It is therefore extremely important to coordinate the logistics and planning for using GPS techniques before leaving for the field.

The procedures to follow when using GPS to locate horizontal positions of site features are relatively simple and easy to conduct. The GPS receiver/data logger is turned on and a predefined point (line or area feature) to be mapped is selected from a data dictionary within the data logger. Once the feature is logged, the receiver/data logger user closes the feature, moves to the next feature for logging and so forth until all site features are logged. The data files are then downloaded, differentially corrected, if necessary, and exported to GIS applications for mapping and display of the features logged.

Navigation to predefined points (called way points) is accomplished by selecting the way point from within the data logger, and proceeding in the direction displayed in the data logger until you arrive at the way point desired. However, depending on which GPS receiver/data logger is used (Pathfinder Pro XR or GEO XT), different types of GPS processing measurements can be made: Code Pseudorange or Carrier Phase. With these different processing measurements comes different accuracy. When code pseudorange is employed, the autonomous position measurements (without differential correction) will be within about 10 - 12 meters using either receiver listed above. When code pseudorange is used with differential GPS (this is either real time or post processed), the position measurements will be 1 - 2 meters for both the Pathfinder Pro XR or GEO XT. Both the Pathfinder Pro XR and the GEO XR receivers are capable of real time differential GPS.

All staff will be trained in the use of the GPS equipment by qualified staff before using the Region's GPS equipment. Specific procedures on the operation and setup of the GPS equipment are found in the Region 2 GPS SOP, and are attached to the end of this section. All instruments will be used consistent with the instructions contained in the Region 2 SOP. A copy of the Region 2 GPS SOP will be maintained by the Regions' GPS Coordinator (Mike Glogower).

16.2.5 Verification of Differentially Corrected GPS Data

If a real time GPS unit was used for data capture, the data file(s) must be checked to see if all positions were differentially corrected through the real time broadcast signal. If any portion of a data file was not corrected with the real time broadcast signal, a base station file must be obtained in order for all positions in the file to be differentially corrected.

In Pathfinder Office software on the PC, select *File* then *Open.* Select the data file(s) to look at then *Ok.* After a brief scan of the features, one by one, identify the features and file name(s) that need a base station file for differential correction then *Close* the file(s).

Obtain base station file(s) from a base station as close to the site as possible and that match the month, date and UTC hour of the data file(s) exactly and place in the Base subdirectory of the Project directory in Pathfinder Office software on the PC (C:\Pfdata\(Project)\Base). These can be obtained through modem, internet, email, or disk via regular mail. Normally, the base station files use a similar file naming convention and will identify the month, date, and UTC hour that the base station file was collected. The Region 2 Base Station files that are collected in Edison, NJ can be found at: http://www.epa.gov/region02/gps/

Once base sation files are obtained that match the month, date, and UTC hour, in the data files as indicated above (and also in the same year), in Pathfinder Office software on the PC, will differentially correct the GPS field data.

The corrected GPS data must be exported into ARC/INFO GIS and transmitted to the appropriate GIS personnel.

November 17, 2003

PRO-XR w/ TSC1 & Asset Surveyor Ver 5.27 Requirements

Rover Settings (should be set/checked each day)

1. Turn the datalogger on by hitting the Green key once, and allow it to boot up and perform a self check. If you try to set the Critical Settings on the datalogger, without assembling the GPS unit, the unit tries to connect to the GPS system. After a minute, or so, the TSC1 will respond with a message stating "No GPS Detected", and it will ask if you want to retry now. Just hit the **F5** softkey for "**NO**" to enter the Main Menu. ***Short cut**: While the unit is searching for the GPS you can hit the "**Esc**" key to stop the unit from searching for the GPS (and enter the Main Menu).*
2. From the Main Menu on a TSC1, use the arrow keys to highlight the Configuration Icon, then press the "**Enter**" key to enter the Configuration Menu (***Short cut**: or hit the letter "**C**" key on the keyboard*).
3. Select "**GPS Rover options**" and press "**Enter**".
4. Then select "**Logging options**" press "**Enter**", and change the Rover settings to those listed below:

GPS Rover Options - Logging options	Recommended value	Comments
Logging intervals: Point feature Line/Area: Not in feature: Velocity:	 1 second 1 second None None	If the logging interval is set incorrectly Asset Surveyor will not log data as often as you require, and may not log certain data at all. For Line or Area features you may want to use an interval of 3 seconds or 5 seconds
Confirm end feature:	Yes	Insures that features are not ended unintentionally.
Minimum Positions:	30 positions	25 positions plus 20 percent
Carrier phase Carrier mode: Minimum time:	 Off 10 Mins	This is not normally used.
Dynamics code:	Land	Choices are Land, Sea or Air .
Audible click:	Yes	You want to hear this.
Log DOP data:	Yes	This provides some of the QA/QC information.
Log PPRT data: (VERY IMPORTANT)	Yes	This allows DGPS data to be Differentially Corrected (**may** result in better accuracy).
Log QA/QC data:	Yes	
Allow GPS Update:	Warn first	
Warning Distance:	Any	
Hit the "**Enter**" key to accept the settings and exit the Logging Options sub-menu. This returns you to the GPS rover options sub-menu		

Next, in the Configuration menu, select the “**Position filters**” sub-menu and press “**Enter**”.

Position filters (sub-menu)

GPS Rover Options - Position filters	**Recommended value**	**Comments**
Position mode	Manual 3D	At least four (4) satellites must be used.
Elevation mask	15 ° (for a rover)	Increase this by 1° for every 100 km (60 mi.) away from the Base.
SNR mask	8.0	Higher SNR’s provide better quality signals.
PDOP mask	6.0	PDOP's > 6.0 shut the receiver off. (Lower is better)
PDOP switch	6.0	Switches the receiver to 2D mode.
Hit the “**Enter**” key to accept the settings and exit the “**Position filters**” sub-menu.		

Now, in the Configuration menu, enter the “**Real-time input**”

Real-time input (sub-menu)

GPS Rover Options - Real-time input	**Recommended value**	**Comments**
Preferred correction source Choice 1 Choice 2	Intergrated beacon Use uncorrected GPS	This display will vary, but it should contain the recommended selections.
General real-time settings Correction age limit	25 seconds	This is the length of time that RTCM corrrections are applied, after the link stops working.
Hit the “**Enter**” key to accept the settings and exit the “**Real-time input**” sub-menu.		

Next, in the Configuration menu, enter the “**Antenna options**” sub-menu.

GPS Rover Options - Antenna options	**Recommended value**	**Comments**
Height	0.000 m	Use only if you need to measure height accurately.
Measure	Vertical	
Confirm	Never	
Type	Integrated GPS/Beacon	
Part Number	29653-00	
Hit the “**Enter**” key to accept the settings and exit the “**Antenna options**” sub-menu.		

Hang in there, we’re almost done with the GPS rover options sub-menu.

Use the “**Initial Position**” sub-menu only if your more than 500 kilometers (300 miles) from the last location the GPS receiver was in.   Call Mike Glogower for this information (732 321-6661).

Finally, we NEVER use the 2D altitude sub-menu, so..........

Use the “**Esc**” key to return to the Configuration Menu.

We will skip over the “**GPS base station options**” since it is rarely used.
We will also skip over the “**NMEA/TSIP output options**” since it too, is rarely used.

<u>Non Critical Display settings - change these to suit your own preferences:</u>
If you're already in the Configuration Menu follow the directions in the Table below. If you're in the Main Menu on the TSC1 go to the Configuration menu.

Setting or Menu names	**Recommended values**	**Comments**
Enter the **Coordinate system** submenu		
Coordinate system	Select Latitude/Longitude and hit the "**Enter**"key	
Datum: Altitude units: Altitude reference:	WGS 1984 Meters (m) HAE	
Hit the "**Enter**" key to exit the "**Latitude/Longitude**" screen, and return to the "**Configuration**" menu.		
Enter the **Map display options** submenu, (***Skip this if you're not going to use the Map display***)		
Layers		
Features: Update Check Marks: Not in Feature: GPS trail Navigation: Scale display: Coordinate display: Background file:	Show Show Show Show Show Show Show None	
Hit the "**Enter**" key to accept the settings and exit the "**Map display options**" sub-menu, and return to the "**Configuration**" menu.		
Enter the **Navigation options** submenu, (***Skip this if you're not going to use the Navigation tools***)		
Direction dial options		
Dial info panel 1: Dial info panel 2: Dial info panel 3: Dial info panel 4: Close-up range (DGPS): Close-up style:	Turn Heading Velocity Time 5.00 meters Target-centered	
Road options	Leave at defaults	
Hit the "**Enter**" key to accept the settings and exit the "**Navigation options**"sub-menu, and return to the "**Configuration**" menu.		

Setting or Menu names	**Recommended values**	**Comments**
Enter the **Units and Display** submenu		
Units Distance (2D): Area: Velocity: Angles:	 Meters (m) Square Meters (m^2) Miles per hour Degrees (°)	
Angle format:	DD.MMSSss	
Order:	Latitude/Longitude	
***North reference:**	**Magnetic**	Use Magnetic to avoid setting the declination on the compass
***Magnetic declination**	**Auto**	
Null string:	?	
Language:	English	
Hit the "**Enter**" key to accept the settings and exit the "**Units and display**" sub-menu, and return to the "**Configuration**" menu.		

* It is critical to set these items properly when using offsets*

We are still in the **Configuration** menu, now go to the **"Time and date"** submenu

Setting or Menu names	Recommended values	Comments
Time and Date submenu settings		
Time and date 24-hour clock: Time: Date format: Date:	 Yes Reset it, if it's wrong MM/DD/YYYY Reset it, if it's wrong	Time and date submenu Once the receiver begins to operate these items will be automatically updated.
Hit the "**Enter**" key to accept the settings and exit the "**Time and date**" sub-menu, and return to the "**Configuration**" menu.		

Quickmark, and Constant offset settings - Skip these settings if you are NOT going to use them

External Sensor setup (Skip this step if you are NOT attaching an external sensor):
For external sensors scroll down to "**External Sensors**" and hit **Enter**, or hit the letter E on the keypad. Scroll down to Laser and hit **Enter**. Make sure TYPE is set to the proper laser data format, (use Criterion 300 for the Geolaser), and set Auto Connect to Yes. Hit the "**Esc**'" key to exit this menu.

More Non-critical settings:

If you are still in the Configuration menu, use the arrow keys to continue down to the "**Hardware"** submenu and then hit the **ENTER** key (*or hit the "**H**" key to enter the **Hardware** submenu*).

Setting names	**Recommended values**	**Comments**
Hardware TSC1 submenu		
LCD contrast:	45 %	On the TSC1 use the **Fn and the E** key to increase the contrast, and the **Fn and the F** key to decrease the contrast.
Backlight:	Off	On the TSC1 you can use the **Fn and the L** key to toggle this on and off.
Low voltage charging:	Off	Can charge the TSC1 battery using the camcorder batteries.
Auto shutoff	20 (minutes)	
Beep volume:	High	Volume of sounds made when data is logged.
Free Space		Space remaining on the dataloggers memory.
PC card free space	16 MB PC card	16 MB PC card is available for storage.
Battery source:		External or Internal
Internal battery:	_____ %	Percent of battery power remaining. **Recharge at 30%.**
External battery:	_____ %	Percent of battery power remaining. **Recharge every day.**
Automatic contrast	On	???
Software version:	5.20	

Now, Hit the ESC Key to return to the Configuration menu, and then Hit the ESC Key to return Main Menu

ASSET SURVEYOR Operation - Use this procedure for collecting locational data.

1 - Assemble the instrument and turn on the datalogger while outside.
2 - Set/verify that **critical parameters** are properly set (Do this **once a day**).
3 - Wait a minute or two for the unit to "warm up". You know the unit is warmed up when there is a PDOP value displayed on the bottom line of the screen.
4 - From the Main Menu, enter the **Data collection** submenu.
5 - Hit **ENTER** on "**Create rover file**".
If you are **reopening a previously saved file**:
Select the file name and hit the **ENTER** key, hit the **F2** key for **NEW** to open the START FEATURE menu. Now select the feature you want to add to the file. **Go to # 10 below.**
6 - *Name the file (see next page for recommended file name format), and remember to write it down. Then hit the **ENTER** key.
7 - Hit the arrow key to select the appropriate **Data Dictionary**.
8 - Hit the **Enter** key.
9 - Select the **Data Dictionary** Feature you are mapping and hit the **ENTER** key to start logging data
10 - Input the Data Dictionary information as required. Sometimes it's useful to hit the **F1** key for **PAUSE** before hitting the **ENTER** key so you don't log positions while entering in attributes. To remove **PAUSE** hit the **F1** key again for **RESUME**.
11 - When collecting point features keep the antenna stationary and collect a minimum of 120 positions. When collecting line or area features you must move the antenna along the feature. (e.g. walking a trail, driving a road, or walking the perimeter of a building)
Note: - the BOTTOM LINE of this screen shows you the number of positions collected on the right
12 - If you can't get the antenna directly over the feature you can enter an **OFFSET** from the antenna location to the feature by hitting the **F3** key while logging point features*, or the **F4** and **F2** key while logging line or area features*. You will need to enter an **Azimuth** and **Distance** for point features, or a **Direction** and **Distance** for line and area features. Note, **Direction** is either **Right** or **Left** of the direction of travel and **Inclination** is usually 0°. Be sure all information you enter matches the settings you put in under the **Units and Display** submenu in the **Configuration Menu**, and remember to make a sketch of what you did, in your notes.
13 - Once you have entered in the correct offset information hit the **Enter key**.
14 - Once you have collected enough positions, close the feature by hitting the **Enter key.** If you are going to collect another feature of the same type return to step 9 and repeat the process. If you are going to map a different kind of feature, or you are done for the day, continue to step 15.
15 - Hit the **Esc key** on the TSC1, and a message will be displayed "**EXIT DATA COLLECTION?,** hit the **F1** key for **YES**.
16 - Now, you may return to Step 5 above, if you want to create a new file or to reopen a file.

When you have finished logging data, and have closed the last data file, please shut off the datalogger by holding down the Green ON/OFF key until the TSC1 shuts off.

Note: To retain the first letter of the file name in memory so that subsequent files names start with the letter assigned to the specific GPS field unit you are using......, Use the left arrow key to select the file name shown and to move the cursor so that it is before the first letter of the file name. Now, use the* Fn *key, followed by the* DELETE *key to remove the first letter of the file name. Finally, enter the corresponding letter of the unit in place of the letter you just deleted. Hit the* ENTER *key to save.

***Allowable GPS File names**

- Must enter a DOS file name (8 characters or less) (**Not allowed / \ : | < > + = ; , . ? ***)
- Automatic files names are based on GPS time

- Recommended file naming convention:

GPS unit letter, 2-Digit Month, 2-Digit Day, 2-Digit for hour (in GMT), and letter

ZMMDDHHa

Downloading GPS data to the PC:

To transfer files from the datalogger to the PC; bring up the PATHFINDER OFFICE program on the computer by double clicking on the PATHFINDER OFFICE icon from the Windows 9X desktop.

1. Set the correct Project Name for the data to be transferred into, or click on the New button to create a new project. If the project already exists, but needs to be modified click on the Modify button. You will need to modify an existing project if you are working on that project for more than one day. Enter a meaningful project name then edit the project directory line to include the date that you collected your data. For Example:

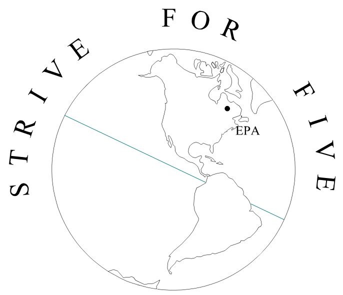
Project	Collection date
C:\training\GPS week (i.e., WK42_98)	

Make sure the Backup, Export, and Base subdirectories all say backup, export, and base respectively.
2. Click the OK button.
3. Hit the Enter key on the keyboard until the messages on the computer disappear.
4. Connect the datalogger to the PC.
5. Turn on the datalogger and get to the Main menu.
6. On the datalogger; hit the "**F**" key to enter the **File manager** menu (or use the arrow keys to highlight **File manager**, followed by the **Enter** key).
7. Go to **File transfer** and hit the **Enter** key. The message "connect cable to PC" will appear.
8. **Back to the PC**, click on the Utilities menu, then click on the Data Transfer option. If a connection is not made within a few seconds click on the Cancel button then change the Port in the data transfer box and click on the Connect button on the right side of the box.
9. Select the desired file(s) by double clicking on each file, or by clicking on the Add All button. Once you have picked all the files you want click on the Transfer button on the right side of the box.
10. After the files are transferred click on the X in the upper right corner of the data transfer box to close it. Then click on the X in the upper right corner of the screen to close the Pathfinder Office software.

To copy (backup) the files from the computer to Diskette using Windows 95 Explorer
(Note: If you're more comfortable using DOS commands, go for it).
1. You need to copy both the .SSF and the .blank file to the disk for backup before you erase the data off the datalogger.
2. To use the Windows 9X explorer to do this please refer to Chapter 5 of your GPS Training Manual for direction.
3. In the Windows 9X Explorer go to the backup directory of the collection date for your project, pick the files and copy them to the A: drive.
4. Check to make **sure that ALL** the files were copied by clicking on the A: drive to look on the disk.
5. **Now, return to the datalogger** and use the procedure below to DELETE all the files.
6. You should still be in **File manager,** so hit the "D" key (twice), or use the arrow keys to get to **Delete files**, and hit the **Enter** key.
7. Delete all files by hitting the **F5** key for **DelAll**. A message will appear asking "Do you want to delete all files?". Hit the **F1** key for **YES**.
8. Hit the **F1 key** to confirm the deletion of the file.
9. Hit the **Enter** key to return to the Main Menu.
10. Hold down the Green key shut the TSC1 off.

Remember to take GOOD NOTES; which include:

Date of collection for each file. GPS unit being used.
Name and address of location, and/or Site name.
The file name. The data dictionary being used.
The starting and ending times.
The number and type of feature inside the file.
A description of the locations (include a diagram/map with North arrow).



Charging Batteries (TSC1)

To check the status of the internal and external batteries, connect the external camcorder batteries to the receiver, and connect the receiver to the TSC1. Turn the TSC1 on and enter the **Configuration** menu. Now, hit the "**H**" key to access the **HARDWARE** submenu. Use the arrow keys to move down to the battery status screen. You must charge the internal Lithium-ion battery when it falls below 30 %. And recharge the two external camcorder batteries after each use.

Note: You CAN charge both the internal Lithium-ion battery in the TSC1, and the two camcorder batteries after each use without harming the batteries. Use the yellow OSM to do this.

GPS Receiver Battery (i.e. the Camcorder batteries)

These two batteries should be **charged after EACH USE**. Use both of the individual charging units to recharge the two 2.3 Amp-hour Camcorder batteries. Typical charging time is 2 - 4 hours for the Camcorder battery(s), but leaving these batteries in the charger longer is OK.

TSC1 Internal Battery:

The internal Lithium-ion battery in the TSC1 battery **can be charged after EACH USE**. Use the yellow OSM. Typical recharging time is about three (3) hours, but leaving it on charge longer is OK. A fully charged Lithium-ion battery will run for about seven (7) hours. **You MUST recharge the TSC1 battery when it the battery level drops below 30 %.**

EMERGENCY PROCEDURES (TSC1) -aka Trouble shooting

If you can't make the TSC1 unit function properly, you've recharged the batteries, and you've checked the connections to the batteries and the antenna, you can try to use this procedure for a WARM BOOT.

WARM BOOT - does NOT erase data in memory, but it resets the default software settings. You have to reset all the Critical Settings.

1. Make sure the TSC1 is turned off, by holding down the Green ON/OFF button for about five (5) seconds. Then, hold down the Backspace key [**Bksp**] and press and release the Green ON/OFF key. If this fails, perform a Cold Boot.

COLD BOOT - WARNING THIS DOES ERASE ALL ENTRIES IN MEMORY

1. Make sure the TSC1 is turned off, by holding down the Green ON/OFF button for about five (5) seconds. Then, hold down the **Fn** key and the **F5** key together.
2. While holding them down, press and release the Green ON/OFF key.
3. Then the following message appears on the screen:

```
Force Reformat Internal Media
```

4. Release the **Fn** and **F5**. After a few minutes the program should start.

Finally, if nothing else works:....... you can always

Call Mike Glogower at (732) 321-6661; or,
call MAPCO (Mike Popoloski) at (973) 728-5767

16.4 References

- United States Environmental Protection Agency, February 1992. GIS Technical Memorandum 3: Global Positioning Systems Technology And Its Application In Environmental Programs. US EPA Document # EPA/600/R-92/036.

- Guide to GPS Positioning, David Wells (Canadian GPS Associates), 1987. ISBN: 00920-114-73-3

- Trimble Navigation Limited - Pathfinder Office Manual, part number 34231-00, version 2.0 September 1997.

- Trimble Navigation Limited - PROXR/XRS with Asset Surveyor- Classroom Manual, part number 30992-10-Eng, Revision A. 1998.

- Trimble Navigation Limited - TSC1 Asset Surveyor Operation Manual, revision A, part number 34182-02-ENG, version 4.02 October 1998.

- Trimble Navigation Limited - TSC1 Asset Surveyor Software User Guide, revision A, part number 34183-02-ENG, version 4.02 October 1998.

- Trimble Navigation Limited - Mapping Systems General Reference (2000), P/N 24177-01, Revision C.

- Trimble Navigation Limited - GPS Guide to the Next Utility, Jeff Hurn. 1989

SECTION 17
FIELD MEASURABLE PHYSICAL/CHEMICAL CHARACTERISTICS

PERFORMANCE OBJECTIVES:

- To measure physical/chemical characteristics of a sample that are representative of field conditions as they exist at the time of sample collection by selecting the appropriate meter/instrument(s) or procedure, and by properly calibrating or verifying each instrument.

17.1 Introduction

Temperature, specific conductance (conductivity), hydrogen-ion concentration (pH), turbidity, dissolved oxygen (DO), chlorine, salinity, flash point and settleable solids are discussed in this section. The order in which the measurements are made may be important in some field investigations. References for each parameter can be found at the end of the section.

Numerous meters/instruments are commercially available. Some meters are capable of multiple measurements which may include: pH, temperature, conductivity, DO, salinity, and turbidity; therefore, individual meters discussed here are not necessarily the only ones available. However, the setup and use of all instruments should follow a basic format to ensure consistency.

Quality Control

All equipment should be maintained and operated in accordance with the manufacturer's instructions. Regardless of the meter used, it should be properly calibrated, or verified, prior to field use. All field meters with thermistors are verified against a National Institute of Standards and Technology (NIST) traceable thermometer, at least annually. This includes, but is not limited to, the pH, conductivity, and DO meters. These verification checks are documented in the inspector’s logbook and/or laboratory logbook. Additionally, the certified NIST thermometer is checked at least annually and documented by the manufacture.

The turbidimeter is calibrated with Formazin Primary Standards with every field survey and a record of the calibration is to be maintained in the inspector’s logbook. The Gelex secondary standards will be standardized against the Formazin Primary Standards by the inspector. The turbidimeter should be verified with the Gelex secondary standards before each use. These verifications are to be documented in the inspector’s logbook.

Standard Methods requires that the conductivity meters’ electrode cell be verified by comparing against a laboratory meter with a platinum-electrode type conductivity cell. The field sampling team will perform and document this quality control check with every field investigation, when the meter is used for monitoring/enforcement activities.

17.2 Temperature

Normally, temperature measurements may be made with any good alcohol-filled thermometer, or a NIST traceable digital thermometer. For field operations, the thermometer should be capable of reading, or have a scale marked in 1.0 ºC, or better. In addition, with glass thermometers, a metal support case should be used to prevent breakage. For laboratory audits involving the analysis of coliform bacteria a thermometer with readable increments of 0.1 ºC is needed in order to verify the accuracy of water bath and/or incubator temperature measuring devices.

Calibration:

Calibrate any temperature measurement device by checking annually against a National Institute of Standards and Technology (NIST) certified thermometer. Clearly indicate whatever correction factor must be applied to the thermometer with the aid of an correction factor label. The label should have the following information; the correction factor, the date the calibration was conducted, and the analysts initials.

Note: Once the correction factor deviates too much against a NIST traceable thermometer the instrument must be replaced, or repaired. All thermometers should be inspected for broken columns of alcohol, leaks, cracks, and/or function prior to use. Store the thermometers upright during periods of long-term storage.

Procedures: (Make measurements in-situ when possible)

1 Clean the probe end with clean water and immerse into sample.

2 Swirl the thermometer in the sample for mixing and equilibration.

3 Allow the thermometer to equilibrate with the sample until the reading holds steady.

4 When taking the reading be sure to suspend the thermometer away from the sides and bottom of the sample container.

5 Record the reading in the logbook. Report temperature readings to the nearest 1.0 ºC, or better.

Note: Always clean the thermometer prior to storage and/or use.

Conversion Formulas:

To convert degrees Fahrenheit (ºF) to degrees Celsius (ºC) use:

$$^{\circ}C = 5/9\ (^{\circ}F - 32)$$

To convert degrees Celsius (ºC) to degrees Fahrenheit (ºF) use:

$$^{\circ}F = (9/5\ ^{\circ}C) + 32$$

17.3 Conductivity (Specific Conductance)

Conductivity is a measure of the ability of an aqueous solution to conduct an electric current. Conductivity is customarily reported in milli-Siemens per centimeter (mS/cm). The conductivity of solutions of ionic species is highly dependent on the temperature. It should be noted that conductivity is a direct measurement, while specific conductivity is temperature corrected. Most field meters will do the calculation and display the results in either mode. The field sampler must be careful to note which measurement is recorded. In the case of conductivity, the temperature of the sample must also be recorded.

Equipment available:

YSI Model 63

Calibration:

System calibration is rarely required because the factory internal calibration of the YSI Model 63 is set. However, from time to time, it is wise to check the system calibration and make adjustments when necessary.

Pre-calibration technique:

1 When filling a calibration container prior to performing the calibration procedure, make certain that the level of calibration buffers is high enough in the container to cover the entire probe. Gently agitate the probe to remove any bubbles in the conductivity cell.

2 Rinse the probe with de-ionized water and blot dry between changes of calibration solutions.

3. During calibration, allow the probe time to stabilize with regard to temperature (approximately 60 seconds), before proceeding with the calibration process.

4. Perform the conductivity calibration at a temperature as close to 25 ºC as possible. This will minimize any temperature compensation error.

Calibration Procedures:

1. Turn the instrument on and allow it to complete the self test calibration.

2. Select a calibration solution most similar to the sample being measured:

   - For sea water choose a 50 mS/cm conductivity std (YSI catalog #3169)

   - For fresh water choose a 1 mS/cm conductivity std (YSI catalog #3167)

   - For brackish water choose a 10 mS/cm conductivity std (YSI catalog #3168)

3. Place at least 7 inches of solution in the plastic container provided, or in a clean glass beaker. **Note: Do Not use a 100 mL graduated cylinder**. The diameter of the cylinder is too small for accurate conductivity measurements.

4. Use the **MODE** key to advance the instrument to display conductivity.

5. Insert the probe into the solution deep enough to completely cover the probe. (Both conductivity ports must be submerged.)

6. Allow at least 60 seconds for the temperature reading to become stable.

7. Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.

8. Press and release the **UP ARROW** and **DOWN ARROW** keys at the same time.

   The **CAL** symbol will appear at the bottom left of the display to indicate that the instrument is now in Calibration mode.

17.4 Hydrogen Ion Concentration (pH)

The pH is defined as the negative logarithm of the effective hydrogen-ion concentration. For routine work use a pH meter accurate and reproducible to 0.2 pH standard units (SU), with a range at least of 2 to 14 and equipped with a temperature-compensation adjustment.

Meter(s) available:

- Analytical Measurements Weatherproof pH Recorder Model 30WP
- Orion Model 250A
- Hydrolab Surveyor
- YSI Model 63 and 85
- WTW portable pH meter

Calibration Procedures:

Because of the wide variety of pH meters and accessories, detailed operating instructions cannot be incorporated into this section. Each analyst should become proficient with the operation of the meter used, and follow manufacturer's instructions. The following calibration guidelines are minimum requirements.

The meter is thoroughly checked and calibrated in accordance with the manufacturer's instructions before it is taken into the field. At least a two-point calibration verification should be used to ensure the accuracy of the meter.

Analytical Measurements Weatherproof pH (continuous) Recorder Model 30WP Procedure:

1 The pH probe should be soaked in 7.0 pH buffer for several hours before checking the operation and calibration of the meter.

2 Label the pressure sensitive strip chart in the pH meter with the facility name, date of calibration, time of calibration, discharge identifier, and initial of the inspector doing the calibration.

3 Turn the pH meter to RECORD.

4 Take the temperature of the DI water that has been stored with the buffers, with a thermometer that has been calibrated against a NIST traceable thermometer.

4. Adjust the temperature CONTROL KNOB on the pH meter to the thermometer reading.

5. Rinse the pH probe in the DI water and blot dry with a paper towel.

6. Place the pH probe into the seven (7) buffer, and adjust the pH meters Calibration knob to the correct reading of the buffer (if necessary), then turn the black switch ON (which enables the needle to mark the pressure sensitive paper). You may need to quickly turn the black switch ON and then OFF in order to let the marking needle float freely along the pH paper, so that it is in (or near) the correct position. Let the needle mark the chart paper at the pH 7 buffer location for 4-5 times, then turn OFF the black switch (to stop the needle from marking the chart paper).

7. Follow the same procedure in step 6 for either the four (4) or the ten (10) buffer. The second buffer used should be selected so that it would bracket the expected pH of the sample(s) being taken. Acceptable pH readings would be within ± 0.2 of the pH unit of the known buffer value.

8. After the pH of the third buffer solution has been checked, circle the marks made on the pressure sensitive paper, and label them accordingly (4, 7 and 10). If the meter is not reading the buffers correctly, try a new buffer (especially for the 10 buffer, which tends to absorb carbon dioxide from the air and makes it slightly more acidic. If that does not improve the reading, then try to repair the probe, next try to replace the probe with one that has been soaked in pH seven (7) buffer solution overnight.

9. Take the temperature of the wastewater stream.

10. Adjust the temperature Control Knob on the pH meter to the temperature of the wastewater stream.

11. Place the pH probe into the wastewater stream (make sure the protective cap is removed).

12. Turn the black switch to ON position to obtain continuous pH reading on the pressure sensitive pH recording paper.

13. Record the time the meter is started on the pressure sensitive chart paper, and in the logbook.

14. You may need to check the calibration of the meter, especially if the readings are unusual, or do not match what is expected.

Shutting OFF the Model 30 pH meter:

1. Turn black switch that stops the needle from marking the pressure sensitive paper to the OFF position, but **DO NOT** turn the meters ON/OFF switch to the OFF position.

2. Roll the pH chart paper up to provide some space to write the information for the calibration check.

3. Check all three buffers **at the temperature of the buffers**; be sure NOT to readjust the calibration of the meter.

4. Circle the marks made on the pressure sensitive paper, and label them accordingly (4, 7 and 10).

5. Write the facility name, date of calibration check, discharge identification, time of the calibration check, and the inspector's initials on the paper.

6. Turn RECORDER off, and remove the strip chart recording paper, and give it to the lead inspector.

Portable pH meter Sample Measurement Procedure:

1. The calibration procedure would be the same as for the Analytical Measurements meter described above.

2. Collect a sample. Measure the temperature prior to measuring the pH.

3. Immerse the probe in the sample keeping it away from the sides and bottom of the sample container. Allow ample time for the probe to equilibrate with the sample while gently stirring the sample.

4. While suspending the probe away from the sides and bottom of the sample container, make note of the pH reading, and write it in your notebook.

5. Rinse the probe with de-ionized water and store it in a container that contains sufficient pH 7 buffer solution (or storage solution or de-ionized water, as recommended by the probe manufacturer) to cover the electrode on the probe, until the next sample is ready.

WTW Portable pH meter

1. There is a "quirk" with the calibration of the portable WTW pH meters. If you are doing a three point calibration, the meter will display a calibration error when the first buffer used in the calibration is a pH 7. Discussion with the manufacturer's representative indicated that the meter is "looking" for a straight line relationship between the calibration standards. Therefore, for this particular pH meter the order of the buffers used in the calibration should be either 4 - 7 - 10, or 10 - 7 - 4.

Operational check:

1. While in use, periodically check the pH by rinsing the probe with de-ionized water, blot dry and immerse it into the pH 7 buffer solution.

2. Perform a post calibration verification when you have finished taking samples for the day, and record all measurements.

17.5 Turbidity

A nephelometer/turbidimeter is used to compare the turbidity of liquids to known standards, by viewing light through them and determining how much light is eliminated.

Meter(s) available:

- Hach 2100P Portable Turbidimeter

Calibration:

1. The turbidimeter is calibrated with Formazin Primary Standards each time it is use in the field. The record of the calibration is maintained in the inspector’s field notebook. The turbidimeter should be verified with the Gelex secondary standards in the field before each use. The Gelex Secondary Standards are supplied with the instrument, but must have assigned values before use after the Formazin calibration. If the instrument readings do not agree within ± 10 % of the Gelex standards, the unit must be re-calibrated, repaired or replaced.

2. Turn the meter "ON".

3. Rinse the sample cell with organic free or de-ionized water.

4. Fill the cell to the fill line with organic free or de-ionized water and then cap the cell (this will be the blank sample).

5. Use a non-abrasive lint-free paper or cloth to wipe off excess water and streaks.

6. Open the cover and insert the cell (arrow to the front) into the unit and close the cover.

7. Press "READ" and wait for the 'light bulb' icon to go off. Record the reading.

8. Using the Gelex standards, repeat steps 5, 6, and 7. Record all measurements (and be sure to note anomalies).

Sample Measurement Procedures:

1. Collect a representative sample, or use a portion of the sample that is collected for pH, temperature, or conductivity analysis, and pour off enough to fill the cell to

the fill line (about 15 mL) and replace the cap on the cell.

2. Wipe off excess water and any streaks with a soft, lint-free cloth or lens paper.
3. Press I/O and the instrument will turn on. Place the meter on a flat, sturdy surface. Do not hold the instrument while making measurements.
4. Insert the sample cell in the in the instrument so the diamond orientation mark aligns with the raised orientation mark in the front of the cell compartment. Close the lid.
5. Select manual or automatic range selection by pressing the range key.
6. Select signal averaging mode by pressing the Signal Average key. Use signal average mode if the sample causes a noisy signal (display changes constantly).
7. Press READ. The display will show ___NTU. Then, the turbidity in NTUs will appear. Record the result after the lamp symbol turns off.
8. Rinse the cell with de-ionized water.
9. For the next sample, repeat Steps 1-8.

Operational check:

1. Periodically (after every twenty samples) check the accuracy of the turbidity meter by using the Gelex secondary standards.
2. Perform a post calibration at the end of the day and record all measurements.

17.6 Salinity

Salinity is the measure of salts of the alkali metals or of magnesium found in water. This measurement is based on the direct proportionality between the magnitude of an induced electric current and the electrical conductivity of the water in which it is induced. Salinity is the total amount of salts (in grams) in 1 Kg of sea water expressed as parts per thousand.

Meters available:

- YSI Model 63 & 85
- Hydrolab Surveyor II

Calibration/Maintenance:

- Follow the manufacturer’s instructions.

- Routinely check the YSI meter against a resistor matched to the meter.

Accuracy:

- The YSI meter has an accuracy of ± 2% or ± 0.1 parts per thousand (ppt) salinity. The range for salinity is 0 to 80 ppt.

- The Hydrolab Surveyor II has an accuracy of ± 0.7 ppt at 1% full scale conductance at ± 0.1°C.

17.7 Dissolved Oxygen (DO)

Dissolved oxygen (DO) levels in nature and wastewater depend on the physical, chemical, and biochemical activities in the water body. The analysis for DO is a key test in water pollution and waste treatment process control.

Meters and Procedure available:

- YSI Models 55, 57 or 58 membrane-covered electrode (ME) DO meter

- Hydrolab Surveyor II

- Winkler Method; Azide Modification.

Membrane-covered electrode (ME) systems utilize a sensing element that is protected by an oxygen permeable membrane that serves as a diffusion barrier against impurities. The meters for determining the DO in water are dependent upon electrochemical reactions. Under steady-state conditions, the current is directly proportional to the DO concentration. Interfacial dynamics at the ME/sample interface are a factor in probe response and a significant degree of interfacial turbulence is necessary. For precision performance, turbulence should be constant.

Inspection:

- Prior to field use, the membrane of the DO probe should be inspected for air bubbles and/or holes. If air bubbles or holes exist, replace the membrane.

- The membrane should be checked for dryness. If the membrane is dry, replace it, and soak the new membrane in analyte-free water prior to calibration of the meter.

Calibration:

- The ME meter should be calibrated against the modified Winkler method (in duplicate) in order to verify its accuracy.

- Once the meter has been calibrated against the modified Winkler method, additional calibration checks can be performed using air calibration procedures. These will be performed in accordance with the manufacturer's instructions, either in air saturated water, or in a water saturated air environment.

Procedures:

1. When making measurements, be sure that the ME stirring apparatus is working. This is especially important in water that is not moving.

2. Adjust the temperature and salinity compensators (if equipped).

3. Read the dial to the nearest 0.1 mg/l and record the measurement.

To Collect a Sample:

1. When possible, measure the DO in-situ with a field probe; otherwise,

2. Collect the sample by completely filling a 300-mL BOD bottle, stopper and measure the DO with a laboratory type probe. **Note**: Special care should be exercised to avoid entrainment of atmospheric oxygen, or loss of DO during sampling and analysis.

3. Care must be exercised to prevent turbulence or the formation of bubbles when filling the BOD sample bottle. If a Kemmerer sampler is used, the BOD sample bottle should be filled to overflowing by inserting the outlet tube of the sampler to the bottom of the bottle. The tube should be withdrawn slowly as the bottle is allowed to overflow three times its volume.

4. Duplicate analyses should agree within ± 0.2 mg/l.

Winkler Method: *Azide Modification*:

1. Fill a 300 milliliter (mL) BOD bottle with the sample until it overflows, and cap it. Care must be exercised to prevent turbulence or the formation of bubbles when filling the BOD sample bottle

2. Remove cap and add 1 mL of Manganous sulfate solution ($MnSO_4$) and 1 mL of Alkali-iodide-azide solution.

3. Cap bottle and mix by inverting bottle (15 - 25 times).

4. Allow manganese hydroxide floc to settle approximately halfway down the bottle volume.

5. Mix the sample again by inverting the bottle (15 - 25 times).

6. Again, allow the floc to settle approximately halfway down the bottle volume.

7. Add 1 mL of concentrated sulfuric acid (H_2SO_4).

8. Recap and mix by inverting 15 - 25 times until dissolution of the iodine is complete. Inspect the liquid in the BOD bottle and make sure that all of the iodine is dissolved. If the iodine is still present (which is visible as red particles floating in the liquid), a small amount of additional acid should be added to the sample. The sample should be shaken and re-checked for iodine.

9. Once the sample is free of iodine pour it into a 500 mL wide mouthed flask.

10. Using a 10 mL pipette, titrate to a pale straw color. Titrate the sample by using sodium thiosulfate solution ($Na_2S_2O_3$). Either:

    <u>0.0250 Normal sodium thiosulfate</u> solution is <u>used for 201 mL of sample</u>, or

    <u>0.0375 Normal sodium thiosulfate</u> solution, is <u>used for 301 mL</u> of sample

    Where 1 mL of $Na_2S_2O_3$ = 1 mg Dissolved Oxygen (DO) per liter.

11. Add a few drops of starch solution, which turns the solution blue.

12. Continue to titrate until the first disappearance of blue color.

13. The number of mls of sodium thiosulfate solution ($Na_2S_2O_3$) used in the titration will be equivalent to the milligrams per liter of dissolved oxygen in the sample.

14. If the sodium thiosulfate solution ($Na_2S_2O_3$) is not exactly the normality specified above, a proportional calculation needs to be performed to correct for the actual Normality of the solution.

17.8 Residual Chlorine

The chlorination of water supplies and polluted waters serves primarily to destroy or deactivate disease producing microorganisms. Chlorine applied to water in its molecular or hypochlorite form initially undergoes hydrolysis to form free chlorine consisting of aqueous molecular chlorine, hydrochlorous acid, and hypochlorite ion. The relative proportion of the free chlorine is dependent on pH and temperature. To fulfill the primarily purpose of chlorination and to minimize any adverse effects, it is essential that proper testing procedures be used with the foreknowledge of the limitations of the analytical determination.

The Section uses the HACH portable Pocket Colorimeter™ II, which uses the DPD colorimetric procedure to determine residual chlorine levels in water and wastewater. The portable colorimeters must be checked with pre-made purchased HACH gel secondary standards prior to use. If the color cells are within an acceptable range then the meter has demonstrated that it is operating properly, and sample measurements can be taken with the instrument. The reading of the gel standards must recorded in the field logbook. However, if the result of this check are not within the acceptable range, then the meter must be re-calibrated according to the procedure below.

Meter(s) available:

- Hand held portable HACH Pocket Colorimeter™ II (Cat. No. 58700-00)

User-Entered Calibration:

- Turn the Colorimeter ON. Press the MENU key and hold it down (for about five seconds) until the display shows “**USER**”, followed by “**CAL**”. Press the “ZERO/SCROLL” key to scroll through the options.
    - Use the “CAL” mode to enter and edit standard values and measure absorbance values.
    - Use the “Edit” mode to enter and edit standard values and measure absorbance values with the keypad, or review the existing calibration Used to enter a predetermined calibration curve.
    - Use the “dFL” mode to return the instrument back to the factory default calibration. NOTE: User-entered calibrations are stored upon exit from the calibration or edit modes.

Using the “CAL” mode:

1. Select “CAL” from the User menu, by pressing the “READ/ENTER” key.
2. Select the range to be calibrated. An arrow on top of the display will point to the selected range. To change ranges press the “MENU” key, then use the “READ/ENTER” key to toggle between ranges 1 and 2.
3. Press “MENU” again to return to the measurement mode.
4. Using a reagent blank and a prepared standard solution (be sure to allow the color to develop fully).
5. Insert the reagent blank into the meter and cover with the cap. Press the “ZERO/SCROLL” key. The meter will display “- - - - “, followed by “0.000". This initializes (zeros) the meter.
6. Press the “MENU” key and hold it down until the display shows “USER”, followed by “CAL”. Press the “READ/ENTER” key to enter the calibration mode.
7. In factory calibrated meters, “S0" will appear in the display.
8. Remove the blank sample. Press the “ZERO/SCROLL” key. “S1" will appear. Press the “READ/ENTER” key, then enter the first standard value. [Use the “READ/ENTER” key to move from digit to digit, and use the “ZERO/SCROLL” key to change the number.]
9. After completing the entry of the first standard value, press the “READ/ENTER” key. The display will show “A1".
10. Insert the first reacted standard solution into the cell holder. Cover the prepared standard with the cap.
11. Press the “READ/ENTER” key. The meter will measure and display the absorbance value of S1.
12. The calibration is complete with two points. If additional standards are required, press the “ZERO/SCROLL” key until “Add” appears on the display. Repeat steps 8 -11 to

enter additional standards.

Preparing Colorimeter Standards:

- Use a purchased standard solution (these are in one of the refrigerators by the Micro Lab) to check the colorimeter. The current Lot # 8317 contains 28.5 mg/l chlorine. To calibrate the meter, add the amount of standard indicated below to 10 mls of DI water in the sample cell.

Preparation of Chlorine Standards		
mls of standard added to 10 ml sample vial	Total Volume	Expected Concentration
0.1 mls	10.1 mls	0.282 mg/L
0.2 mls	10.2 mls	0.559 mg/L
0.3 mls	10.3 mls	0.830 mg/L
0.4 mls	10.4 mls	1.096 mg/L
0.5 mls	10.5 mls	1.357 mg/L
0.6 mls	10.6 mls	1.613 mg/L
0.7 mls	10.7 mls	1.864 mg/L
0.8 mls	10.8 mls	2.111 mg/L

Remember to zero out a blank, then READ the sample value (it should be close to the expected value).

Low Level (0.02 to 2.00 mg/l) - Using the HACH Colorimeter - Free and Total Chlorine:

- Press the “POWER” key to turn the meter on. An arrow will be on the upper top left of the display, indicating that the Low range is selected. Also, the display will have a readout that shows two zeros after the decimal point (“0.00”). Or, switch to the High Level, if necessary (see below). For chlorine levels that are less than 2.0 mg/l, use the Low Level mode.
  - **To switch the range to, and from, Low to High level**:
    a. Press the “MENU” key. The display will show “SEL”. A flashing arrow on the top line of the display indicates the current range.
    b. Press the “READ/ENTER” key to toggle between the ranges.
    c. Press the “MENU” key to accept the range and exit back to the measurement screen.

Operating the HACH Colorimeter (Low Level):

1. Fill two clean 10 mL cells to the 10 mL line with the sample, and record the sample time in the field log book.

2. Add the contents of either one DPD reagent pillow for Free Chlorine, or one DPD reagent pillow for Total Chlorine, to one of the sample cells. Gently shake the contents of the cells for about 20 seconds. The sample without the DPD reagent is the blank sample.

3. Wipe off the sample cells to remove moisture, fingerprints and smudges.

4. Place the sample cell with the DPD in a dark place (inside the Colorimeter case).

5. Place the blank sample in the Colorimeters cell holder with the diamond mark facing the keypad. Put the meter cap over cell compartment to cover the cell.

6. Press the “ZERO/SCROLL” key. The display will show “- - - -“, followed by “0.00".

7. **For FREE Chlorine - within one (1) minute** after having added the DPD pillow to the sample place the cell with the sample (with the DPD) in the cell holder. Cover it with the Colorimeter cap. Press “READ/ENTER”. The display will show “- - - -“, followed by the results in mg/l free chlorine.

8. **For TOTAL Chlorine** - put the cell with the DPD in the dark **Wait for at least three minutes, but not longer than six minutes**. Then place the cell with the sample (with the DPD) in the cell holder. Cover it with the Colorimeter cap. Press “READ/ENTER”. The display will show “- - - -“, followed by the results in mg/l total chlorine.

9. Record the readings in the field logbook.

High Level (0.1 to 8.0 mg/l) - Using the HACH Colorimeter - and Free and Total Chlorine:

- Press the “POWER” key to turn the meter on. An arrow will be on the upper top right of the display, indicating that the High range is selected. Also, the display will have a readout that shows one zero after the decimal point (“0.0”). Or, switch to the Low Level, if necessary (see below). For chlorine levels that are less than 2.0 mg/l, use the Low Level mode.

  - **To switch the range to, and from, Low to High level**:

    a. Press the “MENU” key. The display will show “SEL”. A flashing arrow on the top line of the display indicates the current range.

    b. Press the “READ/ENTER” key to toggle between the ranges. An arrow will be on the upper top left of the display, indicating that the Low range is selected. An arrow will be on the upper top right of the display, indicating that the High range is selected.

    c. Press the “MENU” key to accept the range and exit back to the measurement screen.

Operating the HACH Colorimeter (High Level):

1. NOTE: If the sample turns from a yellow to a brown color after adding the DPD reagent, the sample may have to be diluted, and the test repeated. Remember to multiply the result times the dilution factor used.

2. Fill two clean 1 cm/10 mL cells to the 5 mL line on the cell with the sample, and record the sample time in the field log book.

3. Add the contents of either two DPD reagent pillow for Free Chlorine, or two DPD reagent pillow for Total Chlorine, to one of the sample cells. Gently shake the contents of the cells for about 20 seconds. The sample without the DPD reagent is the blank sample.

4. Wipe off the sample cells to remove moisture, fingerprints and smudges.

5. Place the sample cell with the DPD in a dark place (inside the Colorimeter case).

6. Place the blank sample in the Colorimeters cell holder with the diamond mark facing the keypad. Put the meter cap over cell compartment to cover the cell.

7. Press the “ZERO/SCROLL” key. The display will show “- - - -“, followed by “0.0".

8. **For FREE Chlorine - within one (1) minute** after having added the DPD pillow to the sample place the cell with the sample (with the DPD) in the cell holder. Cover it with the Colorimeter cap. Press “READ/ENTER”. The display will show “- - - -“, followed by the results in mg/l free chlorine.

9. **For TOTAL Chlorine** - put the cell with the DPD in the dark **Wait for at least three minutes, but not longer than six minutes**. Then place the cell with the sample (with the DPD) in the cell holder. Cover it with the Colorimeter cap. Press “READ/ENTER”. The display will show “- - - -“, followed by the results in mg/l total chlorine.

10. Record the readings in the field logbook.

17.9 Flash Point

In order to field screen samples for ignitability, a sample is introduced into the cup of the Autoflash. The results of the screening process will determine if sample(s) are to be taken for the analysis of ignitability in the Edison laboratory. The temperature is sequentially increased, the test flame being applied at appropriate intervals depending on testers used until a flash is observed or until the flash point is determined to be greater than 65 ºC (149 ºF). The lowest temperature at which application of the test flame causes the vapor above the sample to ignite is taken as the flash point.

Equipment:

- Gallenkamp Auto Flash Point Test Instrument, Model AF3 (Pensky-Martin)

Considerations: *Preliminary Determinations*

1. Observe and record description of physical characteristics of the sample.

2. If the sample has flash point less than 140 ºF (60 ºC) it could be considered hazardous waste. If the sample has a flash point greater than 140 ºF (60 ºC), the sample is not considered a hazardous waste, based on the characteristic of ignitability.

3. If possible, determine if the aqueous sample has an alcohol content of greater than 24 percent by volume by using any available information. If the sample has an alcohol content greater than 24 percent, then it is considered a hazardous waste. If the sample contains less than 24 percent alcohol, it is not considered a hazardous waste. **Note**: An exception to this is based on an October 1984 RCRA Hotline Summary. If an aqueous sample with an alcohol content of 0 percent is ignitable, it is still considered a hazardous waste.

4. Thoroughly clean and dry all parts of the Pensky-Martin Tester (Gallenkamp AF3) cups and its accessories before starting the test, being sure to remove any solvent which had been used to clean the instrument. Turn on the autoflash apparatus with the power switch. Set a temperature of 65 ºC (149 ºF) on the digital display that reads expected flashpoint.

5. If the sample flashes at a temperature of 65 ºC (149 ºF), or lower, this would mean that this sample source has the potential to meet the RCRA hazardous waste characteristic of ignitability, and would justify that the source be sampled and analyzed in the laboratory.

17.10 Settleable Solids

Settleable solids in surface and saline waters, as well as domestic and industrial wastes, may be determined and reported on either a volume (ml/L) or a weight (mg/L) basis.

Apparatus:

- Imhoff cone (1-liter) = Volumetric test

Procedure

1. Fill an Imhoff cone to the 1-Liter mark with a well mixed sample (pour it quickly in order not to lose any solids that might rapidly settle out of solution).

2. Allow it to settle for 45 minutes.

3. Gently stir the sample near the sides of the cone with a rod, or by spinning.
4. Allow the sample to settle of 15 minutes longer, for a total of 1 hour.

5. Record the volume of settleable solids in the cone as milliliters per liter.
   Note: If the settled matter contains pockets of liquid between large settled particles, subtract this volume from the total volume of settled solids.

17.12 References

Temperature

1. Standard Methods for the Examination of Water and Wastewater, 18th, 19 and 20th Editions, Method 2550 B.

2. Methods for Chemical Analyses of Water and Wastes, US-EPA, Method 170.1 (1983).

Specific Conductance (Conductivity)

3. Standard Methods for the Examination of Water and Wastewater, 18th, 19 and 20th Editions, Method 2510 B.

4. Annual Book of ASTM Standards, Vol. 11.1, "Water," Standard D1125-91A, P. 202.

5. Methods for Chemical Analysis of Water and Wastes, US-EPA, Method 120.1 (1983).

6. Surveyor II Operating Manual, Hydrolab Corporation, Rev. A February 1985.

7. YSI Model 3560 Water Quality Monitoring System Instructions, July, 1988.

Hydrogen Ion Concentration (pH)

8. Standard Methods for the Examination of Wastewater, 18th, 19 and 20th Editions, Method 4500-H+ B.

9. Instruction Manual for Models 399 A/F, 399 A/L Analog pH Meter, and SA 250 and 230A, Orion Research Incorporated.

10. Instruction Manual for Surveyor II, Hydrolab Corporation.

11. Instruction Manual for YSI Water Quality Monitoring System for the Model 3530 pH Electrode Assembly.

12. Annual Book of ASTM Standards, Part 31, "Water", Standard D1293-78(B).

13. Methods for Chemical Analysis of Water and Wastes, US-EPA, Method 150.1 (1983).

Turbidity

14. Standard Methods for the Examination of Water and Wastewater, 18th, 19 and 20th Editions, Method 2130 B.

15. Methods for Chemical Analysis of Water and Wastes, US-EPA, Method 180.1 (1983).

16. Operating procedures for the Hach 2100P Turbidimeter.

Dissolved Oxygen

17. Standard Methods for the Examination of Water and Wastewater, 18th, 19 and 20th Editions, Methods 4500-O C and 4500-O G.

18. Annual Book of ASTM Standards; Part 31, "Water," Standard D888-92(A and B).

19. Methods for Chemical Analysis of Water and Wastes, US-EPA, Method 360.1 (1983).

20. Methods for Chemical Analysis of Water and Wastes, US-EPA, Method 360.2 (1983).

21. Instruction Manual YSI Model 57, Dissolved Oxygen Meter, Science Division, Yellow Springs Instrument Company.

Chlorine - (DPD Spectrophotometric/Colorimetric)

22. Annual Book of ASTM Standards, "Water," Standard D 1253-86(92).

23. Methods for Chemical Analysis of Water and Wastes, US-EPA, Method 330.5 (1983).

24. Standard Methods for the Examination of Water and Wastewater, 18th, 19 and 20th Editions, Method 4500-Cl G.

25. Instruction Manual, Pocket Colorimeter™ II - Analysis System, Chlorine,Catalog number 59570-88.

Salinity

26. Standard Methods for the Examination of Water and Wastewater, 18th, 19 and 20th Editions, Method 2520 B.

Flash Point

27. SW-846 Test Methods for Evaluating Solid Waste, Volume One, Section C, Method 1010.

28. Standard Test Methods for Flash Point by Pensky-Marten Closed Tester, ASTM D93-80.

29. Sanyo Gallenkamp Autoflash AF3 User manual, PEJ-254-488E, and Getting Started manual, PEJ-254-487G, Sanyo Gallenkamp PLC, Leicestershire, England.

SECTION 18
AIR MONITORING SAFETY EQUIPMENT

18.1 INTRODUCTION

The Branch uses the following criteria for selection of PPE which are excerpts from 4.3.6 - Site Operations (from this manual). It should be noted: No instrument can give the user all the information that must be considered when using the instruments for the selection of respiratory protection or other PPE.

Upon initial entry at a hazardous waste site, a site survey will be conducted. In a facility that has active working employees, the site survey may be conducted in Level D accompanied by air monitoring. At sites that do not have active working employees, the Project leader must use discretion when choosing the level of protection that will be used while conducting an initial site survey. All initial site surveys should be conducted using appropriate air monitoring instruments that detect explosive vapors (CGI), oxygen content, Carbon Monoxide (CO), Hydrogen Sulfide (H_2S) and organic vapors (TVA-1000). The purpose of an initial site survey is to accomplish one or both of the following objectives:

- Determine the hazards that may exist which could affect site personnel.
- Verify existing information, or obtain new information, about the site.

To accomplish the first objective, an assessment of real or potential dangers from fire, explosion, airborne contaminants, radiation, and oxygen deficient atmospheres must be made. This assessment will be made as follows:

- Combustible Gases - (MSA FiveStar) The atmosphere in any location capable of containing or generating a combustible concentration of gases will be monitored with a combustible gas meter. Response of the meter in excess of 25% of the lower explosive limit (LEL) will cause an immediate evacuation of the site.

- Oxygen Deficiency - (MSA FiveStar) A location capable of containing or generating an oxygen deficiency either by depletion or displacement will be monitored with an oxygen meter. Any reading less than 19.5% oxygen will result in the use of self contained breathing apparatus (SCBA).

- Organic Vapors and Gases - (TVA-1000) The atmosphere will be monitored with a photoionization detector (PID) and/or a flame ionization detector (FID). Any response above background concentrations will cause an upgrade to Level C respiratory protection. Any response above 5 ppm when contaminants are not known, will cause an upgrade to Level B respiratory protection. A response above 200 ppm when contaminants are not known will cause an upgrade to Level A protection. In these situations, it is MAB policy that under personnel will not enter sites when it has been determined that Level A protection is required, under any circumstances.

- Inorganic Vapors and Gases - (TVA-1000) There are only a few direct reading instruments with the capability to detect and quantify non-specific inorganic vapors and gases. PIDs have a very limited capability in this area. If specific inorganics are known or suspected of being present, an attempt should be made to provide appropriate monitoring if possible. In the absence of a monitoring capability always assume a worse case scenario and upgrade the level of protection (see below) to a level that gives respiratory and skin protection that is appropriate to a worse case assumption.

- Radiation - (Ludlum Model 3) A radiation survey will be conducted of the site. The primary survey instrument will be a Geiger counter/detector for gamma radiation. Any response above background will result in evacuation of the area.
- Carbon Monoxide - (MSA FiveStar) Any alarm (35 ppm), the area must be evacuated and vented or level B must be worn.
- Hydrogen Sulfide - (MSA FiveStar) - Any alarm (10 ppm), the area must be evacuated and vented or level B must be worn.

Following the initial survey, monitoring will be repeated when new areas of the site are entered, or when operations likely to cause a release are being conducted.

The relationship between air monitoring results and levels of protection (LOP) is shown in the following table.

Instrument	**Response**	**LOP**
PID/FID	Background	D
PID/FID	Less than 5 ppm above background	C
PID/FID	5 ppm to 200 ppm	B
PID/FID	greater than 200 ppm	A
Oxygen	Less than 19.5 %	B

NOTE: Measurements from direct-reading air monitors are only one consideration for LOP decisions. If contaminants are known, protection can be achieved at a lesser LOP.

18.2 CALIBRATION PROCEDURES

This section gives procedures to be followed when calibrating and using air monitoring instrumentation. Calibrations defined in these procedures will result in instrument response accuracy within the capabilities of the instrument(s) The following practices shall be followed with calibration gases:

- Calibrations should demonstrate proper operation of the monitor and insure that results give an acceptably accurate indication of conditions upon which to base safety decisions and actions.

- Calibration gases shall be certified by their supplier to be of a specified and known concentration.
- Concentrations of calibration gases shall be within a relevant range of response for the intended use, but will not exceed any flammability or toxic exposure limits.

Calibration mixtures and approximate concentrations for specific air monitors that the Branch currently uses:

CALIBRATION		
MONITOR GAS/ SUBSTANCE	MIXTURE	CONCENTRATION
Combustible Gas (MSA FiveStar)	Pentane in nitrogen*	58%
Flame Ionization (TVA 100B)	Methane in air	75 ppm
Photo-Ionization Detector (TVA 1000B)	Isobutylene in air	100 ppm
Carbon Monoxide (MSA FiveStar)	Carbon Monoxide in nitrogen*	300 ppm
Hydrogen Sulfide (MSA FiveStar)	Hydrogen Sulfide in nitrogen*	10 ppm
Oxygen (MSA FiveStar)	Oxygen in nitrogen*	15 %
Strontium 90 (Sr90) (Ludlum Model 3)	Strontium 90 (Sr90)	Depends on source

*- Available from Mine Safety Appliance Company - MSA part # 804770
Calibration Equipment

All calibrations will consist of introducing a gas of known concentration into the monitor at atmospheric pressure. Under no circumstances will it be acceptable to attempt calibration when the monitor is measuring gas concentrations below or above atmospheric pressure.

To insure a stable pressure of the calibration gas, a calibration manifold system will be used. The manifold will consist of a "T" fitting, a Teflon® bag, Teflon® tubing, and fittings.

The calibration gas cylinder will be connected to the "T" fitting with Teflon® tubing, so that the gas will flow directly through the top of the "T" into a Teflon® bag.

The "T" fitting and tubing will be purged with calibration gas prior to connection of the Teflon® bag. The bottom or side port of the "T" will be connected with Teflon® tubing to a stainless steel quick disconnect. Once the Teflon® bag has been filled with gas, the gas flow will be turned off. The monitor's probe will be connected to the manifold via the quick disconnect and allowed to sample the contents of the Teflon® bag.

Calibration Frequency

It is required that the monitors be calibrated for each use. Frequent checking of monitor response or proper setting and operation of alarms is encouraged. Calibrations should be documented in the field logbook. The entry needs to include the following information:

Checklist for Air Monitoring Equipment Calibration

Monitor's Identification Number	
Date of Calibration	
Time of Calibration	
Battery Check Response	
Alarm Response	
Instrument Response	
Calibration Gas Concentration	
Fuel Level (FID)	
Operator's Initials	

18.3 Toxic Vapor Analyzer (TVA 1000B)

Introduction

The Toxic Vapor Analyzer (**TVA 1000B**) is a portable inorganic/organic vapor monitor. This analyzer uses both a flame ionization detector (FID) and a photoionization detector (PID) to sample and measure concentrations of gases. Uses of this instrument include; hazardous waste site investigations, soil/sediment hot spots, drum sampling / evaluations and respiratory protection evaluations.

Hydrogen Tank for the FID

In order to prepare the **TVA 1000B** for use, the hydrogen tank should be full and the battery should be charged. The battery (and spare) should be charged overnight. Ensure that any extra hydrogen tanks taken to the field are also filled. Expected battery run life is approximately 6 hours, but expect less. Battery life is relative to how the instrument is being used, i.e., data logging and using both detectors will reduce battery life, and using the instrument in lower ambient temperature will also reduce battery life. When shipping the FID by air, or carrying the instrument on a passenger aircraft, the hydrogen tanks must be completely empty.

Follow proper procedures when filling the hydrogen cylinder. Under no circumstances should the hydrogen cylinder be pressurized over 2,200 psi. The fill line between the hydrogen source and the hydrogen cylinder **must** be purged with hydrogen to eliminate contamination of the fuel source with compressed air. If the instrument has trouble igniting and or has trouble staying lit, a contaminated fuel source should be suspected.

Note that you must always screw the hydrogen tank into the unit when taking the TVA out of the carrying box. The TVA will not fit back in the box without taking the hydrogen tank out of the unit. Extra hydrogen tanks are available. **All** hydrogen tanks use a **left handed thread**. Expected run time on a full tank is about 4 hours.

Operating Procedures

Refer to the Operating Manual for the Instrument (copy kept in instrument’s case, orginal kept in Reshma Punwasi office) for proper operation and calibration procedures.

The **TVA 1000B** is user friendly/menu driven. Pressing the “EXIT” key will take you to the previous menu. The instrument must be **on and warmed up for approximately 30 minutes** prior to calibration. The pump must be ON, the PID lamp must be ON, and the FID must be ignited throughout the warm-up period.

- Check response of each detector by applying the appropriate calibration gases to the instrument. Methane for the FID and Isobutylene for the PID. Record responses. If the response of the detectors is not acceptable refer to the Instruction Manual for detailed calibration instructions. If the response of the detectors is acceptable then the instrument is ready for use. The detectors operate independently of each other, so if one is not working, the other is not affected.

- To power down the instrument press and hold the OFF key. Also turn the red H_2 supply handle to the OFF position.

Care should be taken when operating the unit around liquids. The pump can aspirate liquids into the instrument. If this happens, the instrument should be shut down immediately. The instrument must be cleaned and re-calibrated before it can be used again.

For more information on multi-point calibration, logging and data transfer, consult the Instruction Manual.

18.4 Ludlum Model 3 Radiation Survey Meter

Introduction

The Ludlum Model 3 is a portable radiation survey meter. The instrument is set for 900 volt Geiger- Mueller Tube (GMT) measurement of beta and gamma radiation. The range of the meter is from 0 to 200 milliroentgen per hour. It is important that the operator realizes that this meter will not respond to most alpha radiation. The instrument utilizes standard disposable “D” size batteries. Expect the battery to last >10hrs, but spare batteries should always be taken.

- THE LACK OF A RESPONSE ON THIS METER DOES NOT GUARANTEE THAT THE ENVIRONMENT IS SAFE.
- THESE MONITORING DEVICES SHOULD BE TAKEN TO ANY SITE THAT HAS THE POTENTIAL TO EXPOSE THE EMPLOYEE TO ANY RADIATION.

Operational Checks

1. Place the multifunction switch in the "BAT" position and note the meter's reading.
2. Place the multifunction switch in the "X0.1" position, the F/S switch in the "S" position, and the "AUDIO" switch in the "ON" position. Note that an audible clicking sound can be heard while the meter is counting. After a few seconds, press the "RES" button and note that the meter returns to zero.

Calibration

1. Read and record the background radiation level before calibration check.
2. Place the GMT probe flat against the casing of a certified Sr90 standard.
3. Adjust the multifunction switch until the meter reading remains on scale.
4. Read and record the meter's response.
5. Set the multifunction switch to "X0.1" before entering the site.

With any response over back ground, the employees should leave the area and call Paul Giardina, Radiation and Indoor Air Branch - 212-637-3779 for additional information / guidance.

18.5 MSA (PASSPORT) FiveStar Portable Alarm

Introduction

The MSA (Passport) FiveStar Alarm is a portable combination gas detection meter, that has the capability to use eleven sensors, with as many as five sensors being used at one time. The Branch has three units available for use. These units have sensors installed in them to monitor for percent oxygen content (O2), hydrogen sulfide (H2S), Lower Explosive Limit (LEL) and Upper Explosive Level (UEL) and carbon monoxide (CO). The FiveStar Alarm automatically compensates for atmospheric pressure.

The unit has a gauge which indicates how much longer the instrument can run on the remaining battery charge. When fully charged, it will run for approximately 16 hours. Without a pump module attached, it will run approximately 20 hours. It will require roughly 4 hours to fully charge the NiMH battery. Cold operating temperatures will reduce the instruments run time.

> **THESE MONITORING DEVICES SHOULD BE TAKEN WITH THE INVESTIGATOR ON EVERY SURVEY THAT HAS THE POTENTIAL TO EXPOSE THE EMPLOYEE TO LOW OR HIGH OXYGEN CONCENTRATIONS, OR OTHER TOXIC OR HAZARDOUS GASES.**

Calibration / Quick - Checks

MSA recommends that a calibration quick - check (“Bump Test”) be performed on the unit before each day’s use. A re-calibration of the unit would be necessary only when the instrument check is not functioning or responding correctly.

Performing a “BUMP Test”

A bump test is performed by placing the instrument in its standard operating mode and exposing the instrument to a known concentration of gas using the MSA Squirt Gas Bump Tester. The reading on the instrument is then compared with the allowable ranges established on the label of the cylinder. This process would be considered a calibration check. If the instrument fails any of its checks, a calibration of the instrument must then be performed. Calibration involves running the instrument against a known concentration of gas and making adjustments to the instrument as necessary to reach the ideal levels. Refer to the MSA Instruction Manual kept with each instrument for detailed calibration procedures.

Operating the FiveStar Alarm

Push the “On/Off” button to start up the FiveStar. Once the instrument turns on it will ask if you want to run a FRESH AIR SETUP”. Select YES. The sensor results for combustible gas will appear in the upper left corner of the display, percent oxygen will show in the upper right corner, carbon monoxide will be in the lower left corner, and hydrogen sulfide will be in the lower right corner.

0.00 COMB	O2 **20.8**
0 CO	**0** H2S

Hitting the “On/Off key once will change the display, so that the percent LEL will be in the upper left corner, percent oxygen will still show in the upper right corner, parts per million (PPM) of carbon monoxide will be in the lower left corner, and PPM of hydrogen sulfide will be in the lower right corner.

Pressing the “Page” key once will change the display to show the operating time left on the battery. Hitting the “Page” key again will display the date and time. Hitting the “Page” key again will enter the first screen. The instrument is now ready to use. To turn the FiveStar off hold the “On/Off’ button in for three seconds.

Always consult the MSA Instruction Manual kept with the instrument for detailed instructions for calibration, maintenance and various other settings not covered in this SOP.

Factory Set Alarms

The alarms are set at the factory to go off at the levels shown in the table below:

Default Factory Set Alarm Set points for the FiveStar				
Sensor type	**Exposure warn**	**Low Alarm**	**High Alarm**	
Combustion	LEL - N/A 0.5% CH_4	10% LEL or 1.0% CH_4	60% LEL or 3.0% CH_4	
	Deficiency	**Enrichment**		
Oxygen	19.5	22.0		
	Low Alarm	**High Alarm**	**STEL**	**TWA**
Carbon Monoxide (PPM)	35	1200	400	35
Hydrogen Sulfide (PPM)	10	100	15	10

If any of the alarm(s) are triggered, all personnel are required to exit the area of concern to ascertain why the alarm(s) was activated. Ventilation and or upgrade of PPE maybe required. Further calibration checks maybe required to check the sensors capabilities since contamination may have occurred.

For minimum safety requirements the branch uses for the site entry procedures listed in Section 4.3.6 - Site Operations.

Care should be taken when using the instrument around liquids or when lowering units into manholes/confined spaces since the attached pump module can aspirate liquids into the instrument. If this should happen shut down the instrument immediately. The instrument will need to be cleaned and re-calibrated before use.

When operating any of the instruments in the field, common sense should prevail. Air monitoring should be continued to reflect the actual exposure the user may encounter. Many sampling areas and egress point’s conditions may change quickly, i.e., sewers/manholes, pump stations , drum handling/sampling, excavations etc. Appropriate amount and placement of the instruments is very important. The three instruments discussed in this chapter all have audible alarms that may not be heard in high noise areas such as pump stations, some production areas and with high truck / excavator traffic. The MSA FiveStar also incorporates a red, flashing alarm. When using the MSA FiveStar, have the instrument positioned so this feature can be utilized.

18.6 Location of Instruments:

The amount and location of the listed air monitoring safety equipment.

TVA-1000B - (1) - Located in Reshma Punwasie’s office. Please discuss scheduling of the instrument with either Reshma Punwasie or Marcus Kantz before use.

MSA FiveStar - (4) - Located in MOS/MAB locked equipment room in Bay “C”, building 209.

Ludlum Model 3 - (2) - Located in MOS/MAB locked equipment room in Bay “C”, building 209.

SECTION 19
SLUDGE/BIOSOLIDS SAMPLING

PERFORMANCE OBJECTIVES:

- To collect a sample representative of sludge/biosolids residing in the material of interest.
- To reduce the potential bias caused by the sampling equipment used to obtain the sample.

19.1 Introduction

Sludge, or biosolids, sampling may be required for a variety of reasons. Typically, samples of sludge are collected during a National Pollution Discharge Elimination System (NPDES) Compliance Sampling Inspection. The request(s) for this sampling is normally from the Biosolids Coordinator (Alia Roufael), through the Water Compliance Branch.

19.2 Definitions

- Sludge - Solid material in wastewater that settles, floats or is suspended in the water column. For most situations, the solid material that is sampled for compliance with the 40 CFR Part 503 regulations is the solid material referred to as biosolids, from wastewater treatment plant digesters that is destined to be land applied.
- Biosolids - The soil like residue of materials removed from sewage during the treatment process. During treatment, bacteria and other organisms break sewage down into relatively harmless organic matter.

19.2.1 Health and Safety

Sludge may contain chemical or biological agents which may cause illness. The samplers should wear protective gloves and the sample containers should be handled with appropriate care. The sampler should consider wearing safety items such as, steel toed boots, safety glasses and a hard hat. A respirator may be necessary to sample sludges that are easily airborne. In some cases, sampling sludge may involve an element of hazards from things such as: slips, trips and falls, moving equipment, or leaning over tank walls to dip a bucket. The sampler/inspector must make safety the highest priority, and not take unnecessary risks.

19.3 Sampling of Sludge/Biosolids

Samples should be taken in order to meet the needs of the request made by the Biosolids Coordinator, and to determine compliance with the 40 CFR Part 503 regulations. The specific sampling location(s) are dependent on meeting the objectives of the study. Normally, samples should be taken at the end of the treatment process, and immediately preceeding biosolids disposal or use, if possible. The samples should be taken to determine if the biosolids that are going to be land applied meet the limitations specified in the regulations. Proper sampling practices are found in the US EPA document entitled POTW Sludge Sampling and Analysis

Guidance Document (August 1989). Table 4-1, from EPA's 1989 Sampling and Analysis Guidance Manual, suggests appropriate sampling points for a variety of unit processes.

Typical sampling locations may include sludge from:

- Clarifiers
- Sludge holding tanks
- Tank trucks
- Return activated sludge flows
- Thickeners
- Digester tanks
- Drying beds
- Windrows
- Vacuum, belt filter, or plate and frame presses
- Centrifuge dewatering equipment
- Lagoons and pits

Each sampling location will require sampling techniques that would produce samples that are representative of the entire batch of material that will be land applied on a given day. The samples should be taken to represent the entire flow past the sample point throughout the sampling period. In Region 2, at least seven samples should be taken at each sampling location. Seven samples are taken in order to provide a representative number of samples, and to support a compliance finding with respect to 40 CFR Part 503.32 (Pathogens), section (b)(ii)(2) - Alternative 1, which states,

> **(i) Seven samples of the sewage sludge shall be collected at the time the sewage sludge is used or disposed.**
>
> **(ii) The geometric mean of the density of fecal coliform in the samples collected in paragraph (b)(2)(i) of this section shall be less than either 2,000,000 Most Probable Number per gram of total solids (dry weight basis), or 2,000,000 Colony Forming Units per gram of total solids (dry weight basis).**

This number of samples should provide a sufficient number of samples to determine if the samples are representative of the batch, and to determine compliance with the requirements for Class B, as well as, Class A biosolids.

The taking of samples should be divided (either using time, or volume of material being removed) so that the samples taken are approximately evenly distributed. For example, if 14 trucks of sludge are being remove from a facility for land application, one sample from every other truck should be taken. Or. if only one truck of sludge was being removed from a facility on a given day, then the seven samples would all be taken from the truck, with the samples being taken equally distanced apart. In the case of liquid sludge land application process, if the sludge was going to be pumped over a three hour period, the sampling would not begin until about 15 to 20 minutes after pumping begins (in order to clear out the lines of old material), and would end about 15 to 20 minutes prior to the end of pumping. The seven samples would be taken equally spaced in time over the remaining period of time (or about 2 hours and 20 minutes).

19.3 Sample Containers and Holding Times

- The seven samples for fecal coliform and salmonella should be taken in a clean and sterilized container with a capacity to hold at least 250 milliliters of liquid, or 250 grams of solid material. Samples should be cooled by placing them on ice immediately after taking them. The maximum holding time for bacterial sludge samples is 24-hours, before the analysis is begun.

- The seven samples for percent solids should be taken in a clean container with a capacity to hold at least 250 milliliters of liquid, or 250 grams of solid material. Samples should be cooled by placing them on ice. The maximum holding time for percent solids sludge samples is 7-days, before the analysis is begun.

- For metals samples, a composite sample should be comprised of the seven samples taken. A separate clean container should be taken (one from each of the seven individual grab samples taken). After the last sample is collected, the seven grab samples for the analysis of metals should be combined in a clean container, and manually homogenized. The composite sample is then transferred into a 500 milliliter, or 500 gram, clean container. The sample should be analyzed for arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), molybenum (Mo), nickel (Ni), selenium (Se) and zinc (Zn). The holding time for the analysis of metals is 6 months, except for mercury, which is 28 days.

19.4 References

- NPDES Compliance Inspection Manual, United States Environmental Protection Agency, July 2004. Available as a PDF file at: http://www.epa.gov/compliance/resources/publications/monitoring/cwa/inspections/npdesinspect/npdesmanual.html

- US EPA, POTW Sludge Sampling and Analysis Guidance Document, August 1989.

- US EPA, Guidance For NPDES Inspectors - Evaluating Sludge Treatment Processes, November 1991. Office of Wastewater Enforcement and Compliance.

- US EPA, Guidance For NPDES Inspectors - Verifying Compliance With Sludge Requirements, November 1991. Office of Wastewater Enforcement and Compliance.

- US EPA, Preparing Sewage Sludge for Land Application or Surface Disposal - A Guide for Preparers of Sewage Sludge, Record Keeping, and Reporting Requirements of the Federal Standards for the Use or Disposal of Sewage Sludge, 40 CFR Part 503. EPA 831b-93-002a, July 1993.

- EPA Regulations found at 40 CFR Part 503.

- EPA Regulations and Technology Publication - Control of Pathogens and Vector Attraction in Sewage Sludge (including Domestic Septage) Under 40 CFR Part 503. EPA/625/R-92/013, July 2003.

APPENDIX A
EPA REGION 2 - RECOMMENDED SAMPLE VOLUMES, CONTAINERS, PRESERVATIVE(S) AND HOLDING TIMES

This Appendix consist of two tables, which reflect the Region 2 recommended sample volumes, containers, preservatives and holding times. Table 1 shows Region 2's Laboratory requirements for sample volumes and acceptable containers. The sample volumes specified are needed in order to allow the Laboratory to perform a complete evaluation of the sample(s), and includes all quality control samples. “QA volumes” are required for the first sample (for each parameter) at a site, while the “additional sample volumes” are for additional samples for the same parameter at the same site. Normally, the “QA volumes” sample is the sample of greatest concern or importance, for example, if the inspector is taking an influent and an effluent sample at a wastewater treatment plant, the effluent sample would be the “QA volume” sample because the results would be related to most of the effluent permit limits. If more than 20 samples are submitted for a given site, then another set of samples that contains the QA volumes would be required.

It should be noted that the amounts listed must be considered approximate requirements that are appropriate for most media. If a particular media to be sampled is very light (e.g., low concentration), more sample may be required to obtain the necessary mass for the analysis.

Also, if the samples are shipped to the laboratory, sufficient ice must be placed in the shipping container to ensure that ice is still present when the samples are received at the laboratory.

Table 2 of this Appendix shows the required containers, preservative(s) and holding times that are taken from the Clean Water Act, specifically 40 CFR Part 136, Table II. It must be noted that holding times will vary based upon the regulations that pertain to the relevant Program that the samples are collected under. For example, under the Clean Water Act, the holding time for coliform bacteria in wastewater is six (6) hours, but under the biosolids program the holding time is 24 hours, and under the safe drinking water act the holding time is 30 hours.

Appendix A - Table 1

EPA Region 2 Laboratory Standard Volume Requirements

(As of April 2005)

AQUEOUS SAMPLES:

Parameter	QA Volume	Additional Samples	Container
Acidity	250 ml	100 ml	plastic
Alkalinity	250 ml	100 ml	plastic
Ammonia	250 ml	100 ml	plastic
Asbestos (not done in Lab)	2 x 1 Liter	1 Liter	plastic
BOD	2 Liters (2-1 Liter)	1 Liter	plastic
COD	100 ml	50 ml	plastic
Chloride	100 ml	50 ml	plastic
Color	100 ml	50 ml	plastic
Cyanide	200 ml	50 ml	plastic
Dissolved Oxygen	3 x 300 ml	1 x 100 ml	BOD bottle
Dioxins/Furans	3 x 1 Liter	1 Liter	glass
Fluoride	200 ml	100 ml	plastic
Hardness	250 ml	250 ml	plastic
Herbicides	2 x 1 Liter	1 Liter	glass
Hexavalent Chromium	500 ml	250 ml	plastic
Ignitability	250 ml	250 ml	glass
MBAS (surfactants)	250 ml	250 ml	plastic
Metals	500 ml	250 ml	plastic
Metals (low level)	125 ml	125 ml	teflon
Metals TCLP	1 Liter	1 Liter	plastic
Nitrate	100 ml	50 ml	plastic
Nitrate + Nitrite	100 ml	50 ml	plastic
Nitrite	100 ml	50 ml	plastic
NVOA	2 x 1 Liter	1 Liter	Amber glass
NVOA TCLP	2 x 1 Liter	1 Liter	Amber glass
Oil & Grease (HEM) & TPH	3 x 1 Liter	1 Liter	glass
Orthophosphate	100 ml	50 ml	plastic
PCBs	2 x 1 Liter	1 Liter	Amber glass
PCBs (low level)	4 x 1 Liter	2 L	Amber glass
Pesticides	2 x 1 Liter	1 Liter	Amber glass
Pesticides TCLP	2 x 1 Liter	1 Liter	Amber glass
Phenolics	250 ml	250 ml	Amber glass
Phosphorus	100 ml	50 ml	plastic
Specific Conductance	250 ml	100 ml	plastic
Sulfate	100 ml	50 ml	plastic
Sulfide	250 ml	100 ml	plastic
TKN	100 ml	50 ml	plastic
Total Organic Carbon	100 ml	50 ml	plastic
Total Dissolved Solids	500 ml	250 ml	plastic
Total Suspended Solids	500 ml	250 ml	plastic
Total Volatile Solids	500 ml	250 ml	plastic
Turbidity	250 ml	100 ml	plastic
VOA	6 x 40 ml	3 x 40 ml	glass vials
VOA TCLP	6 x 40 ml + 2 x 1 Liter	3 x 40 ml + 500 ml	glass

Appendix A - Table 1

EPA Region 2 Laboratory Standard Volume Requirements (Continued)
(As of April 2005)

AQUEOUS SAMPLES - MICROBIOLOGY:

Parameter	QA Volume	Additional Samples	Container
Enterococci	150 ml	150 ml	plastic
Fecal coliform	150 ml	150 ml	plastic
Fecal coliform + Enterococci	300 ml	300 ml	plastic
Fecal coliform + Total coliform	300 ml	300 ml	plastic
Giardia + Cryptosporidium	3 x 10 Liter	10 Liter	cubitainer
Total coliform	150 ml	150 ml	plastic

SLUDGE SAMPLES:

Parameter	QA Volume	Additional Samples	Container
Herbicides	100 grams	100 ml	glass
Metals	250 grams	250 grams	plastic (wm)
Metals TCLP	1 kilogram	1 kilogram	plastic/glass
NVOA	100 grams	100 grams	glass wm
NVOA TCLP	250 grams	250 grams	Amber glass
Pesticides/PCBs	100 grams	100 grams	glass wm
Pesticides TCLP	1 Liter	1 Liter	Amber glass
Total Organic Carbon	50 grams	50 grams	glass
Petroleum Hydrocarbons	250 grams	250 grams	glass
VOA	100 grams	100 grams	glass
VOA TCLP	2 x 100 grams	2 x 100 grams	glass
Clostridium perfringens	250 grams	250 grams	plastic/glass
Fecal coliform + Total coliform	250 grams	250 grams	plastic/glass
Salmonella	250 grams	250 grams	plastic/glass

SOIL / SEDIMENT / SOLID SAMPLES:

Parameter	QA Volume	Additional Samples	Container
Asbestos	1 gram	1 gram	plastic
Cyanide	50 grams	20 grams	plastic
Grain size	500 grams	100 grams	plastic
Herbicides	250 grams	250 grams	plastic
Metals	250 grams	250 grams	plastic/glass
Metals TCLP	200 grams	200 grams	plastic/glass
NVOA	100 grams	100 grams	glass wm
NVOA TCLP	250 grams	250 grams	glass wm

Appendix A - Table 1
EPA Region 2 Laboratory Standard Volume Requirements (Continued)
(As of April 2005)

SOIL / SEDIMENT / SOLID SAMPLES:

Parameter	QA Volume	Additional Samples	Container
Petroleum hydrocarbons	250 grams	250 grams	glass
Pesticides / PCBs	100 grams	100 grams	glass
Pesticides TCLP	250 grams	250 grams	glass
Total Organic Carbon	50 grams	50 grams	plastic
VOA	100 grams or 4 encore	100 grams or 4 encore	glass or encore
VOA TCLP	2 x 100 grams or 100 grams + 2 encore	2 x100 grams or 100 grams + 2 encore	glass glass / encore
Clostridium perfringens	250 grams	250 grams	glass
Fecal coliforms + total coliforms	250 grams	250 grams	Sterile plastic
Salmonella	250 grams	250 grams	Sterile plastic

Notes:
wm = wide mouthed

Volumes given in milliliters, which are approximately equivalent to the following:

1 00 ml = 4 oz. = 100 grams
250 ml = 8 oz. = 250 grams
500 ml = 16 oz. = 500 grams
1000 ml = 32 oz. = 1000 grams

Appendix A - Table 2
Wastewater Required Containers, Preservation Techniques, and Holding Times
(Excerpt from 40 CFR Part 136, Table II)

Parameter	Container[1]	Preservative[2,3]	Maximum Holding Time[4]
BACTERIAL TESTS			
Coliform, fecal and total	P, G	Cool, 4 °C 0.008% $Na_2S_20_3$[5]	6 hours
Fecal Streptococci	P, G	Cool, 4 °C 0.008% $Na_2S_20_3$[5]	6 hours
INORGANIC TESTS			
Acidity	P, G	Cool, 4 °C	14 days
Alkalinity	P, G	Cool, 4 °C	14 days
Ammonia	P, G	Cool, 4 °C H_2SO_4 to pH ≤ 2	28 days
Biochemical oxygen demand	P, G	Cool, 4 °C	48 hours
Biochemical oxygen demand, carbonaceous	P, G	Cool, 4 °C	48 hours
Bromide	P, G	None required	28 days
Chemical oxygen demand	P, G	Cool, 4 °C H_2SO_4 to pH ≤ 2	28 days
Chloride	P, G	None required	28 days
Chlorine, total residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4 °C	48 hours
Cyanide, total and amenable to chlorination	P, G	Cool, 4 °C NaOH to pH ≥ 12 0.6 g ascorbic acid	14 days[6]
Fluoride	P	None required	28 days
Hardness	P, G	HNO_3 to pH ≤ 2, H_2SO_4 to pH ≤ 2	6 months
Hydrogen ion (pH)	P, G	None required	Analyze immediately
Kjeldahl and organic nitrogen	P, G	Cool, 4 °C H_2SO_4 to pH ≤ 2	28 days
METALS[7]			
Chromium VI	P, G	Cool, 4 °C	24 hours
Mercury	P, G	HNO_3 to pH ≤ 2,	28 days
Metals except above	P, G	HNO_3 to pH ≤ 2,	6 months

Appendix A - Table 2
Required Containers, Preservation Techniques, and Holding Times
(Excerpt from 40 CFR Part 136, Table II) (Continued)

Parameter	Container[1]	Preservative[2,3]	Maximum Holding Time[4]
INORGANIC TESTS CONTINUED			
Nitrate	P, G	Cool, 4 °C	48 hours
Nitrate + Nitrite	P, G	Cool, 4 °C H_2SO_4 to pH ≤ 2	28 days
Nitrite	P, G	Cool, 4 °C	48 hours
Oil and grease	G	Cool, 4 °C HCl orH_2SO_4 to pH ≤ 2	28 days
Organic carbon	P, G	Cool, 4 °C HCl orH_2SO_4 to pH ≤ 2	28 days
Orthophosphate phosphorus	P, G	Filter immediately Cool, 4 °C	48 hours
Dissolved oxygen			
Probe	Glass bottle & top	None required	Analyze immediately
Winkler	Glass bottle & top	Fix on-site and store in the dark	8 hours
Phenols	G	Cool, 4 °C H_2SO_4 to pH ≤ 2	28 days
Phosphorus (elemental)	G	Cool, 4 °C	48 hours
Phosphorus (total)	P, G	Cool, 4 °C H_2SO_4 to pH ≤ 2	28 days
Residue, total	P, G	Cool, 4 °C	7 days
Residue, filterable	P, G	Cool, 4 °C	7 days
Residue, non-filterable (TSS)	P, G	Cool, 4 °C	7 days
Residue, settleable	P, G	Cool, 4 °C	48 hours
Residue, volatile	P, G	Cool, 4 °C	7 days
Silica	P	Cool, 4 °C	28 days
Specific conductance	P, G	Cool, 4 °C	28 days

Appendix A - Table 2
Required Containers, Preservation Techniques, and Holding Times
(Excerpt from 40 CFR Part 136, Table II) (Continued)

Parameter	Container[1]	Preservative[2,3]	Maximum Holding Time[4]
INORGANIC TESTS CONTINUED			
Sulfate	P, G	Cool, 4 °C	28 days
Sulfide	P, G	Cool, 4 °C, Add zinc acetate, plus Sodium hydroxide to pH $\geq$ 9,	7 days
Sulfite	P, G	None required	Analyze immediately
Surfactants (MBAS)	P, G	Cool, 4 °C	48 hours
Temperature	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4 °C	48 hours
ORGANIC TESTS[8]			
Purgeable halocarbons	G teflon lined septum	Cool, 4 °C 0.008% $Na_2S_20_3$[5]	14 days
Purgeable aromatic halocarbons	G teflon lined septum	Cool, 4 °C 0.008% $Na_2S_20_3$[5], HCl to pH$\leq$ 2	14 days **7 days (if no pH adjustment)**
Acrolein and acrylonitrile	G teflon lined septum	Cool, 4 °C 0.008% $Na_2S_20_3$[5], Adjust pH to 4 - 5	14 days
Phenols[11]	G teflon lined cap	Cool, 4 °C 0.008% $Na_2S_20_3$[5],	7 days until extraction, 40 days after extraction
Benzidenes[11]	G teflon lined cap	Cool, 4 °C 0.008% $Na_2S_20_3$[5],	7 days until extraction[13]
Phthalate esters[11]	G teflon lined cap	Cool, 4 °C	7 days until extraction, 40 days after extraction
Nitrosamines[11,14]	G teflon lined cap	Cool, 4 °C 0.008% $Na_2S_20_3$[5], Store in the dark	7 days until extraction, 40 days after extraction
Polychlorinated biphenols (PCB's)	G teflon lined cap	Cool, 4 °C	7 days until extraction, 40 days after extraction

Appendix A - Table 2
Required Containers, Preservation Techniques, and Holding Times
(Excerpt from 40 CFR Part 136, Table II) (Continued)

Parameter	**Container**[1]	**Preservative**[2,3]	**Maximum Holding Time**[4]
ORGANIC TESTS[8] (Continued)			
Nitroaromatics and isophorone	G teflon lined cap	Cool, 4 °C 0.008% $Na_2S_20_3$[5] Store in the dark	7 days until extraction, 40 days after extraction
Polynuclear aromatic hydrocarbons	G teflon lined cap	Cool, 4 °C 0.008% $Na_2S_20_3$[5]	7 days until extraction, 40 days after extraction
Haloethers[11]	G teflon lined cap	Cool, 4 °C 0.008% $Na_2S_20_3$[5]	7 days until extraction, 40 days after extraction
Chlorinated hydrocarbons[11]	G teflon lined cap	Cool, 4 °C	7 days until extraction, 40 days after extraction
2,3,7,8-tetrachlorodibenzo-p-dioxin[11] (TCDD)	G teflon lined cap	Cool, 4 °C 0.008% $Na_2S_20_3$[5]	7 days until extraction, 40 days after extraction
PESTICIDE TEST			
Organochlorine pesticides[11]	G teflon lined cap	Cool, 4 °C pH 5-9[15]	7 days until extraction, 40 days after extraction
RADIOLOGICAL TEST			
Alpha, beta and radium	P, G	HNO_3 to pH $\leq$ 2	6 months
WHOLE EFFLUENT TOXICITY TESTS			
Acute and Chronic for NPDES Compliance	P, G	Cool, 0 - 6 °C	36 hours to test initiation

Footnotes for 40 CFR Part 136, Table II

[1] Polyethylene (P) or glass (G).

[2] Perform sample preservation steps immediately upon sample collection. For composite chemical samples, preserve each aliquot at the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, then preserve chemical samples by maintaining at 4˚C until compositing and sample splitting are completed.

[3] When shipping any sample by common carrier or sent through the United States mail, comply with the Department of Transportation Hazardous materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of this Table, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined the the Hazardous Materials Regulations do not apply to the following materials: hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater): sulfuric acid (H_2SO_4)water solutions at concentrations of 0.35% by weight or less (pH 1.15 or greater); and sodium hydroxide (NaOH) in water solutions at concentrations of 0.08% by weight or less (pH about 12.3 or less).

[4] Analyze samples as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability.

[5] Used only in the presence of residual chlorine.

[6] Maximum holding time is 24 hours when sulfide is present. Optionally, test all samples with lead acetate paper before pH adjustments to determine whether sulfide is present. If sulfide is present, remove by the addition of cadmium nitrate powder until a negative spot test is obtained. Filter the sample then NaOH is added to pH 12.

[7] Filter samples should be filtered immediately onsite before adding preservative for dissolved metals.

[8] Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific organic compounds.

[9] Analyze samples receiving no pH adjustment within 7 days of sampling.

[10] pH adjustment is if not needed if not measuring acrolein. Analyze samples for acrolein receiving no pH adjustment within 3 days of sampling.

[11] When the extractable analytes of concern fall within a single chemical category, observe the specified preservation and maximum holding times for optimum safeguarding of sample integrity. When the analytes of concern fall within two or more chemical categories, preserve the sample by cooling to 4˚C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to between 6 and 9; hold samples preserved in this manner for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12 and 13 (re: the analysis of benzidine).

[12] If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

[13] Store extracts up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

[14] For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to between 7 and 10 with NaOH within 24 hours of sampling.

[15] Peform the pH adjustment upon receipt at the laboratory and omit samples if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

Additional Preservative Related Notes:

HCl: HCl (Hydrochloric Acid) used as a preservative must be present at concentrations of 0.04% or less by weight (pH about 1.96 or greater), as specified in 40 CFR 136.3, Table II, footnote 3. The proper amount of HCl is added to the sample container at the laboratory prior to sampling.

H_2SO4: H_2SO4 (Sulfuric Acid) used as a preservative must be present at concentrations of 0.35% or less by weight (pH about 1.15 or greater), as specified in 40 CFR 136.3, Table II, footnote 3. Approximately 5 ml. of the laboratory prepared preservative is added to the sample.

NaOH: NaOH (Sodium Hydroxide) used as a preservative must be present at concentrations of 0.080% or less by weight (pH about 12.30 or less), as specified in 40 CFR 136.3, Table II, footnote 3.

HNO_3: HNO_3 (Nitric Acid) used as a preservative must be present at concentrations of 0.15% or less by weight (pH about 1.62 or greater), as specified in 40 CFR 136.3, Table II, footnote 3. Approximately 5 ml. of the laboratory prepared preservative is added to the sample.

NA: Not Applicable. No sample preservation is required.

For footnote 4. Holding Time - Holding time is stated in days unless marked otherwise. A holding time of ASAP indicates the sample is to be analyzed within 15 minutes. A holding time of NS indicates that no holding time is specified in the analytical method.

For footnote 5. Use ascorbic acid only if the sample contains residual chlorine. To test for residual chlorine, place a drop of sample on potassium iodide-starch test paper. If the test paper turns blue, residual chlorine is present. Add a few crystals of ascorbic acid and re-test until the test paper no longer turns blue. Add an additional 0.6 gram of ascorbic acid for each liter of sample.

Residual chlorine may also be checked using the HACH colorimeter and pouring off a portion of preserved sample.

APPENDIX B
STANDARD CLEANING PROCEDURES IN THE FIELD

PERFORMANCE OBJECTIVE:

- To remove contaminants of concern from sampling and other field equipment to concentrations that do not impact study objectives using a standard cleaning procedure.

B.1 Introduction

Cleaning procedures in this appendix are intended for use by field personnel for cleaning sampling and other equipment in the field.

Sampling and field equipment cleaned in accordance with these procedures must meet the minimum requirements for Data Quality Objectives (DQO) definitive data collection. Deviations from these procedures should be documented in the approved study plan, field records, and investigative reports.

These are the materials, methods, and procedures to be used when cleaning sampling and other equipment in the field.

B.1.1 Specifications for Cleaning Materials

Specifications for standard cleaning materials referred to in this appendix are as follows:

- Soap shall be a standard brand of laboratory detergent such as Alconox®. NOTE: Alconox contains phosphates. If phosphorus is an analyte of concern, substitute a nonphosphate detergent, such as Liqui-Nox. Use of other detergent must be justified and documented in the field logbooks and inspection or investigative reports.

- Solvent shall be pesticide-grade methanol. If methanol is not available, acetone, followed by hexane, may be substituted. Use of any other solvents for equipment cleaning purposes must be justified in the study plan. Otherwise its use must be documented in field logbooks and inspection or investigation reports.

- Nitric acid (5%) shall be used to rinse sampling equipment to be used for the collection of samples for the analysis of metals.

- Tap water may be used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

- Analyte free water (deionized water) is tap water that has been treated by passing through a standard deionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard inductively coupled (ICP) Argon Plasma Spectrophotometer (or equivalent) scan. Analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

- Organic/analyte free water is defined as tap water that has been treated with activated carbon and deionizing units. At a minimum, the finished water must meet the analytical criteria of analyte free water and should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the Region 2 laboratory for a given set of analyses. Organic/analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

Other solvents may be substituted for a particular purpose if required. For example, removal of concentrated waste materials may require the use of either pesticide-grade hexane or petroleum ether. After the waste material is removed, the equipment must be subjected to the standard cleaning procedure. Because these solvents are not miscible with water, the equipment must be completely dry prior to use.

Solvents, laboratory detergent, and rinse waters used to clean equipment shall not be reused during field decontamination. Spent solvents must be collected and returned to the laboratory for disposal.

B.1.2 Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. Following are acceptable materials used for containing the specified cleaning solutions:

- Soap must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.

- Solvent must be stored in the original containers until used. They may be applied using Teflon® squeeze bottles.

- Tap water may be kept in clean tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.

- Analyte free water must be stored in clean glass, stainless steel, or plastic containers that can be closed prior to use. It can be applied from plastic squeeze bottles.

- Organic/analyte free water must be stored in clean glass, Teflon®, or stainless steel containers prior to use. It may be applied using Teflon® squeeze bottles, or directly from the generating system discharge port.

Note: Hand pump sprayers generally are not acceptable storage, or application containers, for the above materials (with the exception of tap water). Hand sprayers may have internal oil coated gaskets and black rubber seals that may contaminate the solutions.

B.1.3 Disposal of Solvent Cleaning Solutions

Procedures for the safe handling and disposition of investigation derived waste (IDW), including used wash water, rinse water, and spent solvents are in Section 6.2.5.

B.1.4 Equipment Contaminated with Concentrated Wastes

Equipment used to collect samples of hazardous materials, or toxic wastes, or materials from hazardous waste sites, RCRA facilities, or in-process waste streams, should be field cleaned before returning from the study. At a minimum, this should consist of washing with soap and rinsing with tap water. More stringent procedures may be required at the discretion of the field investigators. The investigator should make an effort to return the wastes associated with the cleaning of this field equipment back to the site for treatment or reprocessing.

B.1.5 Safety Procedures for Field Cleaning Operations

Some of the materials used to implement the cleaning procedures outlined in this appendix can be harmful if used improperly. Caution should be exercised by all field investigators and all applicable safety procedures should be followed. At a minimum, the following precautions should be taken in the field during these cleaning operations:

- Safety glasses with splash shields or goggles, and latex gloves will be worn during all cleaning operations.
- Solvent rinsing operations will be conducted in the open (never in a closed area).
- No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted during cleaning operations.

B.1.6 Handling of Cleaned Equipment

After field cleaning, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the cleaning area to prevent decontamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting, or wrapped in aluminum foil, to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

B.2 Field Equipment Cleaning Procedures

Sufficient clean equipment should be transported to the field so that an entire study can be conducted without the need for field cleaning. However, this is not possible for some specialized items such as portable power augers (Little Beaver®), soil coring equipment, and other pieces of field equipment. In addition, particularly during large scale studies, it is not practical, or possible, to transport all of the pre-cleaned field equipment required into the field. In these instances, sufficient pre-cleaned equipment should be transported to the field to perform at least one days work. The following procedures are to be utilized when equipment must be cleaned in the field.

B.2.1 "Classic Parameter" Sampling Equipment

"Classic Parameters" are analyses such as oxygen demand, nutrients, certain inorganics, sulfide, flow measurements, and multi probe parameters (pH, dissolved oxygen, temperature, and conductivity). For routine operations involving classic parameter analyses, water quality sampling equipment such as Kemmerers, Van Dorn bottles, buckets, weighted bottle samplers, dredges, etc., may be cleaned with the sample to be taken, or analyte-free water, between sampling locations. A hose (if available) or brush may be used to remove deposits of material or sediment, if necessary. If analyte-free water is unavailable the samplers should be flushed at the next sampling location with the substance (water) to be sampled, before the sample is collected.

Multi parameter probes and flow measuring equipment such as staff gages, velocity meters, and other stream gaging equipment may be cleaned with tap water between measuring locations, if necessary.

The previously described procedures are not to be used for cleaning field equipment for the collection of samples undergoing trace organic or inorganic constituent analyses.

B.2.2 Sampling Equipment used for the Collection of Trace Organic and Inorganic Compounds

The following procedures are to be used for all sampling equipment used to collect routine samples undergoing trace organic or inorganic constituent analyses:

1 Clean with tap water and soap using a brush if necessary to remove particulate matter and surface films. Equipment may be steam cleaned (soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.

2 Rinse thoroughly with tap water.

3 Rinse thoroughly with analyte free water.

4 Rinse thoroughly with solvent. Do not use solvent to rinse PVC or plastic items.

5 Allow to air dry.

6 Remove the equipment from the decontamination area and cover with plastic. Equipment stored overnight should be wrapped in aluminum foil and covered with clean, unused plastic.

B.2.3 Well Measuring Tapes

1. Wash with soap and tap water.
2. Rinse with tap water.
3. Rinse with analyte free water.

B.2.4 Automatic Sampler Tubing

The Silastic® and Tygon® and/or teflon tubing previously used in the automatic samplers should be changed, and replaced with new tubing for each new sampling location.

B.2.5 Standard Cleaning Material Specifications

Specifications for standard cleaning materials referred to in this appendix are as follows:

Soap shall be a standard brand of laboratory detergent such as Alconox®, or phosphate free Liqui-Nox. Use of another detergent must be justified and documented in the field logbooks and inspection or investigative reports.

Solvent shall be pesticide-grade methanol. If methanol is not available, acetone, followed by hexane, may be substituted. Use of any other solvents for equipment cleaning purposes must be justified in the study plan. Otherwise its use must be documented in field logbooks and inspection or investigation reports.

Nitric acid (5%) shall be used to rinse sampling equipment that will be used to collect samples for the analysis of metals.

Tap water may be used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Analyte free water (deionized water) is tap water that has been treated by passing through a standard deionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard inductively coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. Analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

Organic/analyte free water is defined as tap water that has been treated with activated carbon and deionizing units. At a minimum, the finished water must meet the analytical criteria of analyze free water and should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the Region 2 laboratory for a given set of analyses. Organic/analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

Other solvents may be substituted for a particular purpose if required. For example, removal of concentrated waste materials may require the use of either pesticide-grade hexane or petroleum ether. After the waste material is removed, the equipment must be subjected to the standard cleaning procedure. Because these solvents are not miscible with water, the equipment must be completely dry prior to use.

Solvents, laboratory detergent, and rinse waters used to clean equipment shall not be reused during field decontamination.

APPENDIX C
FIELD EQUIPMENT STANDARD CLEANING PROCEDURES

PERFORMANCE OBJECTIVE:

- To remove contaminants of concern from sampling and other field equipment to concentrations that do not impact study objectives using a standard cleaning procedure.

C.1 Introduction

Cleaning procedures outlined in this appendix are intended for cleaning sampling and other field equipment prior to field use. These procedures are *not* intended to be used in the field. Cleaning procedures for use in the field are in Appendix B. Sampling and other field equipment cleaned in accordance with these procedures will meet the minimum requirements for the Data Quality Objective (DQO). Deviations from these procedures should be documented in the approved study plan, field records, and investigative reports.

C.1.1 Specifications For Cleaning Materials

The specifications for standard cleaning materials referred to in this appendix are as follows:

- Soap shall be a standard brand of laboratory detergent such as Alconox®. NOTE: Alconox contains phosphates. If phosphorus is an analyte of concern, use a phosphate free detergent, such as Liqui-Nox.

- Disinfectant soap shall be a standard brand of disinfectant cleaner.

- Solvent shall be pesticide grade methanol. If methanol is not available, acetone, followed by hexane, may be substituted. If acetone is used, and later detected in any samples, the cleaned equipment must be suspect. Rarely, project specific requirements may necessitate the use of other solvents.

- Nitric acid solution (5%) shall be made from reagent-grade nitric acid and deionized water.

- Analyte-free water (deionized water) is tap water that has been treated by passing it through a standard deionizing resin column. At a minimum, it should contain no detectable heavy metals or other inorganic compounds as defined by a standard Inductively Coupled (ICP) Argon Plasma Spectrophotometer (or equivalent) scan.

- Organic/analyte-free water is defined as tap water that has been treated with activated carbon and deionizing units. At a minimum, it must meet the analytical criteria of analyte-free water and should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels determined by the Region 2 laboratory for a given set of analyses. Organic/analyte-free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

Solvents, nitric acid solution, laboratory detergent, and rinse waters used to clean equipment cannot be reused, and must be disposed of properly.

C.1.2 Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Containers should be constructed of the proper materials to ensure their integrity. Following are the materials to be used for storing the specified cleaning materials:

- Soap should be kept in clean containers until use. It should be poured directly from the container.

- Disinfectant soap should be kept in clean containers until use. It should be poured directly from the container.

- Solvents should be stored in the original containers until used.

- Analyte-free water should be stored in cleaned containers that can be closed when not being used. It may be applied from squeeze bottles.

- Organic/analyte-free water should be stored in cleaned glass, Teflon®, or stainless steel containers prior to use. It may be applied using Teflon® squeeze bottles, or directly from the system.

- Nitric acid should be kept in the glass container it is received in, and placed in squeeze bottles prior to application.

C.1.3 Disposal of Spent Cleaning Solutions

Procedures for safe handling and disposition of spent cleaning solutions, including wash water, rinse water, spent acid solutions, and spent solvents are as follows:

- Wash water: When large equipment (vehicles, augers, etc.) is washed outside, it may wash onto the ground without recovery of the wash water. Most equipment is decontaminated outside before its delivery to the wash room.

- Rinse water: See above.

- Nitric Acid: Nitric acid and other acid cleaning solutions are to be disposed of in the laboratory’s acid waste receptacle.

- Solvent: All solvents used should be proper disposed in the lab. Used solvents can be classified as either "solvent for recovery" or "solvent for disposal". Solvent for recovery is that which was used in the standard field cleaning or cleaning of equipment. Solvent used for cleaning contaminated equipment (e.g., tar removal, etc.) must be disposed of in proper waste receptacles.

C.1.4 Safety Procedures for Cleaning Operations

Some materials used to implement the cleaning procedures outlined in this Appendix are harmful if used improperly. Caution should be exercised and all applicable safety procedures shall be followed. At a minimum, the following precautions shall be taken in the washroom during these cleaning operations:

- Safety glasses with splash shields or goggles, and neoprene gloves will be worn during all cleaning operations. When cleaning heavy or bulky items such as hollow-stem augers or other large equipment, safety boots and a neoprene apron will be worn.
- All solvent rinsing operations will be conducted under a fume hood or in the outdoors (never in a closed room).
- No eating, smoking, drinking, or any hand to mouth contact shall be permitted during cleaning operations.

C.1.5 Handling and Labeling of Cleaned Equipment

After cleaning, equipment should be handled only by personnel wearing clean nitrile or latex gloves to prevent re-contamination. After the cleaned equipment is wrapped in aluminum foil and sealed in plastic, the cleaning details should be noted on the equipment cleaning adhesive label. If the equipment was not cleaned according to the procedures outlined in this appendix, this should also be noted on the adhesive label.

C.1.6 Initial Processing of Returned Equipment

Field or sampling equipment that needs to be repaired will be identified with a "repair" tag. Any problems encountered with the equipment and specific required repairs shall be noted on this tag, as well as the date and the initials of the investigator. These will be stored on the shelf marked “needs repair.”

Field equipment and reusable sample containers needing cleaning get rinsed and placed in the laboratories glassware wash room. Reusable rods get tape removed, washed off, and wiped dry.

C.2 Trace Organic and Inorganic Constituent Sampling Equipment

Sampling equipment used to collect samples undergoing trace organic and/or inorganic constituents analyses should be thoroughly cleaned according to the procedures outlined in this SOP. However, any modifications to the procedures are required to conform with those solvents and preservatives required for specific inorganic (nonmetal) and organic analyses.

C.2.1 Bailers, Bacon Bombs and Other Sampling Equipment Made of Teflon®, Stainless Steel, Steel, or Glass

The equipment should be prepared as specified in the Section’s SOP for cleaning sampling equipment, as follows:

1. The equipment should be washed with hot water and detergent.
2. Rinse with tap water and air dry.
3. Rinse with analyte free laboratory water and air dry.

STEPS 1-3 MAY BE ACCOMPLISHED WITH THE DISHWASHING SYSTEM IN THE LABORATORY GLASSWARE WASH ROOM.

4. Rinse with a 5% nitric acid solution, and triple rinse with analyte free water, if the equipment will also be used to collect samples for metals.
5. Rinse with solvent, and allow to thoroughly air dry in a fume hood.
6. The equipment should be labeled with the date and the solvent used for rinsing.
7. Wrap the equipment in aluminum foil and store in a contaminant free area.

C.2.2 Reusable Composite Sample and Organic/Analyte-Free Water Containers *

Immediately prior to use, the equipment will be rinsed with organic/analyte-free water and the rinse water will be submitted to the Region 2 laboratory for analysis. Typically, this sample is referred to as an equipment blank, and is used to demonstrate the adequacy of cleaning procedures.

C.3 Automatic Wastewater Sampling Equipment

C.3.1 ISCO© and Other Automatic Samplers

1. The exterior and accessible interior (excluding the waterproof timing mechanism) portions of the automatic samplers will be washed with soap and tap water then rinsed with tap water.
2. Desiccant in the samplers and flow meters should be checked, and replaced if necessary, each time the equipment is cleaned.
3. The face of the timing case mechanism will be cleaned with a clean damp paper towel.
4. Tubing (sample intake and pump tubing) will be discarded after each use.
5. New pre-cleaned, Silastic® pump tubing (see Appendix C.4.1) will be installed.

C.3.2 ISCO© and Other Multi-bottle Samplers - Rotary Funnel, Distributor, and Metal Tube

1. Clean with hot tap water, soap, and a brush.
2. Rinse thoroughly with analyte free water.
3. Replace in sampler.

C.3.3 Reusable Glass Composite Sample Containers (2.5, 3.0 or 3.5 gallon capacity)

If the containers are to be used to collect samples for organic compounds, they should be prepared as specified in the Section's SOP for cleaning sample containers, as follows:

1. The composite container(s) should be washed with hot water and detergent.
2. Rinse with tap water and air dry.
3. Rinse with analyte free laboratory water and air dry.

STEPS 1-3 MAY BE ACCOMPLISHED WITH THE DISHWASHING SYSTEM IN THE LABORATORY GLASSWARE WASH ROOM.

4. If the container will be used for sampling metals, it should be rinsed with a 5% nitric acid solution, and then triple rinsed with analyte free water.
5. Rinse with solvent, and allow to thoroughly air dry in a fume hood.
6. The container(s) should be labeled with the date and the solvent used for rinsing.

NOTE: BE SURE TO VENT THE JAR PERIODICALLY WHEN RINSING WITH SOLVENT, IN ORDER TO AVOID THE DANGEROUS BUILDUP OF PRESSURE INSIDE THE JAR.

C.3.4 Plastic Reusable Composite Sample Containers (4 gallon capacity)

These containers are washed according to the LAB Branch procedures, by the washroom employee. Any plastic composite sample containers that have a visible film, scale, or other discoloration remaining after cleaning procedure will be sent for re-cleaning. If the containers are to be used to collect samples for metals, they should be rinsed with a solution of 5% nitric acid, then triple rinsed with laboratory pure water, and then allowed to air dry in a fume hood. The container(s) should be labeled with the date, the acid used for rinsing, and the initials of the person the prepared the container for use.

C.4 Cleaning Procedures for Tubing

C.4.1 Silastic® Pump Tubing

The Silastic® pump tubing in the automatic samplers and peristaltic pumps should be replaced for each new sampling location. After installation, the exposed ends should be capped with clean, unused aluminum foil.

C.4.2 Teflon® Sample Tubing

For the collection of samples for trace organic compounds use only new pre-cleaned Teflon® tubing. Teflon® lined tubing is purchased in 25-foot lengths, and it is discarded after one use.

C.5 Cleaning Procedures for Miscellaneous Equipment

C.5.1 Well Tapes

1. Wash with soap and tap water.
2. Rinse with hot tap water.
3. Rinse with analyte free water.
4. Allow to air dry.

C.5.2 Little Beaver®

The engine and power head should be cleaned with a power washer, steam jenny, or hand washed
with a brush using soap to remove oil, grease, and hydraulic fluid from the exterior of the unit. Do not use degreasers. Rinse thoroughly with tap water. Auger flights and bits should be cleaned as follows:

1. Inspect thoroughly. If severe rust, corrosion, paint, or hardened grout is present, the equipment will require sandblasting prior to cleaning.
2. Clean with tap water and soap, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Augers that are steam cleaned should be placed on racks or saw horses at least two feet aboveground.
3. Rinse thoroughly with tap water.
4. Completely air dry. Remove and wrap with clean, unused plastic. Return to storage.

C.5.3 Flow Measuring Equipment and Miscellaneous Sampling Equipment

Flow measuring equipment should be washed with soap and tap water, and rinsed with tap water. Then rinsed thoroughly with analyte free water, and completely air dried before being stored.

C.5.4 Field Analytical Equipment

Field instruments for in-situ water analysis should be wiped with a clean, damp paper towel. The probes on these instruments (pH, conductivity, DO, etc.) should be rinsed with analyte free water and air dried. Any desiccant in these instruments should be checked and regenerated, or replaced if necessary, each time the equipment is cleaned.

C.5.5 Ice Chests and Shipping Containers

Ice chests and reusable containers (interior and exterior) shall be and rinsed with tap water and either wiped dry with paper towels, or air dried, before storage. If in the opinion of the field investigators the container is severely contaminated with concentrated waste or other toxic material, it shall be cleaned as thoroughly as possible, rendered unusable, and properly disposed.

C.5.6 SCBA Face-masks (and breathing hose) and Air Purifying Respirators* (APR's)

CAUTION: Face-masks and air hoses should be inspected for wear or damage. If the face-mask or air hose cannot be repaired, it should be discarded and replaced.

1. Wash face-mask thoroughly inside and out with hot tap water and disinfectant soap (MSA Cleaner-Sanitizer II power).
2. Add one package (2 oz.) of powdered Cleaner-Sanitizer II to a gallon of warm water (120 °F). Avoid using water that is much hotter, since it can warp the mask.
3. Immerse soiled equipment in the solution and scrub gently and thoroughly with a soft brush until clean. Do not use scouring pads of any type.
4. Rinse face-mask thoroughly inside and out with warm tap water.
5. Hang face-mask up until completely dry.
6. Place face-mask in plastic bag and return to storage.

***Note: APRs are completely dismantled prior to cleaning.**

C.5.7 Portable Tanks for Tap Water

1. Scrub interior and exterior with soap and tap water.
2. Rinse with tap water.
3. Let completely air dry.
4. Close and place in storage.

C.5.8 Vehicles

Vehicles utilized by field investigators should be washed (if possible) at the conclusion of each field trip. This should minimize contamination of equipment or samples due to contamination of vehicles.

When vehicles are used in conjunction with hazardous waste site inspections, or on studies where pesticides, herbicides, organic compounds, or other toxic materials are known or suspected to be present, a thorough interior and exterior cleaning (using soapy tap water) is required at the conclusion of these investigations. It shall be the responsibility of the field investigators to see that this procedure is followed. Personnel involved will use appropriate safety measures.

Vehicles shall be equipped with trash bags and/or trash containers to facilitate vehicle cleaning. Field investigators are responsible for keeping field vehicles clean by removing trash and other debris. Contaminated trash and equipment should be kept separate from ordinary trash and should be properly disposed on-site, or upon return to Edison.

C.6 Preparation of Disposable Sample Containers

C.6.1 Introduction

No disposable sample container (with the exception of the glass and plastic compositing containers and oil and grease jars) may be reused. All disposable sample containers will be stored in their original packing containers. When packages of uncapped sample containers are opened, they will be placed in new plastic bags and sealed to prevent contamination during storage. Typically, containers are ordered with caps on. Specific pre-cleaning instructions for disposable sample containers are given in the following sections.

C.6.2 Plastic Containers used for "Classical" Parameters

Only new containers may be used for oxygen demand, classical inorganics, and sulfides. There are no pre-cleaning requirements for these plastic containers.

C.6.3 Glass Bottles for Semi-Volatile GC/MS Analytes

These procedures are to be used only if the supply of pre-cleaned, certified sample bottles is disrupted. If the containers are to be used to collect samples for organic compounds, they should be prepared as specified in the Section’s SOP for cleaning sample containers, as follows:

1. The sample jar(s) should be washed with hot water and detergent.
2. Rinse with tap water and air dry.
3. Rinse with analyte free laboratory water and air dry.

STEPS 1-3 MAY BE ACCOMPLISHED WITH THE DISHWASHING SYSTEM IN THE LABORATORY GLASSWARE WASH ROOM.

4. Rinse with solvent, and allow to thoroughly air dry in a fume hood.

5. The box or bag that the containers are stored in (after cleaning) should be labeled with the date, the solvents used for rinsing, and the initials of the person who prepared the containers.

6. Store in a sealed plastic bag, in a contaminant free area.

C.6.4 Plastic Bottles for Metal Analytes

These procedures are to be used only if the supply of pre-cleaned, certified sample bottles is disrupted. When these sample containers are cleaned and prepared, they should be cleaned in large quantities to facilitate the quality control procedures. They should be prepared as specified in the Section's SOP for cleaning sample containers, as follows:

1. The sample jar(s) should be washed with hot water and detergent.

2. Rinse with tap water and air dry.

3. Rinse with analyte free laboratory water and air dry.

STEPS 1-3 MAY BE ACCOMPLISHED WITH THE DISHWASHING SYSTEM IN THE LABORATORY GLASSWARE WASH ROOM.

4. Rinse with a 5% nitric acid solution.

5. Triple rinse with analyte free water.

6. The container(s) should be labeled with the date, the acid used for rinsing, and the initials of the person who prepared the containers.

7. Store in a sealed plastic bag, in a contaminant free area.

C.6.5 Glass Bottles for Volatile GC/MS Analytes

These procedures are to be used only if the supply of pre-cleaned, certified 40 ml vials with Teflon® septa sample bottles is disrupted. If the containers are to be used to collect samples for volatile organic compounds, they should be prepared as specified in the Section's SOP for cleaning sample containers, as follows:

1. The sample jar(s) should be washed with hot water and detergent.

2. Rinse with tap water and air dry.

3. Rinse with analyte free laboratory water and air dry.

STEPS 1-3 MAY BE ACCOMPLISHED WITH THE DISHWASHING SYSTEM IN THE LABORATORY GLASSWARE WASH ROOM.

4. Place the vials in a metal rack (without the caps or septa).

5. Bake the uncapped vials in an oven at 103 to 105 °F for a least one hour.
6. Remove the vials and allow them to cool down for 10 to 15 minutes.
7. Replace the caps and septa, Teflon® side down.
8. The vials should be labeled with the date they were prepared.
9. Store in a sealed box or plastic bag, in a contaminant free area.

APPENDIX D
SAMPLE SHIPPING PROCEDURES

D.1 Introduction

Samples collected during field investigations, or in response to a hazardous materials incident, must be classified prior to shipment, as either environmental or hazardous materials samples. In general, environmental samples include drinking water, most groundwater and ambient surface water, soil, sediment, treated municipal and industrial wastewater effluent, biological specimens, or any samples not expected to be contaminated with high levels of hazardous materials.

Samples collected from process wastewater streams, drums, bulk storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated may require shipment as dangerous goods. Regulations for packing, marking, labeling, and shipping of dangerous goods by air transport are promulgated by the International Air Transport Authority (IATA), which is equivalent to United Nations International Civil Aviation Organization (UN/ICAO).

D.2 Shipment of Dangerous Goods

The project leader is responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample is collected of a material that is listed in the Dangerous Goods List, Section 4.2, IATA, then that sample must be identified, packaged, marked, labeled, and shipped according to the instructions given for that material. If the composition of the collected sample(s) is unknown, and the project leader knows or suspects that it is a regulated material (dangerous goods), the sample may not be offered for air transport. If the composition and properties of the waste sample or highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport.

In addition, the shipment of pre-preserved sample containers or bottles of preservatives (e.g., NaOH pellets, HCL, etc.) which are designated as dangerous goods by IATA is regulated. Shipment of nitric acid is forbidden on all aircraft. Dangerous goods must not be offered for air transport without contacting the Edison dangerous goods shipment designee (Kwong Cho).

D.3 Shipment of Environmental Laboratory Samples

Guidance for the shipment of environmental laboratory samples by personnel is provided in a memorandum dated March 6, 1981, subject "Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Laboratory Samples". By this memorandum, the shipment of the following un-preserved samples is not regulated:

- Drinking water
- Treated effluent
- Biological specimens
- Sediment

- Water treatment plant sludge
- POTW sludge

However, soil and sludge samples require a USDA Soil Permit when shipments originate from certain states (including parts New York State), Puerto Rico of the U.S. Virgin Islands.

- You must check with the appropriate State Health Director prior to collecting soils, sediments or sludges in order to make sure that the soils/sediments/sludges are not regulated. A listing of the appropriate State Plant Health Directors is available at: http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml
- Golden nematode quarantines are in effect for Nassau and Suffolk counties, and well as portions of other counties in New York State (including Orleans, Genesee, Livingston, Stueben, Wayne and Cayuga counties). Updated maps are available at: http://www.aphis.usda.gov/ppq/maps/ Look under *Golden Nematode quarantine* and *Soil Movement regulations*, these are PDF files.
- Imported Fire Ant quarantines are in effect for Puerto Rico and the US Virgin Islands. Updated maps are available at: http://www.aphis.usda.gov/ppq/maps/ Look under *Imported Fire Ant Map*, this is a PDF file.
- In addition, a USDA Soil Samples Restricted Entry label must be affixed to the outside of the container that the soil of sludge is being shipped in.

A copy of the permit and the compliance agreement should be affixed to the sample cooler and a copy should accompany the shipping papers. A copy of the existing USDA soil permit is attached to this Appendix.

In addition, the shipment of the following preserved samples is not regulated, provided the amount of preservative used does not exceed the amounts found in 40 CFR 136.3 (Table II - Required Containers, Preservation Techniques, and Holding Times) (see Appendix A). It is the shippers' (individual signing the airway bill) responsibility to ensure that proper amounts of preservative are used:

- Drinking water
- Ambient water
- Treated effluent
- Biological specimens
- Sediment
- Wastewater treatment plant sludge
- Water treatment plant sludge

Samples determined by the project leader to be in these categories are to be shipped using the following protocol, developed jointly between US-EPA, OSHA, and DOT. This procedure is documented in the "Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples".

Untreated wastewater and sludge from POTW's are considered to be "diagnostic specimens" (not environmental laboratory samples). However, because they are not considered to be etiologic agents (infectious) they are not restricted and may be shipped using the procedures outlined below.

Environmental samples should be packed into a cooler prior to shipment by air using the following procedures:

1 Allow sufficient headspace in all sample containers (except VOC vials with a septum seal) to compensate for any pressure and temperature changes.

2 Be sure the lids on all samples are tightly capped (e.g. will not leak if containers are turned upside down).

3 Place up to three 40-milliliter (ml) VOC vials in one Whirl-Pak plastic bag.

4 Select a sturdy non leaking cooler in good condition. Wipe the cooler dry with paper towel. Secure and tape the drain plug with fiber tape. Line the cooler with two large heavy duty garbage plastic bags (one inside the other). A single extra heavy (4 mil thick, or more) could be substituted for the two garbage bags.

5 Place the glass sample containers in the heavy duty plastic bag(s) inside the cooler. Make sure not to put glass containers next to each other. Insulate them by placing them next to plastic containers or bags of ice. Make sure that there is sufficient space between the sample containers for the bagged ice (ice should be doubled bagged in heavy duty polyethylene bags and properly sealed). In order to protect the bottoms of the glass jars from breakage, a layer of bubble wrap may be placed on the bottom of the cooler. And small pieces of bubble wrap can also be used to cushion the sides of glass containers.

6 Put bagged ice between and on top of the sample containers (making sure that glass sample containers are not next to each other or immediately on top of each other). Fill the remaining space with bagged ice to cover the sample containers.

7 Securely fasten the top of the large garbage bags by knotting them or with tape.

8 Place the Chain-Of-Custody/Field Data Form into a small plastic bag, seal the bag with tape, and then tape the bag to the inner side of the cooler lid.

9 Close the cooler and securely fiber tape the cooler shut. Seal-of-custody tape should be signed by the inspector. Before placing the last wrap of the translucent fiber tape around the cooler, the seal-of-custody tape should placed in order to determine if the cooler had been opened. Therefore, the seal-of-custody tape is normally placed on both the top and side of the cooler (on top of the previous wrap of the securing fiber tape). The translucent fiber tape should be wrapped around the cooler once more, and cover the seal-of-custody tape, so that the cooler cannot be opened without breaking the seal-of-custody tape.

10 Shipping coolers must be marked "ENVIRONMENTAL SAMPLES" or “WATER SAMPLES”, which indicate the contents in the cooler. This label should be affixed to the top of the cooler. In addition to the marking, the label should contain the name, address and telephone number of the person that will receive the sample at the final destination. Also, a business card of the lead inspector should be place on top of the cooler, near the shipping label. Labels used in the shipment of hazardous materials (e.g., Cargo Only Air Craft, Flammable Solids, etc.) are not permitted to be on the outside of containers used to transport environmental samples.

D.4 References

1. Dangerous Goods Regulations, International Air Transport Authority (IATA). Current Edition,which changes annually.

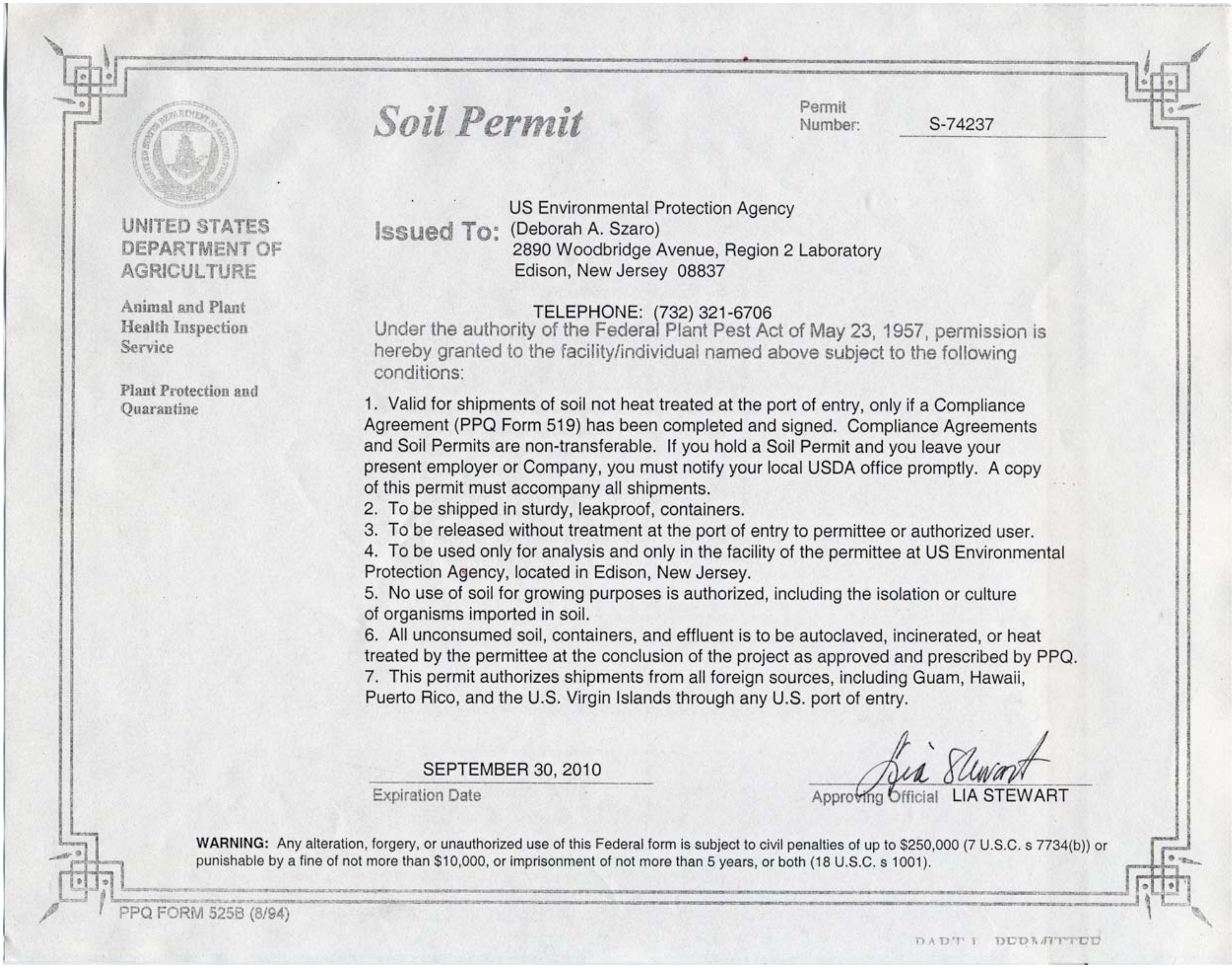
2. "Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples," Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273), US-EPA, April 13, 1981.

3. 40 CFR Part 136.3. July 1, 2003. See Table II, Footnote 3.

4. Updated maps are available at: http://www.aphis.usda.gov/ppq/maps/ Look under Plant Protection and Quarantine Maps, these are PDF files.

5. Updated maps are available at: http://www.aphis.usda.gov/ppq/maps/ Look under *Plant Protection and Quarantine Maps*, these are PDF files.

6. A listing of the appropriate State Plant Health Directors is available at: http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml



Soil Permit

Permit Number: S-74237

UNITED STATES
DEPARTMENT OF
AGRICULTURE

Animal and Plant
Health Inspection
Service

Plant Protection and
Quarantine

Issued To:
US Environmental Protection Agency
(Deborah A. Szaro)
2890 Woodbridge Avenue, Region 2 Laboratory
Edison, New Jersey 08837

TELEPHONE: (732) 321-6706

Under the authority of the Federal Plant Pest Act of May 23, 1957, permission is hereby granted to the facility/individual named above subject to the following conditions:

1. Valid for shipments of soil not heat treated at the port of entry, only if a Compliance Agreement (PPQ Form 519) has been completed and signed. Compliance Agreements and Soil Permits are non-transferable. If you hold a Soil Permit and you leave your present employer or Company, you must notify your local USDA office promptly. A copy of this permit must accompany all shipments.
2. To be shipped in sturdy, leakproof, containers.
3. To be released without treatment at the port of entry to permittee or authorized user.
4. To be used only for analysis and only in the facility of the permittee at US Environmental Protection Agency, located in Edison, New Jersey.
5. No use of soil for growing purposes is authorized, including the isolation or culture of organisms imported in soil.
6. All unconsumed soil, containers, and effluent is to be autoclaved, incinerated, or heat treated by the permittee at the conclusion of the project as approved and prescribed by PPQ.
7. This permit authorizes shipments from all foreign sources, including Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands through any U.S. port of entry.

SEPTEMBER 30, 2010
Expiration Date

Lia Stewart
Approving Official LIA STEWART

WARNING: Any alteration, forgery, or unauthorized use of this Federal form is subject to civil penalties of up to $250,000 (7 U.S.C. s 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C. s 1001).

PPQ FORM 525B (8/94)

APPENDIX E
PUMP OPERATING PROCEDURES

E.1 Peristaltic Pump

E.1.1 Introduction

When relatively small volumes of water are required for purging and sampling, and the water level is within the limit of suction (generally around 25 feet vertical separation between the pump and water surface) peristaltic pumps can be used. These pumps are generally small, light-weight, and portable and are powered by 12-volt batteries.

The application of these pumps differs with respect to purging and sampling. The following sections detail the use of peristaltic pumps for both purposes.

E.1.2 Purging with a Peristaltic Pump

1. Place a coil of standard pre-cleaned Teflon® tubing equal to the well depth, plus an additional five to ten feet, in a standard cleaned bucket or box which has been lined with clean plastic sheeting. Enough tubing is needed to run from the ground surface up to the top of the well casing and back down to the bottom of the well. This will allow for operation of the pump at all possible water level conditions in the well.

2. Place one end of the tubing into the vacuum side of the peristaltic pump head. Proper sizing of the Teflon® and Silastic® or Tygon® tubing should provide for a snug fit of the Teflon® tubing inside the flexible tubing mounted in the pump head. However, the place where the two pieces of tubing connect should be secured in place by tightly wrapping the junction with electrical tape. This will prevent any accidental separation of the two pieces of tubing, and eliminate the potential for any air leakage.

3. Run a short section of tubing (which does not have to be Teflon®) from the discharge side of the pump head to a graduated bucket.

4. Place the free end of the coil of Teflon® tubing into the well until the end of the tubing is just below the top of the water column.

5. Secure the Teflon® tubing to the well casing or other secure object using electrical tape, or other suitable means. This will prevent the tubing from being lost in the well should all of the tubing be deployed and come loose from the pump head.

6. Turn on the pump to produce a vacuum on the well side of the pump head, and begin the purge. Observe the direction of flow from the pump, to ensure that a vacuum is being applied to the purge line. If the purge line is being pressurized reverse the pumping cycle on the pump.

7. Purge the well according to the criteria described in Section 6.2 of this manual. If the pumping rate exceeds the recovery rate of the well, continue to lower the tubing into the well several feet at a time, as needed, until the draw down stabilizes, or the well is evacuated to dryness. If the pump is a variable speed peristaltic pump, and the water

level in the well is being drawn down, reduce the speed of the pump in an attempt to stabilize the draw down. If the well can be purged without evacuating the well to dryness, a sample with greater integrity can be obtained.

8. For wells which are not evacuated to dryness, particularly those with recovery rates equal to, or very nearly equal to, the purge rate, there may not be a complete exchange and removal of stagnant water in that portion of the water column above the tubing intake. For this reason, it is important that the tubing intake be placed in the very uppermost portion of the water column while purging. Standard field measurements should frequently be taken during the purging process to verify adequacy of the purge. (See Section 6.2 for specific details regarding purge adequacy measurements.)

E.1.3 Sampling with a Peristaltic Pump

If the flexible (Silastic®) tubing used in peristaltic pump head is decontaminated according to Appendix C of this SOP, samples for analyses of some inorganic constituents may be collected through the tubing, provided that blank samples are collected. At each location a new pre-cleaned piece of flexible tubing must be used, because it cannot be easily field cleaned between sampling locations prior to collecting samples for other parameters.

NOTE: Samples for volatile organic compound analyses cannot be collected using this method. If samples for VOC analyses are required, they must be collected with a Teflon® or stainless steel bailer, or by other approved methods, such as the straw method. The straw method involves allowing the Teflon® tubing to fill, by either lowering it into the water column or filling it via suction applied by the pump head. Upon filling, the tubing is removed from the well and allowed to drain into the sample vial. This is repeated, as necessary, until all vials are filled.

APPENDIX F
REGIONAL TECHNICAL SUPPORT FOR CRIMINAL INVESTIGATIONS

The Division of Environmental Science and Assessment (DESA) - Monitoring and Assessment Branch (MAB) provides technical support to the Criminal Investigation Division (CID) offices located in New York City, New York, Trenton, New Jersey, Syracuse, New York, and Buffalo, New York. This assistance provided is for those investigations requiring the collection of samples, laboratory analyses, or other technical support. These procedures address the means by which technical support is requested by the CID Offices and provided by DESA-MAB.

The primary objectives of DESA-MAB support for the CID criminal investigations are to provide accurate, complete, admissible, and defensible reports and data for case development and subsequent legal proceedings. To accomplish these objectives, DESA-MAB and the CID Offices have agreed to the following procedures.

All information collected during a criminal or civil investigation is considered Sensitive But Classified (SBU) information. Anytime you conduct a criminal or civil investigation, all files and records that are kept related to the investigation must be clearly marked and stored in "RED" folders marked Sensitive But Classified (SBU).

F.1 Technical Assistance Required by Region 2 CID

The CID Offices, under the Direction of a Special Agent-in-Charge (SAC), conducts criminal investigations in Region 2 pursuant to federal environmental laws and regulations. The technical assistance requirements for criminal cases vary from investigation to investigation. To assist the SAC in identifying the type and scope of technical assistance required, a Regional Technical Coordinator (RTC) position has been established in the Trenton Area Office. The RTC's primary function is to provide technical advice to the SAC and Case Agents. It is the responsibility of the RTC to assure that requests for technical support are directed to the appropriate Regional Program and DESA-MAB offices. After a decision by the SAC to request technical support for a criminal investigation, the RTC will discuss the case with the appropriate Regional Program office. Following the Regional Program offices' decision that technical support will be provided, a written request will be prepared by the Program office to DESA-MAB.

Prior to conducting the investigation, the RTC will discuss the case with DESA-MAB personnel, and will inform the Case Agent of any technical requirements that may influence project planning. Conversely, it is the responsibility of the RTC to inform DESA-MAB personnel of all known technical aspects of a case including the presence of any known situations which may pose health and/or safety risks, or otherwise interfere with their operations.

Subsequent to the field investigation, the RTC, in consultation with the Case Agent, will discuss with DESA-MAB personnel the progress of scheduled analyses and the potential need for additional or more detailed analyses. Information regarding the need to alter work schedules so as to meet changing grand jury or federal court dates will be transmitted immediately from the RTC to DESA-MAB. When work schedules must be delayed, the technical reasons for the delay will be communicated from the RTC to the Case Agent.

Upon completion of the analyses a report will be prepared by the RTC, or by DESA-MAB, for the Case Agent, with a copy being sent to the SAC, and the Program office.

F.2 Project Requests

All requests for DESA-MAB support for criminal investigations shall originate with the CID offices that are located in New York, New York, Trenton, New Jersey, Syracuse, New York, and Buffalo, New York. Any information obtained by DESA-MAB staff regarding potential criminal activities shall immediately be referred to the appropriate CID Office. Direct requests to DESA-MAB from any other federal, state, or local agency shall be referred to the corresponding CID SAC for appropriate action.

Prior to an official request from the respective CID Office, and the concurring Program Office to DESA-MAB, an informal contact shall be made with the appropriate DESA-MAB Branch or Section Chief concerning the availability of resources and expertise necessary for providing the requested technical support. If DESA-MAB is able to provide the support, the Program Office shall prepare a written request to the DESA-MAB. For criminal investigations when DESA-MAB's priorities prohibit an immediate response, the Division Director will determine an appropriate course of action. If the Division Director determines that providing the requested technical support will be in the best interest of the Region, the support will be provided and adjustments will be made to other DESA-MAB commitments. DESA-MAB's technical support may begin immediately after receiving concurrence from the Division Director. The SAC has the responsibility of notifying appropriate regional organizational units, e.g., Office Directors, Division Directors, etc., of potential or on-going investigations receiving assistance from DESA-MAB.

All emergency requests shall be handled expeditiously. In such instances, DESA-MAB may provide the requested assistance immediately upon obtaining verbal approval from the Division Director. However, all such requests shall be followed by a written request from the Program Office to the DESA Director (or their designee).

F.3 Project Coordination

Once the decision has been made to provide technical support, the DESA-MAB Director (or their designee) shall assign the project to the appropriate Branch/Section for assignment of a Project Leader. The Project Leader will be responsible for coordinating with the Case Agent, and/or the RTC, to obtain necessary background information to determine logistical requirements, skill needs, laboratory support, etc.

The Project Leader shall discuss the technical and workload requirements with his/her immediate supervisor. A core team shall then be selected which will eventually conduct the study, coordinate analytical support, and/or provide other technical support. When required, additional staff will be assigned from other Sections or Branches with the approval of the appropriate Branch Chief, or DESA-MAB Director. Once the core team has been selected, initial planning for the investigation shall begin under the direction of the Project Leader and in concert with the RTC, and the Case Agent.

F.4 Project Planning

After the appropriate, and available, background material has been obtained, specific assignments will be given to each member of the core team for development of a study plan. Concurrently, the Project Leader, and/or the RTC, shall discuss analytical requirements and time-frames with appropriate DESA- Laboratory Branch personnel. The study plan and site-safety plan shall be assembled under the direction of the RTC, and/or the Project Leader, and submitted to the appropriate individuals, and Case Agent, for review and concurrence. The time-frame for receiving comments will depend upon the urgency of the investigation, but shall not exceed 10 working days. During emergencies, an investigation may be conducted without the preparation of a detailed study plan. However, during these situations, a memorandum shall be prepared by the RTC, and/or the Project Leader, briefly describing the technical work to be accomplished and stating that the investigation will strictly conform to appropriate DESA-MAB Standard Operating Procedures and Safety Procedures.

A final study plan will be prepared once all appropriate comments are received by the Project Leader, and/or the RTC. In general, these study plans should contain the following elements. However, upon advice of the Case Agent, the content and format of any study plan may be substantially changed to meet the needs of the particular investigation. The general format of the study plan should include the following items:

- Introduction - a brief statement of the problem to be investigated;
- Background a short but concise history of the case history;
- Objectives - a statement as to what the investigation is to accomplish and what specific laws and regulations may have been violated;
- Scope - a definition of the limits of the study;
- Time Schedule - a statement outlining when the study will be conducted, when analytical results will be available, when the draft report will be written, and when the final report will be completed;
- Methodology - specific field techniques to be employed. A statement that the techniques in the DESA-MAB's Standard Operating Procedures will be employed shall be included. The use of any techniques not included in the Standard Operating Procedures shall be thoroughly justified and must produce evidence which can withstand objections by the defense;
- Analytical Requirements - an estimate of the number of samples to be collected, required analyses, and which laboratory(s) will analyze the samples;
- Logistics - an estimate of manpower requirements and a general description of specific functions of project personnel, special equipment and vehicles to be used, use of mobile laboratories, how samples are to be transported to the laboratory, etc.; and,
- Safety Plan - a site safety plan will be included.

F.5 Field Investigation

The field investigation will be conducted under the direct supervision of the Project Leader, and/or RTC, and the general supervision of the Case Agent responsible for conducting the investigation. DESA-MAB will endeavor to meet all objectives set forth in the study plan and any on-scene changes or additional activities requested by the Case Agent. The DESA-MAB Project Leader, and/or the RTC, shall have sole responsibility for enforcing the provisions of the safety plan. The study will be conducted conforming to the requirements and objectives of the study plan and appropriate Standard Operating Procedures. Any deviations from the study plan or the appropriate Standard Operating Procedures must be approved and documented by the Project Leader, and/or RTC. Any deviations must be documented, and produce evidence which can withstand objections by the defense.

During the field activities the Project Leader, and/or RTC, or their designee, is responsible for insuring that all chain-of-custody and quality control procedures for sampling, flow measurements, field analyses, record-keeping, etc., are followed. All field personnel participating in criminal investigations must understand and follow the chain-of-custody and quality control procedures relative to their assignments. Following completion of the field activities, the Project Leader, and/or RTC, or their designee, shall account for all field documentation (e.g. field logbooks, sample tags and Chain-Of-Custody/Field Data Forms), and verify that they are complete. Sample labels will remain on the sample containers, in the custody of the laboratory, until relinquishment to the court, or until final disposition of the case.

F.6 Laboratory Support

The Team leader, or a senior staff member, shall determine the analytical needs of the investigation and provide overall coordination of sample analyses and data reporting. Upon delivery of samples to the Laboratory Branch, the samples shall be transferred, via chain-of-custody procedures, from the Project Leader, and/or the RTC, or their designee, to the laboratory Sample Custodian for criminal cases, or their designee. The Sample Custodian for criminal cases shall document the condition of the samples, and verify the validity of the information on the sample labels and Chain-Of-Custody/Field Data Forms prior to placing the samples in the secure sample custody area.

All sample handling, sample preparation, and analyses shall be in strict conformance with the Laboratory Branchs' Standard Operating Procedures. A senior staff member of the Laboratory Branch shall notify the Project Leader, and/or RTC, once the validated results become available. Final analytical data shall be reported directly to the Project Leader, and/or RTC, after all QA/QC procedures have been completed. Any analytical problems, or deviations, concerning holding times, analytical procedures, etc., shall be reported to the Project Leader, and/or RTC. When requested by the Case Agent, this information shall be documented in a memorandum stamped "CONFIDENTIAL", and transmitted to the Project Leader, and/or RTC, who shall immediately notify the Case Agent. A copy of the memorandum shall also be immediately sent to the RTC and the Case Agent as requested.

F.7 Final Report

The Project Leader, and/or RTC, is responsible for preparing a final investigative report. A draft report shall be prepared for internal review by the Section and Branch Chiefs, and other staff, as needed. All draft reports shall be destroyed upon completion of the final report.

A final investigative report will be prepared by the Project Leader, and/or RTC. This report shall be limited to factual information and observations concerning DESA-MAB activities, e.g., sampling, analyses, etc., but shall not contain conclusions, recommendations, or personal opinions. At the request of the Case Agent, a memorandum will be prepared containing conclusions, recommendations, or personal opinions. When this is done, the memorandum will be stamped "CONFIDENTIAL" on each page and delivered to the Case Agent. The final report(s) shall be delivered to the Case Agent who shall be responsible for ultimate distribution.

F.8 Document Control

The core team members are responsible for the initial collection and maintenance of all DESA-MAB documents, records, and evidence obtained during the field investigation. The documents, records and evidence shall be delivered to the Project Leader, and/or RTC, at the completion of the field investigation. The Project Leader, and/or RTC, shall immediately construct an inventory of all such materials obtained. If requested, the Project Leader, and/or RTC, will deliver all such materials to the Case Agent. All original analytical data and supporting documentation, e.g., chromatograms, mass spectra, QA/QC records, calculations, etc., shall be maintained by the Laboratory Branch according to their Laboratory Standard Operating Procedures. If requested, copies of all records shall be provided to the Case Agent. Dissemination of such records shall only occur under federal court order, as directed by DOJ, or as directed by the prosecuting attorney. The Laboratory Branch shall construct a project file of all laboratory data and supporting documentation immediately after completing analyses and reporting of data to the Project Leader, and/or RTC. An inventory of that file will be prepared and maintained.

All documents, records, evidence, etc., retained by the DESA-MAB will be maintained in a locked filing cabinet, or in a secure area, under the direct control of the Project Leader, and/or RTC.

In addition, all documents, records, evidence, etc., developed by the DESA-MAB gathered or collected during a civil investigation, where there is a likelihood, or a good potential for the case to “go” criminally, should be handled in the same manner, that is it should be maintained in a locked filing cabinet, or in a secure area, under the direct control of the Project Leader.

F.9 Sample Disposal

All excess samples and/or sample containers shall be maintained in the secure sample custody area until written authorization for sample disposal is received from the Case Agent. Because of insufficient space in the sample custody room, the Case Agent shall expeditiously inform the laboratory when samples can be disposed. Sample disposal procedures shall be as described in the Laboratory Branch Standard Operating Procedures.

APPENDIX G
BATTERY CHARGING AND STORAGE OPERATIONS

PERFORMANCE OBJECTIVES:

- To ensure that field batteries are properly charged and maintained.
- To ensure that field battery charging is conducted in a safe manner.

G.1 Battery Maintenance

1 Check battery terminals for cleanliness; clean with wire brush, if necessary.

2 Periodically test the batteries with voltmeter in order to determine their condition and remaining life. Batteries that do not recharge fully to the voltage necessary to operate equipment should be removed from the inventory and recycled.

3 Label each battery with the date it was received into inventory with a permanent marker, or waterproof label.

G.2 Charging Batteries

Battery charging equipment is to be operated only by trained personnel who are familiar with these procedures. If at any time personnel are not absolutely sure of what to do, work should stop and assistance should be sought.

Battery Charging Procedure

1. Inspect all terminal clips and casings for broken insulation and proper connection.
2. Clean all terminal clips with a wire brush.
3. Connect the batteries to the charger.
4. Connect the terminal clips securely to the battery terminals. Dirty terminal clips, dirty battery terminals, or loose connections may result in dangerous arcing when the charger is turned on.
5. Nickel-Cadmium (NiCd) Batteries: ISCO battery packs - Charge for at least 18 hours, but preferably not more than 24 hours. Indicate that the battery has been charged by placing a removable tag, or tape, with the relevant information.
6. Lead-Acid: Continuously-recording pH meter batteries - Attach battery to pH meter and plug in pH meter using black charging cord. When the indicator light on front of meter’s panel is lit, battery is charging. Charge for at least 24 hours, but not longer than 72 hours.

DANGER OF ACID BURNS - Always use caution when handling batteries. In case of skin contact with acid, immediately wash affected area for at least 15 minutes, using safety shower, eye wash, or sink. Seek medical attention as soon as possible. Notify the designated Safety Officer, or management, in the event of any injury.

APPENDIX H
DESA/MAB's PROCEDURE FOR COMPILING, DISTRIBUTING, AND TRACKING INSPECTION REPORTS FOR NPDES, RCRA, AND OTHER PROGRAMS

Prior to its transmittal to a program office, an inspection report needs to be signed and dated by the project leader, and reviewed and signed by the Branch chief. Typically, the report is due within 30 days after the inspection is complete, or, for sampling inspections, within 30 days after a hard copy of the laboratory data is received in the Branch.

Reports for the NPDES program should be assembled in the following order, and covered with blue inspection covers:

1. Report cover sheet (with signatures and dates)

2. Report with all attachments

3. EPA Form 3560-3 (Water Compliance Inspection Report form)

4. Deficiency Notice (DN) or Notice of Non-Compliance (NNC)

   Note: The DN or NNC typically includes the signed letter to the permittee (on EPA Edison letterhead), the completed and signed DN or NNC, and a copy of the report (or a copy of the "Findings & Conclusions" section from the report). The DN or NNC is date stamped and sent to the permittee by the project leader using return receipt certified mail. The receipt is retained in the facility file.

The reports and reviewed permittee responses to DN and NNC, are grouped by State and inspection type for use in the transmittal letter. The report groupings include: NY, NJ VI and PR industrial and municipal facilities, facilities at Tribal Nation, and reviewed DN permittee responses. The transmittal letter should mention whether there are reports and/or reviewed permittee responses to DN and NNC.

If the report is for the RCRA program, the formatting of a RCRA transmittal letter is similar to the one for NPDES, except that the term NPDES is replaced by RCRA. If the report is for another program, substitute the appropriate program information. Transmittal letters for each program should be prepared on a bi-weekly basis, if needed.

The number of document copies that are needed for transmittals are:

1. NPDES -

   a. Reports - Usually three copies and the original are needed. An additional, fourth copy is made in the case of sludge/biosolids reports (for the Regional Biosolids Coordinator). The original is bound with the blue report cover and sent by the Document Coordinator to the Chief of CAPS at the NYRO. One copy is sent to the Chief of WCB at the NYRO. An additional copy is sent by her/him to the State office (see address list below). The third copy is retained in the facility file. An extra copy would be made for the inspectors personal files, if desired. For municipal inspections conducted in PR and VI, the original report is sent to the Chief of CEPD-ESB.

Administrator
Water Compliance & Enforcement Element
New Jersey Department of Environmental Protection
401 East State Street, Floor 4 East
P.O. Box CN - 422
Trenton, New Jersey 08625-0422

Director
Bureau of Water Compliance Programs
Division of Water
New York State Dept. of Environmental Conservation
625 Broadway
Albany, N.Y. 12233-3506

b. DN/NNC - The signed original is returned to the project leader who originated the DN and NNC. Usually two copies and the original are needed, and a third copy for sludge/biosolids reports. The original is sent to the permittee, and the copies are distributed to the New York and Caribbean offices. A copy of the DN/NNC is attached to the report.

c. Multimedia Checklist - The original is retained in the MAB permittee file. This checklist is not transmitted to the facility or the program office.

2. RCRA reports - The original is bound with the blue report cover and sent by the Document Coordinator to the Chief, DECA-RCB, with a courtesy copy sent to the RCRA enforcement coordinator. One copy is retained in the facility file, and an additional copy could be made for the inspectors personal files, if desired.

3. Children Health Initiatives reports.

   a. TSCA: AHERA: The original report goes to the DECA-Air Compliance Branch Chief with the transmittal letter. One copy is kept at Edison.

   b. SDWA: Lead in Drinking Water at Schools: The original chain-of-custody with the sample results goes to DECA-Public Water Supply Team program manager. One copy of the chain-of-custody form, including the sample results, is kept in Edison.

4. Other program reports - Usually two copies and the original are needed. The original is bound with the blue report cover and sent to the New York office. One copy is retained in the facility file, and an additional copy could be made for the inspectors personal files, if desired.

All inspections must be entered into the Integrated Compliance Information System (ICIS) in order for DESA to get credited for its program commitments and outputs. Information on NPDES reports that have been completed and transmitted is provided to the person who inputs the information into PCS. Once inspections are only entered into ICIS, information will not have to be entered into PCS.

The DESA tracking systems

a. Creation of Fiscal Year (FY) tracking files

i. NPDES - When the list of candidates is provided by the program office, the NPDES candidate information is entered into an Excel spreadsheet. The information provided for these permittees includes; the name of the facility, its location, and permit number. The FY tracking sheet is printed and posted outside the MAB mail room for updating by staff.

ii. RCRA and other program inspections - When the list of candidates is provided by the program office, the RCRA tracking sheet is posted the program office. The FY tracking sheet is printed and posted outside MAB mail room for updating by staff.

iii. NPDES commercial laboratory inspections - The FY tracking sheet is printed and posted outside the MAB mail room for updating by staff.

b. Updating of the tracking system occurs as needed. Older tracking sheets should be save for verification purposes.

c. The tracking systems files should be archived.

DEFICIENCY NOTICE AND NOTICE of NON-COMPLIANCE PROCEDURES

Complete Deficiency Notice (CDN): Includes the Deficiency Notice (or NNC) letter ("DNL") signed by the Branch Chief, the Deficiency Notice ("DN") (EPA Form 3560-4) or NNC, and the inspector's Findings and Conclusions ("F & C"). If there are few deficiencies, they may be compiled directly on EPA Form 3560-4, thus eliminating the need for the Findings and Conclusions attachment. If entire report is sent to the permittee, revise procedures as needed.

Photocopies needed are as follows: DNL - 4*, DN/NNC - 4, F & C - 4
(* 4 in addition to "pink" and "yellow" office copies)
- "Yellow" office copy of DNLetter with concurrences (signed & dated by inspector & supervisor) is returned to the inspector
- "Pink" office copy of DNLetter with concurrences is given to the Branch Admin. Assistant
- Original **CDN** to Permittee, sent via Certified Mail and logged into tracking sheet
- Copy of **CDN** for inclusion in original report with blue covers
- Copies of **CDN** go in *each* report copy
  (Copy of **CDN** for inspector's copy of report, if desired)

Response From Permittee: Check to see that all deficiencies have been adequately addressed. If so, in upper right-hand corner write Permit #, NFAR (No Further Action Required), or FAR**, inspector's initials and the date. Make 3 copies; only 2 if WCB Chief (McKenna) is cc'd on their response.
- Original in NPDES permit file and logged onto tracking sheet
- 2 copies to Document Coordinator's in-box (to be sent to NYRO; only 1 if WCB Chief is cc'd
  (Inspector copy, if desired)

****Unsatisfactory Response from Permittee:** FAR
- Make copies as above, logging into tracking sheet
- Follow-up with a response indicating reasons for FAR

Untimely Response:
<u>It is the inspector(s responsibility to track timely response from the Permittee</u>

- If a response is not received by EPA within 45 days, a follow-up letter should be written requesting response within 14 business days. A telephone inquiry re: the status can also be made.
- Copies made as above.
- This should also be noted on the tracking sheet
- If no response is received within 14 business days, refer to the Program Office for enforcement action via memo sent under Branch Chief's signature.